International Conference on Education in Mathematics, Science & Technology

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Antalya / TURKEY

PROCEEDING BOOK

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Assoc. Prof. Dr. Ismail SAHIN

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THE USE OF SIMPLE EXPERIMENTS IN TEACHING PHYSICS TO THE CHILDREN WITH SPECIAL NEEDS

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ABSTRACT: This paper deals with inclusive teaching to the children with problems in intellectual development and sand-blind children. In the Republic of Serbia children with special needs are included in regular classrooms in the Primary schools and that is called inclusive teaching. Inclusive teaching strategies are of great importance in order to help children with special needs to attend classes with the children of the same age. Their difficulties in the learning process require special developed curriculum custom to them. In teaching physics the use of simple experiments could be of great help. While conducting simple “Hands-on” experiments, children become active participants in teaching process and also it helps their socialization with their classmates. It is very important to choose adequate simple experiments so child can be included in its conduction, despite of his or her problem. It is necessary to create a friendly atmosphere in the classroom. When sand-blinded child is included in conducting simple experiments, his or her classmates must sometimes describe phenomena and compensate their friend’s inability of observation. Usually classmates will not be able to help their friend with problems in intellectual development to understand how experiment should be conducted. In this case, the teacher will have to provide additional assistance in conducting the experiment and also in the process of drawing conclusions. Teacher must be careful in creating groups for conducting experiments, so regular students will accept their classmates with special needs. In this paper, a suggestion of some adequate simple experiments for teaching physics to the children with special needs is given. Experiments in the fields of motion, pressure, density, heat, electromagnetism and sound are proposed.

Key words: physics, simple experiments, special need children

INTRODUCTION

The process of inclusion is based on the assumption that every student has equal rights regardless of the capabilities and individual differences. The inclusion of children with special needs in regular classes of general education and vocational schools requires some adjustment of the educational system to their needs (Alper & Ryndak, 1992; Clark et al., 1995; Hunt et al., 1994). The education system should be directed to the individual abilities of children enabling the participation of children with special needs in everyday life in schools and local communities. To achieve this, the necessary changes are not only within the school system and its adaptation, but also in society. Inclusive education needs to ensure active participation and learning of children with special needs, as well as identifying, reducing or eliminating barriers to their participation and learning. Barriers to inclusive education can be: *psychosocial* that are a result of lack of information about people with disabilities and result in negative attitudes and intolerance, as well as ignoring and social rejection; *physical obstacles* such as a lack of adaptation of the entrance to the building, not adapted public transport for persons in wheelchairs, lack of audio signals and tactile paths, pavements with high side banks...; *institutional barriers* that illustrate the way in which social institutions contribute to isolation or exclusion of inclusive person from various forms of social life (Logan et al., 1997; Logan & Malone, 1998).

Education of children with disabilities and difficulties in development took place in special educational institutions. Defectologists dealt with education of children, their development and rehabilitation. In recent years, children with difficulties in development can attend a regular school, under the supervision of professional pedagogical and psychological services. Children with disabilities and developmental disabilities and persons with disabilities are given the possibility to access to equal education and training, enabling them to develop their abilities to the maximum. The basic question in the context of inclusive education is the way to organize the regular classes that should meet the educational needs and specificities of children with disabilities and other children in the class. Characteristic of inclusive schools is encouraging of each student to learn and progress according to his/her abilities (Hay, 1997). A new way of thinking during the formation of the inclusive school states how school should better organize classes, and teaching and learning processes. Educational activities should adapt to the needs and abilities of children with disabilities and other children. Teachers prepare for classes individually for each child with special needs with occasional consultation with the pedagogical - psychological services. It is necessary to work on creating the most favorable social and emotional climate in the classroom. For the realization of this teaching approach, it is necessary to organize individualized lessons and to enable a greater communication between students. In the ordinary education there is no systematic support and adaptation to the special educational needs of students, because of that their achievement is minimal, so many children repeat a grade or drop out. Teachers in classes with great number of students are not sufficiently prepared nor motivated to working with these groups of children. Most regular schools are largely unprepared for the education of children with disabilities and developmental difficulties because they are not prepared in regards to teaching staff, programs, technical and physical support (Wisniewski & Alper, 1994). Various studies suggest that teachers are not willing to work with students with special needs and conditions are unsatisfactory for the inclusion of these children in regular schools. The aim of this paper is to show the importance of the application of simple experiments in physics teaching in elementary schools, which allow students with special needs to acquire knowledge about physical phenomena and processes in a simple way. The experiments are appropriate for students with reduced intellectual ability, students with difficult orientation in space, visually impaired students and the students with any developmental disability.

APPLICATION OF SIMPLE EXPERIMENTS IN INCLUSIVE EDUCATION

Contemporary teaching in schools should be directed towards improving and rewarding thinking. It is imperative in education today to overcome the classical teaching of physics, which stimulates the "correct" answers, which are often a repetition of definitions and memorizing without understanding the term, by stimulating individual thinking and the use of experiential knowledge. Since the spontaneous organizing concepts acquired through experience does not use scientific methodology based on experimental verifications, the existing empirical knowledge of students is mainly different from scientific knowledge, and the answers that are based on it are often wrong. However, on the culture of thinking such responses should be encouraged, corrected, and even awarded and used as a basis for further intellectual development of students. The introduction of the basic concepts of natural science since the first grade of compulsory education refers to the importance of systematization of empirical knowledge of the students and the gradual development of concepts depending on the level of knowledge and level of development of the students. Simple experiments have an important role in the process of acquiring knowledge through thinking. They allow the student to check their own hypotheses about the studied phenomena, as well as the application of theoretical knowledge in practical situations and solve new problems. The student, alone or in group, can find in his conceptual model of phenomena detail which leads to disagreement with observation, as well as the way it should be adjusted to achieve agreement between assumptions and actual events.

Simple experiments are of particular importance when it comes to inclusive education. The teacher's role is to act as a mediator, carefully selecting experiments, to direct students with developmental disabilities and enable them to independently carry out experiment. In this way, in addition to understanding the physical phenomena, which is demonstrated by experiment, students' manual skills are developed; we promote self-reliance, individual thinking and stimulate the use of experiential knowledge to develop awareness of their own knowledge and skills (Maker et al., 1994; Sindelar et al., 1989).

The treatment of teaching themes

With students are treated different themes: motion, pressure, heat, electricity and magnetism... Simple experiments that are conducted are adapted to the specific needs of each student.

For treatment the theme "motion" is proposed an experiment available to sand-blind students, called "How to make a cup to slide faster?" The goal is to show the impact of the slope and the properties of the contacting surfaces of the body and the substrate on the speed of motion of the body. The material needed for conducting experiment is a thin board length 1 - 1,5 meters, clear plastic cup, hot and cold water and a few books. Students form an inclined plane by settings it on several books. They set a slope of the board to make cup slide down on an inclined plane. Then alternately immerse the upper end of the cup in the cold and into the warm water and noticed when cup more quickly slide down the board. In order to make cup to start sliding down the inclined plane it is necessary to place slope at adequate angle. Sand-blind students have the opportunity to change the slope of the board, feel if objects are moistened and to distinguish hot and cold water. With one hand they hold sup, and with other hand they are waiting to cup slides off. Independently conducting experiments the student can understand that speed of cup depends on angle of inclined plane, as well as friction, which reduces by immersing the upper end of the cup in cold or warm water. In working with sand-blind student a metal plate, that will make a sound effect when object slides down, should be placed, that allows the student to determine easier time of motion and it helps them to clarify the characteristics of motion.

For treatment the theme "pressure" are proposed experiments by which the dependence of the pressure on force or surface is observed. The material required for conducting experiments is graphite pen with a pointed tip, modeling clay and sand. If student press with fingers the pen from both ends in the same way or with the same force, finger which acts on the tip of pen will hurt students. Of equal amounts of modeling clay students make different body shapes (rectangular, cube, shape of the letter T ...) and posed them on a sandy substrate. Based on the touch sand-blind students perceive that objects with smaller surface leaves deeper traces, that is the pressure is greater if the surfaces of the body is smaller. This experiment requires students' manual activity, so it is recommended for students of reduced intellectual ability. In order to illustrate the effect of the atmospheric pressure can be conducted experiment "How a straw reserves the juice?" Material needed is a straw, and a glass of juice. Straw is placed in the juice and with mouth air is extracted until the juice is not lifted to half of straw. The upper end of the straw should be closed with finger so that air can not enter into it and straw is pulled out of the glass. Juice remains within the straw because the air pressure acting on all sides equally (acts as well on the bottom) does not allow the juice to leak. This experiment is recommended for working with students with intellectual disabilities and sand-blind students.

Experiment "Obedient bubble", on the basis of which it is possible to check the Archimedes' law, is suitable for treatment the theme "density". The required material is: balloon, salt, paper clips, larger pot and water. The balloon is filled with water so that in it there is no air, then should be tied the knot, balloon made heavy with paper clips and put in a pot of water. Since the gravity acting on the balloon is greater than the buoyancy force $\vec{Q} \rangle \vec{F}_p$, the balloon sinks. If we pours salt in the water, solution density is increasing and in the case $\vec{Q} = \vec{F}_p$, the balloon floats and for $\vec{Q} \langle \vec{F}_p$, balloon is floating on the surface. Students with intelectual disabilities visually tracked that with adding salt balloon is made to float. Thus, they concluded that adding salt increases the density of water, and because of that the balloon can float. Sand-blind student is independently conducted experiment, so he is adding salt with one hand and with the other hand he felt how the balloon started to float.

For treatment the theme "heat" in order to students understand the process of transferring heat, for example conduction, through different materials it suitable to conduct the following experiments. In the three containers is poured water of different temperatures, cold, medium and hot. If the left hand is placed in a cold, right into hot water, and then both in medium water, feeling in hands is different. With his left hand he feels that the medium water is warm, and with the right hand he feels that the medium water is cold. Students conclude that this happens because the heat is transferred from the warmer to the colder body. The process of heat conduction can be demonstrated by the use of sticks of different materials (wood, plastic, metal), rice, margarine and containers with hot water. At each stick with margarine is glued rice and sticks were placed in a heated water. After a while the rice falls of the sticks, because margarine melted. Students can easy see that the metal is the best conductor of heat.

Treatment of the theme "sound" requires the introduction of the basic concepts that characterize it: the occurrence and intensity of sound, pitch and timbre.... By the use of experiment "Produce the sound of chicken" can be shown that the sound occurs as a result of vibration of some items. For conducting experiment is required: a plastic cup, woolen string, paper clips, paper, nail scissors and water. A nail is used to pierce the bottom of the cup and pull through the woolen string, so that the one end of string is hooked up to paper clip which is located at the bottom of the cup, and the other end of string hangs freely. Paper should be fold and moisten with water and then holding a glass in one hand with the other hand sudden short multiple pulling up and down the paper on the string. Vibration of the string would be noiseless without the cup. Going through the cup vibrations propagated and amplified, causing the sound. The sound is generated by the flow of the air across the string. This experiment is a simple and interesting so that students have a greater desire to understand the way in which sound is produced. Students with low intellectual abilities and sand-blind students can follow the performance of the experiment and understand it. In order to sand-blind student understand the creation of sound, must include the sense of touch and sense of hearing. The experiment was interesting to students because of its characteristic sound of chicken.

For conducting experiment which shows that the sound pitch depends on the length of the air column is required glass bottle and water. Of particular importance is to direct attention to students on essential elements by asking adequate questions. If the sound produced by gently blowing air over the side of the bottle (close to the opening of the bottle), then the sound is a consequence of the oscillation of the air column above the water. Adding water to the bottle, the height of the air column is reduced and the sound becomes higher. If the sound is produced by pounding metal spoon on the bottle wall, glass wall oscillation is transferred to water, which oscillating produces sound. Adding water to the bottle length of water column increases, and the sound becomes lower! If the experiment is performed with sand-blind students it is suitably to take two bottles with different amounts of water in them and sand-blind students can assess in which bottle is more water by shaking them. The experiment is a problem for students of weaker intellectual abilities because they can not determine the appropriate distance from the lip to the bottle to produce sound.

CONCLUSION

Inclusive education allows students with special needs the same education as other children have. This paper is an attempt to easier students with special needs to learn about the natural phenomena, from the aspect of physics and physical processes. Simple experiments, by which we can demonstrate the physical processes and phenomena, have a highly motivational character and contribute to the greater interest of students. If you adjust them to students with special needs, simple experiments become sometimes the only source of knowledge on the basis of which they can realize and understand content that is processed.

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METACOGNITIVE AWARENESS OF SCIENCE ORIENTED STUDENTS IN REPUBLIC OF SERBIA

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ABSTRACT: This paper presents an analysis of science oriented students' metacognitive awareness. Research sample consists of about 200 students of both genders that have enrolled in science oriented department in one of four Grammar schools in Novi Sad. Students enrolling Grammar school in Serbia are mainly 15 years old girls and boys. For the need of this research, the questionnaire (that included Metacognitive Awareness Inventory - MAI) was constructed. According to the first framework given by Flavell (1971), metacognitive awareness can be categorized into awareness of: metacognitive knowledge, metacognitive regulation and metacognitive experiences. Knowledge of cognition usually includes three different kinds of metacognitive awareness: declarative knowledge, procedural knowledge and conditional (strategic) knowledge. Regulation of cognition refers to awareness of the need to use certain strategies, such as planning, information management, monitoring, evaluation and debugging in process of thinking and learning. The students, who conceive the experiments (scientific method) in teaching physics helpful for their understanding of the physics contents, have shown higher level of metacognitive awareness. The same could be concluded for the students who are writing down in a notebook the performed experiments (procedure, explanation, conclusions...) and the students who understand experiments and their explanations. If metacognition is defined as the knowledge and control over children's own thinking and learning activities, it is very obvious that metacognition have great impact on learning process.

Key words: physics, science, metacognition, metacognitive awareness

INTRODUCTION

Important problem in teaching science is how to make students think on their own and acquire applicable long-lasting knowledge. Also it is very important to prepare students for lifelong learning. In order to achieve those goals the quality of science teaching must be improved. Contemporary teaching methods enable active participation of the learners in the teaching process, as well as improving the quality of science teaching (Obadovic et al., 2013; Obadovic et al., 2012). There are different ways for improving teaching/learning process. One of factors that influence learning is students' metacognition. High level of students' metacognitive abilities allows students to learn efficiently and to learn in everyday life, not only in school, also, to gain applicable knowledge.

In this paper the analysis of science oriented students' metacognitive awareness and a relation between different aspects of implementation of simple experiments in physics teaching and the level of students' metacognition are discussed

METACOGNITION

Henry Brooks Adams stated, "They know enough who know how to learn". In order to learn how to learn it is very useful to understand the concept of metacognition. It deals with questions related to the development of cognitive and affective area; also it can improve understanding and analysis in all areas where the process of self-regulation is included. Metacognition has been subject of studies conducted by many authors since the seventies of the twentieth century. The first study was conducted on metamemory (Flavell & Wellman, 1977). John Flavell (1979) was the first who had used the term metamemory. Later the term metacognition was used with meaning "knowledge and cognition about cognitive phenomena," or simpler "thinking about thinking", "knowledge about knowledge". Concept of metacognition is attributed with different meanings. Most researchers believe that metacognition refers to one's thinking process, monitoring and control of thinking.

Metacognition can be defined as the knowledge and control that children have over their own thinking and learning activities (Cross and Paris, 1988). Kuhn and Dean (2004) gave definition that it is awareness and management of one's own thought. Martinez (2006) declares that metacogniton refers to the monitoring and control of thought. The general understanding of metacognition is that it is activity of monitoring and controlling one's cognition (Weinert & Kluwe, 1987).

According to first framework given by Flavell, metacognitive awareness can be categorized into awareness of:
1. metacognitive knowledge,
2. metacognitive regulation and
3. metacognitive experiences.

Metacognitive knowledge (knowledge of cognition) includes three different kinds of metacognitive awareness:
1. declarative knowledge,
2. procedural knowledge and
3. conditional (strategic) knowledge.

These kinds of metacognitive awareness cover how to do something; skills, strategies and resources required to perform the task (knowledge of how to perform something); and knowledge of when to apply certain strategy, respectively.

Regulation of cognition refers to awareness of the need to use certain strategies, such as (Schraw & Dennison, 1994, Schraw & Moshman, 1995):
1. planning – planning, goal setting, and allocating resources prior to learning,
2. information management – skills and strategy sequences used to process information more efficiently (e.g., organizing, elaborating, summarizing, selective focusing),
3. monitoring – assessment of one's learning or strategy use,
4. debugging in process of thinking and learning – strategies used to correct comprehension and performance errors and
5. evaluation – analysis of performance and strategy effectiveness after a learning episode.

Metacognitive experiences are manifestations of the online monitoring of cognition as the person comes across a task and processes the information related to it. They are the interface between the person and the task. They comprise metacognitive feelings, metacognitive judgments/estimates, and task-specific knowledge (Efklides 2001, 2006)

Metacognitive experiences are for example:
1. feeling-of-knowing,
2. judgments-of-learning and
3. ease-of-learning judgments.

Metacognitive experiences can have influence on students' motivation. If student believe that he/she is able to learn something easily it will make them more willing to learn it. Also feeling-of-knowing can make student self confident…

RESEARCH METHODOLOGY

Research aim was to analyze science oriented students' metacognitive awareness and a relation between different aspects of implementation of simple experiments in physics teaching and the level of students' metacognition.

A research hypothesis was that some aspects of implementation of experiments (demonstrative experiments, simple "Hands-on" experiments) help in developing different metacognitive level.

Research sample consisted of 203 students of both genders that have enrolled in science oriented department in one of four Grammar schools in Novi Sad.

Appropriate questionnaire was constructed, part of it included Metacognitive Awareness Inventory – MAI. In questionnaire students answered on general questions and on questions about teaching physics. They were asked about carried out experiments in physics class. MAI questionnaire is intended to assess metacognitive skills of adolescents and adults and contains items that examine each of the eight components: knowledge of cognitive processes (declarative, procedural and conditional) and regulation of cognitive processes (planning, information management, monitoring, evaluation and debugging in thinking process). MAI is constructed in the early nineties (Schraw & Dennison, 1994). The scale of the instrument has satisfactory validity (accuracy) and reliability, the Cronbach alpha coefficient is 0.90. Of the 52 items with five-point response Likert scale of MAI 32 items appropriate for the selected sample were retained and adjusted. The choice of items was made based on the capabilities of students to understand the items that constitute the scale, which was tested by pilot survey, and based on example of the survey about the children's awareness of metacognition that is proposed for children aged less than 14 years (Junior Metacognitive Awareness Inventory - Jr. MAI; Sperling, Howard, Miller, & Murphy, 2002). Examples of used items:

I ask myself periodically if I am meeting my goals.
I try to use strategies that have worked in the past.
I pace myself while learning in order to have enough time.
I know how well I did once I finish a test.
I slow down when I encounter important information.

Students had one school our to complete questionnaire.
The obtained results were treated statistically.

RESULTS AND FINDINGS

Descriptive statistic of variable students' metacognitive awareness is given in Table 1.

Table 1. Descriptive Statistic of Variable Students' Metacognitive Awareness

Total number	189
Mean	125.376
Median	124.0
Mode	123.0
Standard deviation	12.3198
Variance	9.82634%
Minimum	98.0
Maximum	150.0
Range	52.0
Standardised skewness	-0.143915
Standardised kurtosis	-1.57919

Because of incomplete questionnaires there total number of 189 answered questionnaires was obtained. Mean score was 125.376 (maximum possible sum score was 160). Minimal achieved score was 98 and maximum was 150. Values of standardised skewness and standardised kurtosis indicate that variable *students' metacognitive awareness* has normal distribution.

In analysis of results, Mann-Whitney U Test is performed in order to determine is there statistically significant difference in students' metagognitive level regarding to different aspects of implementation of simple experiments in teaching physics. It is shown that statistically significant difference between the students' metacognition exists regarding to some, but not all, aspects of implementation of simple experiments in teaching physics. It is shown that there is no statistically significant difference in metagognitive level of students whose teacher has performed demonstrative experiments in Physics class. Also, there is no statistically significant difference in metagognitive level of students who performed demonstrative experiments on their own. Different matacognitive levels have shown students that carried out experiments in steps of scientific method and those who did not carry out experiments that way. Students who carried out experiments in steps of scientific method have shown higher matacognitive level. Different matacognitive levels have shown students that answer differently to questions:

Were experiments and their explanations clear?
Were experiments helpful for your understanding of the physics contents?
Did you write down in a notebook the performed experiments (the procedure, explanation...)?

Higher matacognitive level have shown students who understand experiments and their explanations and they who are opinion that experiments in teaching physics (implemented through scientific method) were helpful for their understanding of the physics contents. Also, higher matacognitive level has shown students who are writing down in a notebook the performed experiments (the procedure, explanation...).

CONCLUSION

Metacognition enables students to solve new problem by retrieving and deploying strategy that they have learned regarding to similar context. Metacognition is important for working on cognitive styles and learning strategies. Metacognition implies that the individual has some awareness of his/her thinking or learning processes. Students' metacognitive awareness is very important in effective physics teaching/learning process. Experiments help in improving scientific knowledge and students' motivation. In order to improve students' metacognition it is not enough that teachers choose adequate experiments. Since there is difference between the students' metacognition regarding to some aspects of implementation of scientific method as teaching method it can be proposed that teachers pay more attention on their instructions and way of carrying out experiments.

Results of this research imply that similar researches are necessary in order to better understand relations between the use of experiments in Physics classroom and students' metacognition and that is of great importance in order to improve teaching science.

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NEW SCIENCE CURRICULUM BASED ON INQUIRY BASED LEARNING – A MODEL OF MODERN EDUCATIONAL SYSTEM IN REPUBLIC OF MACEDONIA

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ABSTRACT: The process of globalization, more progressive development of the scientific findings, new technology and the way of communicating with the new forms of literacy in which the most secure spot has been taken by the development of natural sciences in the spirit of *sustainable development* have been the reasons that make science and sustainable development an educational imperative.

The development of *natural sciences* in the educational processes in Republic of Macedonia has become an essential process which is being permanently improved with the goal to find the best solutions for its improvement. Currently, all of the elementary grade teachers have to face this process.

One of the most recent changes is the study of natural sciences according to the adapted educational *curriculum* from the Cambridge International Examination Center. The goal of this reform is to lead the students on the right way of becoming future "scientists".

The programs include research that encourages students to ask questions and derive the answers themselves with the support from their teachers. This is a proven method with which natural science classes will become more interesting for the students and the findings will remain learned. The educational curriculum also allows the students to develop their critical thinking and to think and use the proofs. Students will easily learn that natural sciences are important and can help them in solving everyday life's problems according to the principles of education for sustainable development.

A very important part in the adaptation and realization of the adapted educational curriculum from the Cambridge International Examination Center is being played by the *information and communication technology (ICT)* that is a very useful resource for the development of the knowledge, skills and understanding among students. ICT needs to improve the quality of the teaching. The teachers will have the opportunity to choose and use the most appropriate and effective ICT resources.

Key words: new science curriculum, inquiry based learning, ICT, education for sustainable development

INTRODUCTION

Few years ago, according the results of PISA (a triennial international survey which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students), Macedonian government decide to find a way to improve the given results. Cambridge International Examinations was approached in January 2013 by the Ministry of Education and Science (MoES) of the Republic of Macedonia in the context of MoES's ambition to raise school-level educational standards. As part of the Republic of Macedonia's plans for educational reform, the Bureau for Development of Education (BDE) is working in partnership with Cambridge and started implementing an adapted form of Cambridge primary science curricula at Grades 1-9 from September 2014.

Implementation of educational reform requires a balance of speed and sustainability. It is essential that the changes required do not exceed the capacity to deliver them effectively. This may relate to the ability of teachers to familiarize them with new content and implement new approaches to teaching and to the evolution of professional support systems and the alteration of operational practice by schools and education agencies. Financial and resource constraints also have an impact on successful implementation in terms of the reform's educational impact for learners. The first year of new science curriculum implementation is at the end. The BDE and Cambridge International Examinations teams monitored more than 50 schools until now in term to collect more data about the ongoing curriculum realization. The first results given by the surveys and interviews provide to BDE and MoES the first impressions about the success of the process of new science reforms.

Correlation between inquiry based learning and new science curriculum

Inquiry-based learning or inquiry-based science describes a range of philosophical, curricular and pedagogical approaches to teaching. Its core premises include the requirement that learning should be based around student questions. Pedagogy and curriculum requires students to work independently to solve problems rather than receiving direct instructions on what to do from the teacher. Teachers are viewed as facilitators of learning rather than vessels of knowledge. The teacher’s job in an inquiry learning environment is therefore not to provide knowledge, but instead to help students along the process of discovering knowledge themselves. Its core premises include the requirement that learning should be based around student questions. Pedagogy and curriculum requires students to work independently to solve problems rather than receiving direct instructions on what to do from the teacher. Teachers are viewed as facilitators of learning rather than vessels of knowledge. The teachers job in an inquiry learning environment is therefore not to provide knowledge, but instead to help students along the process of discovering knowledge themselves. Inquiry-based learning is a concept which underlines the importance of students engaging into meaningful hands-on science experiences (Louca, Santis & Tzialli, 2010). Inquiry can't be separated from the world of science and as National Science Educations Standards states: "Inquiry is central to science learning" (NRC, 1996 p2). Inquiry learning cause beyond memorizing information and aims to give students an understanding and reasoning of the knowledge which they develop. Inquiry-based learning is active and provides opportunities for students to engage themselves with scientific activities (Edelson, Gording and Pea, 1999). This self-engaging into activities should lead to a less guided situation in which students design their learning by exploring. Exploring is the essence of inquiry learning, students design their own question and hypothesis in order to engage in hands-on activities which are aligned by exploration. Hakkarainen (2002) shows that inquiry learning leads to students who design their own intuitive theories by explaining answers on their research question. Kirschner, Sweller and Clark (2006) strongly oppose to the concept minimal or non- guidance, cause it places a huge burden on working memory. Guided instruction is seen to lead to vastly more learning, IBL can't be seen as a fully guided instruction (Kirschner et al. 2006). Hmelo-Silver, Duncan and Chinn (2007 p 99) wrote an article specially in response to Kirschner et al. (2006) and state that IBL isn't minimally guided but could use "extensive scaffolding to facilitate student learning".

Inquiry-based learning or inquiry-based science describes a range of philosophical, curricular and pedagogical approaches to teaching. A distinction has to be made between teaching and doing science in IBL (Colburn, 2000). Doing science refers to the student who enact with IBL and teaching refers to the way IBL is instructed to students and the way of guiding students into science inquiry. Teaching inquiry science might evoke more discussion and different opinions. In order to address this distinction first will be looked at teaching inquiry-based science and next doing inquiry-based science. Inquiry-based science is an approach to science education that is student constructed as opposed to teacher-transmitted, hands-on as opposed to lecture-based. Students learn science by using methods, adopting attitudes, and applying skills as scientists do when conducting scientific research. Students are able to find their own problems and generate their own questions, formulate their own hypotheses, design and implement their own methods for testing their hypothesis, and use their own data to answer their original questions. There is a progression from teacher-guided inquiry to completely student-directed inquiry. Even though students direct the course of study, the teacher still assesses progress and introduces critical skills and concepts. An inquiry-based classroom enables students to actively construct meaningful knowledge rather than passively acquire facts. Because students learn by connecting information to their own experiences, inquiry-based learning allows students to have experiences with germinating seeds, maintaining an aquarium, and working with circuits to light bulbs. After engaging in such activities, students are able to apply the information from the experience to new science concepts and life in general. Inquiry-based learning environments are such environments. Inquiry-based learning refers to a learning process in which students are engaged (Anderson, 2002) and is defined as an active learning process: *“something that students do, not something that is done to them”* (National Science Education Standards, NRC, 1996, p. 21). Inquiry and constructivist teaching approaches therefore, share many educational objectives, such as emphasizing student construction of concepts and the relationship between student acquisition of concepts and the concepts’ development in the history of science (Abd El Khalick et al., 2004) and promise the fostering of motivation for students in terms of self-regulated learning.

1.1 Teaching inquiry-based learning

Which role the facilitator or teacher should play during science inquiry is widely recognized and answers aren't always equivocal. This question is very legit and importance for the success of IBL, How should you support the students? Overall there is a confusion about the definition of inquiry and what inquiry implies for the teacher

(Colburn, 2000). The reform from traditional education to a more inquiry-based learning asks for a paradigm shift. Teachers need to shift their emphasis from textbooks to exploring questions (Crawford, 1999). This might sound easy to implement, but is far from easy. This new paradigm on education ask for specific new actions and teachers shouldn't 'simply' provide hands-on activities for students. Teachers should provide students with inquiry activities that build on prerequisite knowledge and elaborates understanding (Crawford, 1999). This asks for a new approach in teaching which 'forces' teachers to change their current form of teaching. Learning in IBL should come from experiments and inquiry activities which should be conducted by collaboration and interaction with other students and teachers. The current situation of science education and the importance of a scientifically literate society is in the course of international comparative studies such as PISA and TIMSS increasingly discussed. With respect to the discussion about deficiencies, shortcomings and inadequateness in the field of science education and the regarding educational mandate of general school education, science education researchers express wide consensus about scientific literacy being the central aim of science education (Gräber & Bolte,1997; Gräber, Nentwig, Koballa & Evans, 2002). Although there is no single right answer as to what defines inquiry-based science, educators have outlined what it looks like. In simple terms it is a learning process or strategy rather than any specific set of lessons. This process aims to enhance learning based on increased student involvement. Through hands-on investigations, knowledge becomes more relevant and easier to comprehend. Inquiry-based science leads to active construction of meaningful knowledge, rather than passive acquisition of facts provided by a teacher. The old Chinese proverb, "Tell me and I forget, show me and I remember, involve me and I understand" is the essence of what inquiry-based science is all about.

Advantages of Inquiry-Based Science

Unfortunately, our traditional educational system has evolved in a way that discourages the natural process of inquiry-learning. The current system is teacher-focused and revolves around giving out information about what is known. The emphasis is on student's ability to recall facts and master the chosen material so that they may proceed to the next grade level.

However, memorizing facts and information is not the most important skill in today's world. Facts are constantly changing and thanks to our digital age, we are overwhelmed with information. The skill needed for this new age of information is the ability to examine and make sense of this avalanche of data. Students who actively make observations, collect, analyze, and synthesize information and draw conclusions are developing the critical skills that they will encounter both at school and in the future workforce.

Students need to develop inquiry skills so that they can cope with future situations and become lifelong learners. Ultimately, the significance of inquiry learning is that students learn how to continue learning, something they will use and rely upon throughout their lives.

The science curriculum emphasizes inquiry-based teaching and learning. A balanced and engaging approach to teaching will typically involve context, exploration, explanation and application. This requires a context or point of relevance through which students can make sense of the ideas they are learning. Opportunities for student-led open inquiry should also be provided within each phase of schooling.

The new Macedonian science curriculum provides opportunities for students to develop an understanding of important science concepts and processes, the practices used to develop scientific knowledge, of science’s contribution to our culture and society, and its applications in our lives. The curriculum supports students to develop the scientific knowledge, understandings and skills to make informed decisions about local, national and global issues and to participate, if they so wish, in science-related careers. In addition to its practical applications, learning science is a valuable pursuit in its own right. Students can experience the joy of scientific discovery and nurture their natural curiosity about the world around them. In doing this, they develop critical and creative thinking skills and challenge themselves to identify questions and draw evidence-based conclusions using scientific methods. The wider benefits of this “scientific literacy” are well established, including giving students the capability to investigate the natural world and changes made to it through human activity. Science understanding is evident when a person selects and integrates appropriate science knowledge to explain and predict phenomena, and applies that knowledge to new situations. Science knowledge refers to facts, concepts, principles, laws, theories and models that have been established by scientists over time.

1.3. Science Inquiry Skills

Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analyzing and interpreting evidence; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, drawing valid conclusions and developing evidence-based arguments. Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modeling and simulations. The choice of the approach taken will depend on the context and subject of the investigation.

In science investigations, collection and analysis of data and evidence play a major role. This can involve collecting or extracting information and reorganizing data in the form of tables, graphs, flow charts, diagrams, prose, keys, spreadsheets and databases. There are five sub-strands of *Science Inquiry Skills*. These are:

Questioning and predicting: Identifying and constructing questions, proposing hypotheses and suggesting possible outcomes.

Planning and conducting: Making decisions regarding how to investigate or solve a problem and carrying out an investigation, including the collection of data.

Processing and analyzing data and information: Representing data in meaningful and useful ways; identifying trends, patterns and relationships in data, and using this evidence to justify conclusions.

Evaluating: Considering the quality of available evidence and the merit or significance of a claim, proposition or conclusion with reference to that evidence.

Communicating: Conveying information or ideas to others through appropriate representations, text types and modes.

The curriculum will be divided in three developing periods:
Grade 1-3 – first developing period
Grade 4-6 – second developing period
Grade 7-9 – third developing period

Grade 1-3 – first developing period-Young children have an intrinsic curiosity about their immediate world. Asking questions leads to speculation and the testing of ideas. Exploratory, purposeful play is a central feature of their investigations. They use the senses to observe and gather information, describing, making comparisons, sorting and classifying to create an order that is meaningful. They observe and explore changes that vary in their rate and magnitude and begin to describe relationships in the world around them. Students' questions and ideas about the world become increasingly purposeful. They are encouraged to develop explanatory ideas and test them through further exploration. During these years students can develop ideas about science that relate to their lives, answer questions, and solve mysteries of particular interest to their age group. In this stage of schooling students tend to use a trial-and-error approach to their science investigations. As they progress, they begin to work in a more systematic way. The notion of a 'fair test' and the idea of variables are developed, as well as other forms of science inquiry. Understanding the importance of measurement in quantifying changes in systems is also fostered.

Through observation, students can detect similarities among objects, living things and events and these similarities can form patterns. By identifying these patterns, students develop explanations about the reasons for them. Students' understanding of the complex natural or built world can be enhanced by considering aspects of the world as systems, and how components, or parts, within systems relate to each other. From evidence derived from observation, explanations about phenomena can be developed and tested. With new evidence, explanations may be refined or changed. By examining living structures, Earth, changes of solids to liquids and features of light, students begin to recognize patterns in the world. The observation of aspects of astronomy, living things, heat, light and electrical circuits helps students develop the concept of a system and its interacting components, and understand the relationships, including the notion of cause and effect, between variables.

Grade 4-6 – second developing period - during these years, students continue to develop their understanding of important science concepts across the major science disciplines. It is important to include contemporary contexts in which a richer understanding of science can be enhanced. Current science research and its human application motivates and engages students. Within the outlined curriculum, students should undertake some open investigations that will help them refine their science inquiry skills. The quantitative aspects of students' inquiry skills are further developed to incorporate consideration of uncertainty in measurement. In teaching the outlined curriculum, it is important to provide time to build the more abstract science ideas that underpin understanding.

Students further develop their understanding of systems and how the idea of equilibrium is important in dynamic systems. They consider how a change in one of the components can affect all components of the system because of the interrelationships between the parts. They consider the idea of form and function at a range of scales in both living and non-living systems. Students move from an experiential appreciation of the effects of energy to a more abstract understanding of the nature of energy. As students investigate the science phenomena outlined in these years, they begin to learn about major theories that underpin science, including the particle theory, atomic theory, the theory of evolution, plate tectonic theory and the Big Bang theory.

Grade 7-9 – third developing period - the senior secondary courses for physics, chemistry, biology, and Earth and environmental science build on prior learning across these areas. The implementation of this part of new science curricula will be realized in upcoming school year.

General capabilities

In the Macedonian Curriculum, the general capabilities encompass the knowledge, skills, behaviors and dispositions that, together with curriculum content in each learning area and the cross-curriculum priorities, will assist students to live and work successfully in the twenty-first century. There are seven general capabilities:
Literacy
Numeracy
Information and communication technology (ICT) capability
Critical and creative thinking
Personal and social capability
Ethical understanding
Intercultural understanding.
In the Macedonian curriculum of science, general capabilities are identified wherever they are developed or applied in content descriptions. They are also identified where they offer opportunities to add depth and richness to student learning through content elaborations.

Sustainability in Macedonian science curriculum

Across the Macedonian science curriculum, sustainability will allow all young Macedonian to develop the knowledge, skills, values and world views necessary for them to act in ways that contribute to more sustainable patterns of living. It will enable individuals and communities to reflect on ways of interpreting and engaging with the world. The sustainability priority is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through informed action. Actions that support more sustainable patterns of living require consideration of environmental, social, cultural and economic systems and their interdependence.

In the Macedonian Curriculum of science the priority of sustainability provides authentic contexts for exploring, investigating and understanding chemical, biological, physical and Earth and space systems.

Science explores a wide range of systems that operate at different time and spatial scales. By investigating the relationships between systems and system components and how systems respond to change, students develop an appreciation for the interconnectedness of Earth's biosphere, geosphere, hydrosphere and atmosphere. Relationships including cycles and cause and effect are explored, and students develop observation and analysis skills to examine these relationships in the world around them.

In this learning area, students appreciate that science provides the basis for decision making in many areas of society and that these decisions can impact on the Earth system. They understand the importance of using science to predict possible effects of human and other activity and to develop management plans or alternative technologies that minimize these effects.

Monitoring process of implementation process in 1-3 grade

The school year 2014/2015 was the first year with implementation of new science curricula in 1-3 grade. Prior to the arrival of Cambridge consultants, staff from the BDE visited over 50 schools, observing lessons and interviewing learners, teachers and head teachers. In the period of 3 November to 7 November 2014, a team of BDE and Cambridge advisors visited 7 schools, where the surveys, interviews and students impressions of science class trough drawing were monitored. On the following period the Cambridge consultants accompanied BDE staff and interpreters to the following schools in urban and rural areas:
• Bratstvo (Skopje)

• Draga Stojanonva (Skopje)
• Kirli Pejcinovic (Skopje)
• Zilko Brajkovski (Skopje)
• 7 Marsi (Chelopek)
• Kosta Racin (Brvenica)
• Bratvo Ligieni (Migjeni)

4.1. Survey responses

There were delivered two surveys: for principals and for the teachers. After removing duplicates and other invalid entries, the principal survey received 160 valid responses (132 on the Macedonian version; 28 on the Albanian version; 22 responses discarded). The teacher survey received 1036 valid responses (902 on the Macedonian version; 134 on the Albanian version; 294 responses discarded). The information gathered here indicates the perceptions of the respondents. It should be interpreted as what they would like to tell us about their school, their teaching and their learners. It provides a greater sense of the variety of contexts in which the new curriculum is being applied.

The key findings of principal survey results are:

• There is large variation in the size and social context of schools.

• Schools are well established with experienced teachers.

• Most schools have a clear majority language but in some regions over 30% of schools have notable numbers of learners who have a different first language.

The principal survey provides contextual information that supports the interpretation of information collected by other methods. Responses to the principal survey came from all regions of Macedonia. The Northeastern region was the least represented (n=12). Skopje was the most represented (n=34). Average number of teachers (from 9 in Southwestern to 14 in Polog) and the number of Grade 1–3 classes (from 9 in eastern to 13 in Polog). These class averages hide significant variation within regions which all had a mixture of small (2–6 classes) and large (13–23 classes) schools. Some basic arithmetic suggests that on average there is one teacher per 10 children across the three grades and the average class size is 11. These ratios are lower in Northeastern (6 learners per teacher) and higher in Polog and Southeastern (13 learners per teacher). It should be noted that there is tremendous variation in these figures within regions. Teachers are generally very experienced with all regions reporting that the average teacher has between 17 and 19 years teaching experience (standard deviation across all regions is eight years). Schools are generally well established and even the region with the youngest schools on average had an average school age of 46 years. Macedonian (79%) and Albanian (17%) are the most commonly- used languages in the 116 schools that responded to the question about languages. There was, unsurprisingly, significant variation between regions. Eastern and Vardar were predominately Macedonian speaking while Polog had more Albanian speakers. Other regions were largely Macedonian speaking but with significant (10-25%) speakers of other languages. Turkish was most commonly spoken in the Southeastern region while Serbian is only spoken by 5% in the Northeastern region, where it is most common. However, there are two schools where Serbian is the first language of more than a quarter of learners. 20 schools reported having Turkish-speaking learners. In half of these, Turkish speakers make up more than 20% of learners, in a quarter of them they make up more than 80% of the school population. These schools are in a diverse range of regions (Eastern, Pelagonia, Skopje, Southwestern, Southeastern). In total, 27 schools reported that more than 10% of their learners do not share a first language with the majority of the school. Such schools accounted for 30% (i.e. 5–6 schools) of those that responded from Pelagonia, Polog and Southwestern regions. By contrast Eastern region only has one such school. The responses to the survey suggest that learners predominantly come from 'middle- income' families in all regions except Polog (where 53% learners are from low-income families). In all regions an average of 6–10% of learners are reported as coming from high-income families. Most schools reported that learners tend to leave at the end of compulsory schooling (50 of 116). Only Vardar and Southeastern regions had the majority of schools sending the majority of their learners to further education. A diverse range of employment sector for learners leaving Macedonian schools was reported (minimum of five different sectors reported within each region). However, the most common sector was reported as being agriculture and the food industry (n=66). The only regions for which agriculture was not the primary employment sector were Skopje.

The key findings from teacher survey are:
• Teachers are familiar with the new curriculum with some regional variation.
• Teachers are using the textbooks but are less familiar with them.
• Some of the issues with textbooks reported by teachers reflect the changes in pedagogy required by the new curriculum and the partial nature of the curriculum reform.

• Lack of language learning (particularly reading and writing) is a potential barrier to successful implementation of the new curriculum.

The responses to the Teacher survey came from all regions of Macedonia. Polog (n=66) and Vardar (n=69) were the least represented regions. All other regions registered over 100 responses and Skopje was the most represented region with 204 responses. Questions about teachers' prior experience were in line with the findings of the Principal survey with teachers from all regions reporting an average of 13-17 years' experience of teaching primary mathematics. Teachers reported having less experience teaching primary science (7 years less on average). The majority of teachers (88%) described their own level of learning as higher education. Teachers responding to the survey had been teaching all three grades of the new curriculum but in Eastern and Southeastern it was noticeable that fewer teachers had been teaching Grade 2 than had been teaching Grades 1 and 3. Teachers' initial responses to reform are always affected by their relative uncertainty with the new material they are being asked to teach and this is reflected in teachers' responses to questions about the new curriculum. There were ambiguous levels of satisfaction reported. Scaled from 0-1 (disagree to agree) teachers reported uncertainty about whether the new curriculum is interesting enough (0.48 down from 0.71 in May), whether it enabled progression (0.39 from 0.67), whether it is pitched at the right level (0.42 from 0.62), whether it is equally accessible in all languages (0.53 from 0.66) and whether it is easy to teach (0.44 from 0.65). It will be important to monitor these attitudes again after a period of time to see if opinion is shifting and whether a change to the implementation plan is necessary. There was some regional variation. Teachers from the Eastern and Polog regions were generally more positive than others but still not rate any aspect higher than 0.58. Eastern and Vardar regions were notably less concerned about accessibility in all languages (these regions do not have the same diversity of languages as other regions). Most teachers thought that the curriculum provides a balance of skills and content (58%); fewer teachers thought it emphasized only content (18% compare to 27% when asked about the old curriculum) or skills (24% compared to 3%). Teachers reported being uncertain about finding resources to support the new curriculum (0.41; scaled from 0-1, not confident to very confident). As with the previous survey, teachers reported being happy using different types of resources but were less likely to use video material (down to 41%) compared to others (textbooks – 76%, practical equipment – 82%). Many teachers use ICT (61%) and a significant proportion use it 'often' or 'always' (56%). Only twenty teachers reported that they never use ICT (including at least one teacher from each region). It should be noted that these results are in conflict with the observations of the monitoring team who did not report ICT being used regularly. Teachers reported using the new textbooks and workbooks in equal measure (355-390 responding that they had used each subject/grade combination). There was more variation in the language versions that teachers had used. Most teachers (83%) had used the Macedonian versions and many (14%) had used the Albanian version. Only 28 teachers had used the Turkish version and five had used the Serbian versions. Whichever language version they had used, they saw the textbooks and schemes of work as important (scaled 0-1, not important to very important). The range was 0.61-0.76. The only document to fall outside this was the Albanian version of the schemes of work which only scored 0.40. This is in conflict with other data that suggests that learners have responded more positively to the Albanian workbooks and textbooks (0.78, scaled 0-1) than others (Macedonian 0.53, Turkish 0.46 and Serbian 0.55). Also, most teachers (including those who have used the Albanian documents) report preferring the schemes of work to the textbooks and workbooks. The most common uses of the textbooks are to provide ideas for lessons (55%), to support the whole class as part of a lesson (52%) or for homework (53%). Only 5% of teachers said that they had not used the textbooks or workbooks at all. A particular challenge of implementing a new curriculum in a small number of subjects is that they may not immediately align with learning in other subjects. When teachers were asked what they would like to change about the new textbooks the majority of teachers commented on the appropriateness of providing textbooks to learners without the language skills to read or write and therefore access the content. This comment was particularly directed at Grade 1 textbooks but was also mentioned in terms of Grade 2 where teachers note the significant challenge for learners who have made the transition from Grade 1 of the previous curriculum to Grade 2 of the new curriculum.

European science education projects that supports new science curriculum in Macedonia

In Macedonian educational system are present lots of international project. One of the project that has a strong correlation with new science curriculum is EU portal, named as Scientix. Year after year, hundreds of science education projects are funded by the European Commission but apart from the persons directly involved in these projects (teachers, project managers, etc.) not many people hear about the results obtained, especially when the projects are over. The objective of the Scientix portal is to ensure that the knowledge and results of the projects reach a larger audience. In other words, Scientix was created to facilitate regular dissemination and sharing of know-how and best practices in science education across the European Union. The portal collects and disseminates teaching materials and research reports from European science education projects financed by the

European Union. Launched in May 2010, the portal is targeted especially at teachers and schools, but also at other science educators, curriculum developers, policy-makers, researchers and EU stakeholders. It is a free-to-access and free-to-use portal, so that anyone interested in science education in Europe can join the Scientix community. Most of the content on the portal is accessible for all users, without registration. However, after registration, users are able to access some additional content, such as their personal pages, and use additional services, such as the forum and the chat tool, and request translations of the existing teaching materials. All users are encouraged to give feedback on the portal through the feedback tool, and thus to take part in developing the portal further. The philosophy of the portal can be summarized in the following keywords: "search, find, engage". This motto emphasizes the shift from a central portal where information is disseminated to end users (who act in this case as passive users) towards a more dynamic and user-centered platform. Scientix thus should not be seen as an information transmission mechanism, but rather as a knowledge building platform. Scientix is managed by European Schoolnet (EUN) on behalf of the European Commission. European Schoolnet is a key player at EU level in education, representing a network of 31 Ministries of Education in the EU Member States and beyond. EUN provides major European education portals for teaching, learning and collaboration and leads the way in bringing about change in schooling through the use of new technology.

Science project of EU that can be find on Scientix platform

As previously mentioned Scientix collects and distributes information about past and present science education projects carried out in Europe. Priority is given to projects funded by the European Commission, but other publicly funded projects are accepted as well. Projects accepted for Scientix must provide accurate information on the project goals, research and results, and preferably also links to the public reports and resources developed in the project. These are displayed on the Scientix portal, in both the Projects and Resources sections. Project authors are also invited to promote their events and news (e.g. new publications and calls for conference speakers) through the Scientix portal. Examples of currently active projects which are included in the Scientix portal can be found below. As most of them had just started at the time of this publication, their final results or achievements are not available yet. However, these will be updated on the Scientix portal at a later stage.

Projects on Scientix portal

Places

Developing the concept of the European City of Scientific Culture, the PLACES project facilitates cooperation between science communication institutions and local authorities. The project focuses on developing and strengthening City Partnerships, bringing together 67 science centres, museums and festivals (each partnering with local authorities) and ten European regional networks. The partnerships provide a basis to foster interactions between science centers / museums, science festival / events and universities on one side and cities / local authorities on the other. PLACES puts emphasis on topics and issues with social relevance (e.g. environmental sustainability, ageing populations, healthcare, social security, drinking water, agriculture, biodiversity, transportation, clean energy, education policies, innovation for economic growth) which allow citizens to engage in dialogue with researchers and local authorities.

Temi

The project (2013-2016) introduces inquiry-based learning (IBS) into the science and mathematics classroom using magic tricks, myths and mysteries. TEMI is a teacher training project, working with teacher training institutions and teacher networks across Europe to implement innovative training programmes – inquiry labs. The Enquiry labs are based around the core scientific concepts, but use local myths and mysteries to explain them. The labs are supported by scientists and communication experts to guide teachers through the transition to use inquiry in science teaching. The TEMI Central hub coordinates the activities of the local training centers and provides a platform to share best practice across all aspects of the project.

4.4.3. Cyber-Mentor

CyberMentor is an e-mentoring programme for girls and young women ages 12–18 in Germany designed to foster their participation in science, technology, engineering, and mathematics (STEM). Each female student (mentee) is paired with a professional woman in STEM, i.e. a researcher, a professor, or an engineer, (mentor) who informs and advises her. CyberMentor offers an online platform which provides communication possibilities and helpful suggestions for STEM activities and information on STEM courses of study and professions. Community members can introduce themselves through personal pages and interact regularly via email, chat, or discussion forum for the period of one year with their mentoring partner and with all programme participants. Discussion topics range from specific scientific questions about the mentors' work to private matters. Each year, at least 800 girls and 800 women take part in the programme. Having so many other students and mentors as contact persons offers a great possibility for information exchange. In order to encourage engagement within the platform, the CyberMentor management team regularly makes suggestions for STEM-related experiments, activities, and competitions that participants can work on together. CyberMentor edits a monthly journal, CyberNews, which offers reports on interesting STEM articles, quizzes, and interviews with professionals in the STEM-Field.

4.4.4. Inspiring Science Education

Inspiring Science Education is a project aimed at providing resources and opportunities for teachers to make science more attractive to their students. The project includes:
an online portal that provides an interactive inventory of e-learning tools and resources from research centers and other facilities; communities of practice as the place where the collaboration between teachers and students will take place.

The project will be implemented through pilot activities that will take place in 5.000 primary and secondary schools in 15 European countries. The schools will be selected to participate in piloting the project tools and resources through case studies developed in cooperation with the local teachers.

4.4.5. Science on Stage Europe

Science on Stage is a European initiative designed to encourage teachers from across Europe to share good practice in science teaching. Innovative and inspirational science teaching is seen as a key factor in attracting young people to deal with scientific issues, whether or not they finally choose a career in science. Hence, Science on Stage aims to stimulate the interest of young people through their school teachers, who can play a key role in reversing the trend of falling interest in science and current scientific research. Ultimately, the aim of Science on Stage is to enable teachers to deliver science in a more creative and engaging way.

4.4.6. e-Twinning

The eTwinning community for schools provides teachers across Europe with the opportunity and the tools for collaboration in math, science and technology education projects. eTwinning promotes collaboration between schools in Europe through the use of Information and Communication Technologies (ICT). The community provides support, tools and services to make it easy for schools to form short- or longterm partnerships in any subject area, and thus to improve and develop teachers' practices and education in Europe. Additionally, eTwinning provides Professional Development Workshops and Learning Events where teachers can learn more about eTwinning and develop their skills in using ICT in teaching.

4.4.7. Go-Lab

Go-Lab (2012-2016) has created an infrastructure (the Go-Lab Portal) to provide access to online laboratories run by research centers and universities worldwide. These online labs can be used by universities, schools, instructors, students and lifelong learners to extend regular learning activities with scientific experiments, giving students a real experience of research work. The Go-Lab Project offers a federation of remote laboratories, virtual experiments, and data-sets (together referred to as "online labs"), as well as facilities for teachers to embed these online labs in pedagogically structured learning spaces.

4.4.8. E-Bug

e-Bug is a free educational resource repository that makes learning about micro-organisms, antibiotics and hygiene fun and easy. e-Bug helps to teach children about the different types of microbes, the activity of antibiotics against them, and the increasing problems of antibiotic resistance with unnecessary use, and thus to raise awareness of wise antibiotic use. The e-Bug project aims to • Reduce the incidence of antibiotic resistance across Europe by educating future prescribers and users on prudent antibiotic use;
Complement national antibiotic and hygiene educational campaigns;
Exchange information and experience of good practice in the educational curriculum with European partner countries, and Translate and implement the e-Bug resources across Europe in close collaboration with local Ministries of Health and Education.

4.4.9. Profiles

PROFILES promotes Inquiry-Based Science Education by raising teachers' awareness of more effective ways of teaching, with the support of various science education actors. The project aims to work towards a better understanding of the changing purpose of teaching science in schools and the value of science education stakeholders' networking. PROFILES is based on "teacher partnerships" aiming to implement existing inquiry-based science teaching materials. Long-term teacher training courses reflecting challenges relevant to the participants raise their skills in developing creative, scientific problem-solving and socio-scientific related learning environments, which enhance students' intrinsic motivation to learn science and their individual competences such as decision-making abilities and abilities in scientific inquiry. The intended outcome of PROFILES is that science education becomes more meaningful for students and more strongly related to 21st century science and Inquiry-Based Science Education (IBSE), and thus fosters students' scientific literacy.

4.4.10. Science: It's a girl thing

A pan-European awareness campaign to encourage girls to develop an interest in science and engage young women in scientific research careers. This reflected Commissioner Geoghegan-Quinn's commitment to promote gender equality and the gender dimension in research and innovation. With the slogan "Science: it's a girl thing!", the first phase of the campaign targeted girls aged 13 to 18, aiming to challenge stereotypes around science and show girls that science can be a great opportunity for their future.

4.4.11. Responsible Research and Innovation

Responsible (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organizations, etc.) work together during the whole research and innovation process to better align both the process and its outcomes with the values, needs and expectations of society. In practice, RRI is implemented as a package that includes multi-actor and public engagement in research and innovation, enabling easier access to scientific results, the take-up of gender and ethics in the research and innovation content and process, and formal and informal science education.

CONCLUSION

Macedonian new science curriculum is in the process of implementation of the second developing period, based on proposed reforms suggested by Cambridge international examination center, approved by Ministry of education and science and Bureau for developing of education. The BDE advisers and Cambridge consultants conduct monitoring process trough interviews, surveys and conversations on the field after first year of new curricula implementation. Based on monitoring and observations process, were noted positive attitudes, work ethic and recognition of need for change. But, still, the teachers do not seem to have the necessary level of subject and pedagogical knowledge for learners to benefit fully from the new curriculum. There is no evidence so far of a shift away from content-focused to skills-focused lessons or any shift in the level of expectation. As many principals have not attended the training events they are not aware of the challenges presented by the new curriculum. During the visit the monitoring team from BDE and Cambridge team made the following observations of the changes needed in respect of pedagogy, attainment and attitudes:

A greater variety of teaching styles are needed where the focus is more on the children learning than the teachers teaching. Learners should have more autonomy to complete work themselves.

Practical work should focus on exploratory and investigative work that will develop skills e.g. accuracy of measurement or planning an investigation.

There should be more group work. Learners often sit in groups but continue to work individually on tasks. This does not encourage them to discuss how to approach the task or solve the problems presented to them.

Teachers should be encouraged to reflect on their teaching practice. This will help them to review their teaching in the light of how well the children have progressed in their learning.

Learners are positive about science and are well-behaved and focused on their work. However, they need to be given more autonomy within the tasks they carry out to develop a resilience and commitment to problem solving. Learners need exposure to a range of strategies to enable them to start developing the decision making process needed for higher order thinking.

As additional support to the new science curriculum is the EU Scientix portal that was launched in May 2010. Since then, it has proven to be a very successful portal, which attracts users to search for science education projects and studies, browse and download reports, resources and tools, and use the communication and translation services provided. Most teachers are looking for project information, news and teaching materials, and they are generally happy with the content and resources that they found. Scientix is gradually growing as more and more projects join the community and share their resources and materials through the portal, which is also constantly updated and developed to display the current status and latest results of the projects, and to fulfill the needs and wishes of the users. Scientix is all the time looking for new educational initiatives to join its community to demonstrate new ideas and good practices for science education in Europe and Macedonia as well.

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A POSSIBLE MECHANISM FOR ENHANCING THE ADVANCED KNOWLEDGE CONSTRUCTION IN ONLINE LEARNING COMMUNITIES

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ABSTRACT: In recent years, regarding learning, the applications of peer collaborative learning through online learning communities have been progressively developed, applied and explored. Especially after the rise of social networking site--Facebook, the concept of social network service (SNS) has provided innovative reforms in the operations of online learning communities. Peer collaborative learning of online learning communities is often conducted with the discussion teaching method, which serves as a key teaching method in many cooperative learning activities. Literature has suggested that an asynchronous or synchronous online discussion session incorporating different teaching strategies may improve students' cognitive ability and knowledge construction process. However, some studies found that an online discussion activity without any control or interferences from educational instructors would lead to a lack of an advanced knowledge construction. To address this issue, this study treats Facebook as the learning community and attempts to assist students' online discussion activities through adopting the teaching strategy--collaborative problem solving (CPS) and using the concept mapping as cognitive tools. Thus, this study aims to develop a collaborative problem solving (CPS) teaching strategy, and integrate the system of concept mapping.

Keyword: online discussion; collaborative problem solving (CPS); concept mapping; facebook

INTRODUCTION

With the widespread use of internet technologies and the much-changed pattern of social interactions, the social networking service (SNS) has become an integral part of modern society. Especially in the field of learning, online learning community has become an important field of study for students nowadays (Mazman & Usluel, 2010; Wu, Hou, Hwang, & Liu, 2013).

In online learning communities, collaborative learning via online discussion activities has become the most commonly used learning method (Dawson & Venville, 2009; Vighnarajah, Wong, & Bakar, 2009). The process of online discussion activities not only provides students with the means to develop cognitive abilities and critical thinking skills (Anderson & Krathwohl, 2001), but it also allows the teacher to monitor and supervise the group discussion in real time (Bernard, Abrami, Lou, Borokhovski, Wade , Wozney, Wallet, Fiset, & Huang, 2004).

During the peer collaborative learning, the teacher usually integrates certain interactive teaching strategies in it. In the asynchronous peer assessment online discussion activities based on topic-oriented learning approach proposed by Hou, Chang, and Sung (2007), it was shown that significance was achieved only in the P1 → P1 (sharing, comparing information or proposing similar ideas) and P6 → P6 (messages irrelevant to knowledge construction), indicating that students were not able to reach more advanced discussions during the peer assessment activities, and that the causes for the lack of in-depth discussions may include students' attitudes, individual opinions, and the length of assessment time. The research by Wever, Schellens, Keer, and Valcke (2008) on role-play-based discussion activities reveals that while the students were properly stimulated by role-playing to elicit diverse ways of thinking, their capacity for advanced-level discussions still need to be strengthened. Wu, Hou, and Hwang (2012) also stated in their research that although synchronous peer assessment activities can prompt basic and advanced two-way cognitive interaction, it also acknowledges a lack of advanced cognitive discussions and the continuous behavioral patterns of digression. In short, pertinent literature have all pointed out that online discussion activities via different teaching strategies can indeed enhance students' cognitive levels and knowledge construction process. However, these studies have also showed that in a non-controlled and non-intrusive discussion environment, process of advanced knowledge construction is relatively lacking.

Therefore, to solve this problem, this study aimed to develop a Facebook-based online learning community system to assist students' discussions in the hope that it would improve the process of students' advanced knowledge construction in online discussion activities.

THEORY FOR THE SYSTEM DEVELOPMENT

To achieve the above objective, this study set out to design an online discussion system that would improve the advanced knowledge construction process. As a result, a collaborative problem-solving approach was used as the teaching strategy, and concept mapping as the cognitive tool. Regarding online discussion teaching strategies, the collaborative problem-solving (CPS) model proposed by Nelson (1999) is presently a widely used teaching strategy adopted by researchers and educators (e.g., Guimarães, Antunes, García & Fernandes, 2013; Pollastri, Epstein, Heath, & Ablon, 2013). Since CPS approach encourages learners to "learn by doing", emphasizes the authenticity of the collaborative learning environment, and promotes the ability of problem-solving, the learning activities proposed by this study would follow the scheme of the nine stages in collaborative problem-solving approach.

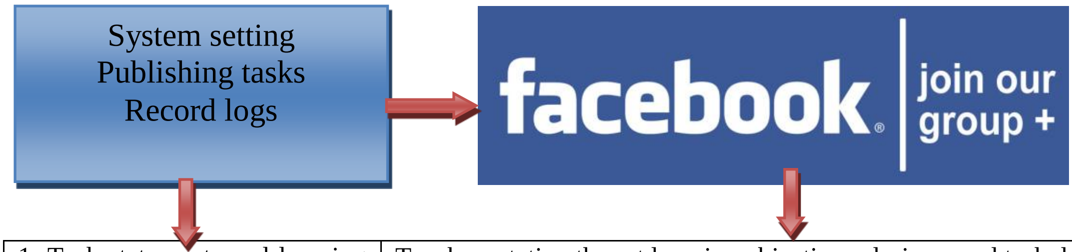
In addition, concept mapping is currently a coveted system tool used by researchers or educators in the application of cognitive development aid. Concept mapping is a technique used to depict relationships between information, ideas, or concepts. A concept map is represented by 'concept nodes' which are connected with 'relation links'. Two concept nodes and its relation link constitute a 'proposition', and the relationship between concepts in a concept map is articulated in 'hierarchy' (Novak & Gowin, 1984). This study regards concept mapping as a cognitive tool in the hope that teachers can use it as the cognitive scaffolding to the intended teaching subject, which in turn should help students recognize the best ways to learn and make their coding process become explicit, thus promoting their understanding in the relationships between concepts.

This study established the online learning community based on a social network environment (i.e., Facebook), applied the CPS model as the teaching strategy, and concept mapping as the cognitive tool. Teachers can pre-set different concept maps based on different subjects, and guide the students to solve the problems arisen in the online discussions using the CPS model. Such system, equipped with these two mechanisms, is expected to motivate the students to engage in sequential thinking and more in-depth issues, thus enhancing their advanced knowledge construction process; furthermore, the Q&A mechanism of concept mapping allows students to attain prior knowledge on the subject before problems and solutions are discussed and thus the students can conduct more in-depth online discussions.

SYSTEM PLAINNING

The system designs a situational problem based on individual teaching subjects and curriculum goals set by the teachers and conducts pretesting and grouping based on learning objectives. After students are assigned to the preset Facebook groups, teachers then announce the procedures of nine-step CPS model in accordance with the prior plan or students' discussion performance (i.e., content can be displayed in Facebook Group after the backend announcement). Students will then enact the discussions according to the published content. Diagram of the conceptual system is shown in Figure 1. During the discussions, students in each group are to work independently, and they cannot view the content of other group discussions via Facebook. In addition, all behaviors involving discussions and concept mapping are chronologically recorded and stored in backend database to facilitate future analysis.

In step 5 (collaborative exploration and concept formation), teachers need to formulate a backend concept map to facilitate the process of guiding students in online discussions (Figure 2). When completed, students from each group are required to answer the questions within the concept map. This approach is to provide clues to students' thought and discussions, thus forming relevant concepts. After their discussions, students, need to answer every assigned question to determine whether the formation of the concept is properly understood, and their answers would also serve as a guide and clues to assist the students in the discussions and online information gathering.



1. Task statements and learning objectives	Teachers stating the set learning objectives, designs, and task descriptions.
2. Group List	Presenting the group list (the list must be compiled in advance).
3. Problem defining	Describing and defining potential problems.
4. Leader(s) electing	Nominating and electing leader(s).
5.Collaborative exploration and concept formation	Teachers formulating an apt concept map to facilitate the process of guiding students in online discussions.
6. Problems and solutions	Proposing solutions based on the problems raised.
7. Ideas exchange and reflections	Sharing ideas on the whole process through online discussions and reflecting on whether the proposed solutions meet the raised problems.
8. Testing	Implementing learning assessments.
9. Summary and Feedback	Giving final feedbacks.

Figure 1. Diagram Of A Conceptual System

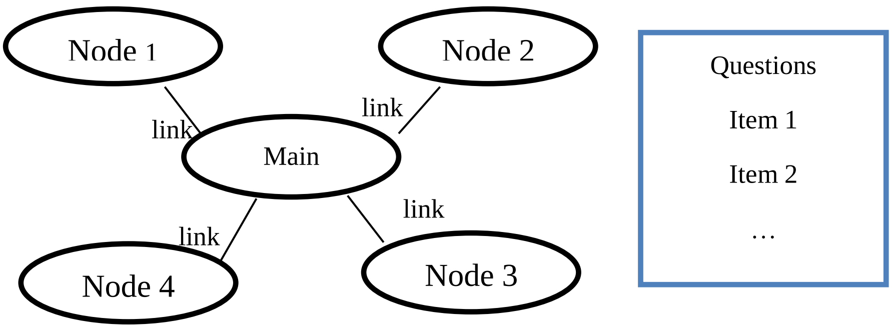


Figure 2. Interface Diagram Of A Concept Map

CONCLUSION

Previous studies have explored an online discussion environment without guidelines or the intervention of teachers, and determined that it was very difficult to achieve the process of advanced knowledge construction. Therefore, it was the goal of this study to build an online learning community based on a social network environment (i.e. Facebook), applying CPS model as the teaching strategy, and concept mapping as a cognitive tool. Teachers can pre-set different concept maps based on different subjects, and guide the students to tackle the problems arisen in the online discussions using the CPS model. This study believes that the CPS approach can prompt the students to engage in sequential thinking and in-depth issues, and that the Q&A mechanism in concept mapping allows students to gain prior knowledge on the subject before problems and solutions are raised and thus the students can conduct more in-depth online discussions. Once the system is completed, this study will explore the said mechanism through empirical studies as to validate its effectiveness.

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A NEW STEAM AGE: TOWARDS ONE CULTURE FOR LEARNING SCIENCE

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ABSTRACT: In many cultures learning has been organised around subject disciplines broadly conceived as the Arts, Humanities and Sciences. Subject disciplines of the curriculum have evolved structures and characteristics creating boundaries between them that are counter to the experiences of many adolescents, who rarely meet such borders in their daily lives. Disciplinary borders favour a utilitarian view of knowledge and creativity, often under-valuing some disciplines, including the creative and performing arts, not directly associated with primary means of economic production. The borders between self-reinforcing disciplinary structures result in inadequate attention paid to the potential of working across, between and beyond disciplines. In this paper I examine how this schism between the 'Arts' and 'Sciences' has come about and the potential harm it continues to do. An example from the history of science, the case of Darwin's changing relationship with the two cultures, is used to promote the benefits of more creative approaches to teaching science in a new project, 'Darwin Inspired Learning'. The benefits to learning science using methods from one of the Arts, drama, are shown. The argument is made for '**STEAM**', showing how education in the 21st Century is moving away from a restricted notion of STEM (Science, Technology, Engineering and Mathematics) to one that encompasses the Arts (Science, Technology, Engineering, **ARTS** and Mathematics). **STEAM** promotes economic development, encouraging people to work creatively to generate and communicate ground breaking new ideas. It is argued that teaching methods and content from arts subjects should be used to promote a more engaging and cognitively challenging experience of science education at a time when poor pupil attitudes to studying science subjects continues to be an issue in many countries.

Key words: science education, teaching innovation, drama, curriculum.

INTRODUCTION

In the history of education there has been a constant intention to create a curriculum representing the cultural, intellectual and social activities characterizing our world and to prepare future citizens to profitably live in it. From the muses of the Ancient Greeks, who provided inspiration for the intellectual pursuits of poetry, astronomy, dance, comedy and history (among others), through ecclesiastical thinkers of medieval times and pedagogues such as Comenius and Rousseau, to the school curriculum of the present day, the Arts and the Sciences have been seen as essential in educating the rounded human being. A problem has been that these two fields of learning and endeavor have tended to be seen as alternative, competing fields rather than as complementary and interrelated. It is important to make clear right from the start that I do not make a case for science and the Arts being the same in the way they proceed or what they achieve. Science is not like Art. Though science is socially and culturally embedded, it produces knowledge through empirically testing ideas to produce better understanding of the world. The science of the universe in the 2st Century is better now than in the time of Aristotle, Ptolemy, Copernicus or Galileo. Art is not like that. Although technology may provide more advanced representational techniques, the paintings of Pollock or Renoir are not better than those of Giotto – they are just different; open to aesthetic rather than empirical judgment and validation. It seems that the separation in schools between the Arts, the sciences and humanities is most noticeable at the secondary school level where subjects appear to be learned in disconnected silos where skills and knowledge exist as separated entities. It is my contention in this paper that the subject boundaries created around school subjects are artificial, created and maintained by those with vested interests and associated power, and that these boundaries harm the progress of all learning especially of science. In a world where technological innovation is fast evolving and drives economies, science increasingly draws on the Arts to provide the creative stimulation for new ideas and even new knowledge of science. The idea of combining Science, Technology, Engineering and Mathematics (STEM), to better contextualize these subjects and draw benefits from collaboration between them, has been around for some time (Bennett, Braund & Sharpe, 2014). In the last four years there is a new letter, 'A' for the Arts, to be added to the STEM acronym. STEAM (Science, Technology, Engineering, 'The ARTS' and Mathematics) is a growth area in Higher Education and industrial and technological communities but, with the exception of some states of the US and in Korea, the concept of STEAM in education and implications for teaching and learning of science in schools lags behind what is happening to science and how it is changing in the real world. After exploring an historic example of how Charles Darwin's science was impacted by the Arts and how this relates to the 'Two Cultures' (Arts and Sciences) concept, an example of how science teaching may be improved by drawing on Arts pedagogy will be discussed. Thus a STEAM example is shown as an achievable reality in modern science teaching.

DARWIN AND 'THE TWO CULTURES'

As a young man struggling to make sense of what others thought should be his professional destiny, first in medicine and later theology, Darwin wholeheartedly embraced the Arts as did many in fashionable society of the early 19th Century. At this stage of life there were no conflicts between his growing interests in science and nature and cultural connections to poetry, opera, ballet, fine arts and theatre. Even when at school in Shrewsbury, the adolescent Darwin turned to the plays of Shakespeare and the poetry of Byron to relieve the tedium of rote learning from the classics and other school subjects, which he found so abjectly boring (Desmond & Moore, 1992: 16). Edinburgh's Theatre Royal provided welcome relief from the horrors of medical dissections by way of ballet or other 'terpsichorean delights' (Desmond & Moore, 1992: 23).

As his interests turned towards science, especially avid collecting and fascination with South American landscapes, plants, animals and fossils on the voyage of the Beagle, Darwin turned to Rossini's operas to relieve the tedium of scientific 'downtime' in Montevideo. In the busy days collecting on the voyage, Darwin expressed his experiences (for example, of summiting the Andes and of collecting in the dense rainforests of Brazil) in terms of the imagery of Tennyson, the landscapes of artist Claude Lorrain and choruses of Handel's Messiah. Darwin often used the term 'sublime' as if to recognise that the beauty of what he saw was beyond mere rationalisation and theory. Thus for Darwin the Arts provided not only a holistic experience of culture but also a celebration of the natural world. Yet, after the Beagle's voyage, as he became progressively more engrossed with validating evidence and constructing theory, Darwin became noticeably estranged from the Arts. For example in a letter to Joseph Hooker in 1868 he wrote:

> I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me. I have also almost lost my taste for pictures and music. I am glad you were at the 'Messiah', but I dare say I should find my soul too dried up to appreciate it; and then I should feel very flat, for it is a horrid bore to feel as I constantly do, that I am a withered leaf for every subject except Science. The loss of these tastes is a loss of happiness. My mind seems to have become a kind of machine for grinding out general laws out of large collections of facts. It sometimes makes me hate Science.

(Darwin, cited by Fleming, 1961: 219)

It seems that as his science progressed Darwin increasingly set the atomising nature of his science above the integrating vision provided by the Arts. Fleming likens Darwin's atrophy for aesthetics and estrangement from the Arts as transformation from an aesthete and broader intellectual, able to draw equally on science and the Arts, to an 'analytical man' concerned only with scientific facts and theories. Hence, the title of Fleming's paper, '*Charles Darwin, The Anaesthetic Man*' (1961). It seems that later, in his increasingly scientific life, Darwin could not find the emotional space or mental capacity to integrate the Arts, yet this was the very aspect of intellectual life that might have made him more emotionally complete and at peace with himself at a time of increasing self-doubt. Towards the end of his life his regret for not having embraced the Arts is plain to see. In his autobiography, published after his death, he wrote:

> ... if I had to live my life again, I would have made a rule to read some poetry and listen to some music at least once every week; for perhaps the parts of my brain now atrophied would thus have been kept active through use. The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature.

(Darwin, 2005: 115)

Darwin's changing relationship with the Arts is a fascinating example in a debate that has continued to affect educational thinking for some time. The schism in western intellectual thought, seen as a cultural divide between the Arts and sciences, found its most famous expression when physicist and novelist C.P. Snow delivered his landmark Rede lecture on *Two Cultures and the Scientific* in May 1959. For Snow it was the ignorance and lack of education in the sciences, particularly for the 'governing classes', that was his chief concern (Snow, 1959). While being well versed in the classics and the Arts were seen as essential attributes for those who wanted to get on in society, ignorance of science and the fundamental principles on which the world works were seen as conferring no real disadvantage.

The perception that studying the Arts is intrinsically and intellectually different to studying sciences stems from a world view in which thought is divided into two separate realms. As Morris puts it, the first (the science one) is "tangible, measureable and real and the other (the arts one) is immaterial, intangible, unquantifiable and imaginary" (Morris, 2006: 152). In this way science is seen as a reductionist enterprise reducing the world, as Darwin started to do, to its most simple and understandable parts. But, as Darwin soon realised, grand ideas such as his require much synthesis and integration of parts to create a whole. From this world view science is then a more creative enterprise, yet few science teachers in schools or their pupils seem to recognise the creativity of science. It is no wonder that poorer attitudes of pupils to science are the result, particularly when studying science gets harder and seemingly more remote from the real world it is supposed to explain.

USING THE ARTS TO TEACH SCIENCE

UNESCO's decade of educational effort (2005-2014) promoted change based on interdisciplinary effort rather than purely subject-focused innovation (UNESCO, 2005). A central tenet of UNESCO's resolution was emphasis on holistic teaching practices using multiple instruction methods including those of the Arts. The idea of using methods more normally associated with the Arts to explain science ideas and engage more pupils with science content is not new. Activities involving creative writing, poster art, making 3-D models, science poetry, making animated films and using drama and role play have all been suggested and adopted as part of science teachers' repertoires (Braund, 2015a). However, the pressure of performance accountability, judging teachers' on the examination successes of their students rather than also on the extent of their engagement and attitudes to learning, has become increasingly prevalent in many educational systems. This has limited the variety of instructional methods used by science teachers, especially methods drawing on Arts-based pedagogy.

Arts-based teaching helps students learn science because it offers alternatives to the usual expository texts of comparison, description, sequencing and listing, cause and effect and problem solution (Begoray and Stinner, 2005). In contrast, students' daily lives are dominated by narratives and visualizations associated with films, novels, oral storytelling, television and gaming. Accordingly, it is appropriate to look in more detail at an example from a recent international project which used some of these Arts ideas to communicate and celebrate the work of Charles Darwin.

Arts-based methods in the Darwin-inspired learning project

Darwin-inspired learning was a writing project involving 21 Darwin scholars in the production of an academic and resource book celebrating Darwin's life and achievements and providing inspirational and innovative ways to learn from and through Darwin's life and work (Boulter, Reiss & Sanders, 2015). As part of the project the author of this paper was commissioned to write a chapter showing how Darwin's ideas could be taught using drama.

Reviewing literature on drama in science, Marianne Ødegaard sees drama contributing to three areas of learning: about *concepts*, about the *nature of science* and about *science's interactions with society* (Ødegaard, 2003). The example provided in this paper is in the first area, though examples for the other two can be found in the full chapter in the *Darwin-Inspired Learning* book (see Braund, 2015b).

Teaching concepts using role-play simulation

The idea of using role-play simulations, that are effectively types of games, is that they provide analogues for the concepts to be learned but in an engaging and learner-centred way (Abrahams & Braund, 2012; Braund, 2015a). In the example shown here, of 'Reed Warblers and Cuckoos', the central target concept is colour variation conferring different survival rates of prey (caterpillars) so that individuals with better survival chances are more likely to breed. Thus, the simulation acts as an analogue for Natural Selection.

Students' roles are to 'play' organisms involved in prey selection. Science teachers have often used analogy or metaphor in their teaching to try to connect pupils with, sometimes abstract, ideas. The value of drama is that these methods provide memorable, enjoyable and highly active examples where pupils are part of the process the teacher wants to explain.

The Reed-Warblers and Cuckoos game-simulation can be played outside or in a classroom or school hall and is suitable for pupils in the age range 11-16, depending on the level of the concepts developed. The idea is that a pupil or the teacher plays 'the cuckoo' who wears a 'tongue' made from card carrying *velcro* strips to which the caterpillars collected as prey by the other pupils playing 'reed warblers' are attached. A teacher acting as the cuckoo is shown as Figure 1.

Figure 1. The 'Cuckoo' Showing The Card 'Tongue' With Captured Wool 'Caterpillars' Attached.
(From: Abrahams and Braund, 2012: 43/4)

The game starts when the cuckoo calls "feed me". The 'reed warblers' search for and capture caterpillars, represented by different coloured wool strands (about 15 in each of 12 different colours should do), some brightly coloured which stand out against various backgrounds, others having more camouflaged colours. The rule that reed warblers can only retrieve one caterpillar at a time to return to the cuckoo's tongue helps prevent over-zealous collection of bunches of caterpillars. The wool 'caterpillars' can be stuck onto the cuckoo's tongue from top to bottom in order of retrieval, providing a record of colours of prey selected as predation continues. The patterns can be discussed in terms of changes in relative selection pressure as more brightly coloured and obvious individuals are selected out. If the game is played in the school grounds, then a distinct area can be pegged out that includes grass, bushes and trees, and any remaining caterpillars on each background can be counted when the game has terminated. I have seen the game played in a classroom where camouflaged military netting was suspended above pupils' heads with the wool 'caterpillars' laid just inside the netting.

A feature of drama, like some other interactive learning activities, is that it has potential to generate additional misconceptions through comparison with reality. In this case it is necessary for pupils to appreciate that cuckoos are not normally fed by more than one pair of reed warblers. How good the drama is as an analogue for nature can be part of discussion that follows the drama-game. In some of my observations of drama used in science classrooms I have noticed that teachers do not spend enough time debriefing or discussing the drama (. This was particularly noticeable for student teachers who were drama specialists. They seemed to assume that the potential of the drama to establish learning was so powerful that nothing else was needed to embed concepts or address shortcomings of simulations (see Braund, Ekron & Moodley, 2013). As with most learning events, consolidation by the teacher and reflection by learners makes fuller impact of the activity more likely.

CONCLUSION – THE NEW STEAM AGE

A continuing concern in many countries is that, while students recognize the value and benefits of science for society, decreasing numbers of them want to go on and study the subject at a higher level or take up a STEM-based career (Bennett, Braund & Sharpe, 2014; Søberg & Schreiner, 2010). It seems that school science fails to engage school students and is often seen by them as a cold, fact-based subject, boringly taught and stripped of everyday contexts and real-life meaning (Gilbert, Bulte and Pilot, 2011). It is my contention here that an important contributing factor is that the Arts have been isolated from the sciences in the school world, denying science some of the very methods that could make it a more interesting and enjoyable subject without losing sight of having to learn content at a high level.

It is widely recognised that the Arts, including the example I have given here of a drama role-play, have a significant part in developing overall intellectual capacity. The contribution of drama to creative and critical thinking, including advancing skills in scientific argumentation, is of particular importance (Duschl & Osborne, 2002). This is one of the reasons why, in South Korea, there is now a government initiative aimed at fostering students' creativity and critical thinking through the inclusion of Arts subjects in a STEM-focused curriculum. The idea is to broaden the curriculum from 'STEM' to 'STEAM': Science, Technology, Engineering, the Arts and mathematics. Educational systems in other countries, if they are interested in improving science education and at the same time drawing it closer to the innovative and economic collaborations between the Arts and sciences in the real world, should take note of these more collaborative curricula.

I have shown that Darwin's work, his life and his ideas lend themselves to learning activities that involve learners in highly interactive methods. Drama and other Arts-related activities are memorable, not only because they can be highly enjoyable, but because they help establish meaningful and long-lasting links between science and content and learning events. As a student in a South African classroom, having just completed a drama in science lesson put it:

> I liked doing the drama because you can learn and you can do it yourself. It's a quicker way of learning than from books and stuff even from video … You will know what it would feel like and that kind of thing, like maybe we could remember about how we moved and how we acted in the grade exams.

Perhaps dramatic and other Arts-based activities might even improve pupils' performances on examination questions, but I hope that examination success is not the only justification for a more holistic science education that embraces and uses the Arts.

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THE COMPARISON OF COLLEGE AND UNIVERSITY STUDENTS` LEARNING STRATEGIES FOR CHEMISTRY COURSES

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ABSTRACT: It is essential to know, comprehend, apply, analyze, synthesize, and evaluate the physical science (chemistry, earth science, physics, etc.) for the science and engineering students. The purpose of this study was to compare the tendency of the higher education technical vocational school and engineering students to physical science. The research was conducted with 166 students. Data were collected using Learning Strategy Survey (LSS). Cognitive/metacognitive strategies (CMS) and resource management strategies (RMS) of the students were compared with the help of this survey designed for chemistry courses. The results presented that the usage of learning strategies of the higher education technical vocational school and engineering students were similar in terms of chemistry. The students` thoughts revealed that the chemistry is not accepted as a key-course for their major field and they preferred to memorize the content of the course without any comprehension. The detailed findings and suggestions were reported in the study.

Key words: chemistry, higher education, learning strategies

INTRODUCTION

Fundamental sciences (chemistry, physics, earth science, etc.) are mandatory courses and also essential to know and understand for engineering students and higher education technical vocational school students. Science students should remember, understand, apply, analyze, evaluate, and create necessary principles not only in major fields but also in fundamental sciences. This type of learning was reported to be a part of metacognitive process. The metacognitive process consists of three phases: a) developing a plan for approaching a learning task, b) monitoring the plan, and c) evaluating the results of the plan (Flavel, 1979; Schraw & Moshman, 1995; Schraw, Crippen, & Hartley, 2006). Many studies were conducted to determine/apply similar learning strategies both in science education (Cook, Kennedy, & McGuire, 2013; Lynch & Trujillo, 2011) and social science education (Karadeniz, 2010; Rao & Liu, 2011).

One of the pioneers in this area, Pintrich, Smith, Garcia, and McKeachine (1991), reported that learning strategy comprises of cognitive and metacognitive strategies-CMS- (rehearsal, organization, elaboration, critical thinking and metacognitive self-regulation) and resource management strategies-RMS- (help seeking, peer learning, effort regulation and time and study environment).

Rehearsal strategies (questioning techniques, visualization, quick writes, preprinted response cards, etc.) is based on memory enhancement by revisiting the content as many times as possible. *Organization strategies* (clustering, outlining, taking notes, selecting the main idea, mapping or connecting key ideas in learning material, etc.) covers selecting suitable information and construct connections among the information to be learned (Pintrich et al., 1991). *Elaboration strategies* (paraphrasing, summarizing, interpreting, effective note-taking, making analogies, etc.) are used to detailed investigation of new information for better understanding. *Critical thinking strategies* (reasoning, evaluating, problem solving, decision making, and analyzing) are based on solving problems, comprehending the connections between ideas, evaluating discussions, determining the importance and relevance of ideas/situations, etc. *Metacognitive self-regulation strategies* consist of planning process (self management, self determination, goal setting, etc.), monitoring process (self focusing, self reflection, self regulation, etc.) and regulating process (self assessment, self questioning, self criticism, etc.). It was claimed that these strategies enhances the awareness, knowledge, and control of cognition of students.

The second part of the process covering both instructor and students are resource management strategies in which *help seeking strategy* encourages students to take the experts' support when they do not know a problem/ concept or content to be learned. *Peer learning strategy* provides learning by collaborating with peers (friends, classmates, etc.). *Effort regulation strategy* controls their effort and attention against distractions and uninteresting tasks (Pintrich et al., 1991). *Time and study environment strategy* helps student to manage and regulate their time and study environments. Pintrich *et al.* (1991) developed a learning strategy survey to determine even if students follow the strategies aforesaid.

In the present study, with the help of this survey, the cognitive and metacognitive learning strategies and resource management learning strategies were compared for both students of engineering and higher education technical vocational school. The two different levels of student groups were selected based on the achievement at the university entrance. Research questions were analyzed to fulfill the purpose of study.

1. Are CMS and RMS different for higher education technical vocational school and engineering students?

2. What is the reflection of these strategies to students learning process?

METHOD

Learning Strategy Survey (LSS) was used to determine the learning strategies of engineering and higher education technical vocational school students enrolled in introductory chemistry course. The research was performed in Torbali Technical Vocational School of Higher Education and Engineering Faculty at Dokuz Eylul University, Turkey. The study sample was consisted of 166 students. 49% of the students were engineering students (N=82). The survey was conducted to mining engineering students in faculty of engineering whose the education curriculum is similar to technical program. The rest of the students are higher education technical vocational school students (N=86). The survey was administered to Geotechnic and Drilling Technology, departments. The students were between 18 and 22 years of age.

The learning strategies survey (LSS) part of the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich *et al.* (1991) was used in the study. The Turkish version of the LSS, consisting of 36 items, modified and translated into Turkish by Buyukozturk, Akgun, Ozkahveci, & Demirel (2004) was conducted. The learning strategies section consisted of “cognitive and metacognitive strategies (rehearsal-6 items, organization-6 items, elaboration-4 items, critical thinking-4 items, and metacognitive self-regulation-3 items)” and “resource management strategies (help seeking-5 items, peer learning-3 items, effort regulation-3 items, and time and study environment-2 items)”. Students rated each item on a 7-point Likert-type scale (ranging from 1 = not at all true of me, to 7 = very true of me). Statistical analysis results (Explanatory Factor Analysis-EFA, Confirmatory Factor Analysis-CFA) of the LSS performed by Buyukozturk *et al.* (2004) are presented below.

According to EFA, LSS was comprised of nine factors with eigenvalues greater than 1.00, the factor loadings of the items were found to be 0.38 and over, and the total variance was 53.45%. The results of CFA include Chi-Square Goodness of Fit “X^2” (4.73), Root Mean Square Error of Approximation “RMSEA” (0.066), Goodness of Fit Index “GFI” (0.80), Adjusted Goodness of Fit Index “AGFI” (0.77), Normed Fit Index “NFI” (0.97), Root Mean Square Residuals “RMR” (0.22), and Standardized Root Mean Square Residual “SRMR” (0.06). The Cronbach’s α values were calculated between 0.41 and 0.75 (Buyukozturk et al., 2004). These results are reasonable for a survey used in low-risk research (Hutcheson & Sofroniou, 1999).

The collected data were analyzed by IBM-SPSS Statistics 22. The frequency distributions, means and standard deviations of engineering and higher education technical vocational school students’ values were calculated and independent-samples *t*-test was conducted to the statistical difference of means between students according to the statements. The difference between students was considered significant with p values less than 0.05. The students were given approximately fifteen minutes to fill out the questionnaire.

RESULTS AND FINDINGS

The results of cognitive and metacognitive strategies and resource management strategies of higher education technical vocational school students (TVSS) and engineering students (ES) were given in Table 1.

Table 1. Descriptive Statistical Values of Higher Education Technical Vocational School and Engineering Students Related to Cognitive and Metacognitive Strategies (CMS)

Factor	Group	N	M	sd	*t*-value	df	*p*-value
Rehearsal	ES	82	28.52	7.13	0.063	164	p>0.05
	TVSS	84	28.45	7.62			
Organization	ES	82	29.47	6.77	1.610	164	p>0.05
	TVSS	84	31.28	7.67			
Elaboration	ES	82	18.79	4.97	0.858	164	p>0.05
	TVSS	84	19.48	5.45			
Critical Thinking	ES	82	16.56	5.12	0.507	164	p>0.05
	TVSS	84	17.00	5.99			
Metacognitive Self-Regulation	ES	82	13.24	4.66	1.249	164	p>0.05
	TVSS	84	14.08	3.98			

Note: M mean; sd standard deviation; df degree of freedom

Mean values for cognitive and metacognitive strategies calculated for engineering students are 28.52 (sd =7.13) for rehearsal, 29.47 (sd=6.77) for organization, 18.79 (sd=4.97) for elaboration, 16.56 (sd=5.12) for critical thinking, 13.24 (sd=4.66) for metacognitive self-regulation and higher education technical vocational school students are 28.45 (sd=7.62), 31.28 (sd=7.67), 19.48 (sd=5.45), 17.00 (sd=5.99), and 14.08 (sd=3.98), respectively. Independent-samples *t*-test was conducted to the statistical difference of means between engineering and higher education technical vocational school students for cognitive and metacognitive strategies. The differences in the values between the students were not statistically significant for rehearsal [df =164, t=0.063, p>0.05], organization [df =164, t=1.610, p>0.05], elaboration [df =164, t=0.858, p>0.05], critical thinking [df =164, t=0.507, p>0.05], and finally metacognitive self-regulation [df =164, t=1.249, p>0.05].

Table 2 shows the findings of resource management strategies of higher education technical vocational school and engineering students.

Table 2. Descriptive Statistical Values of Higher Education Technical Vocational School and Engineering Students Related to Resource Management Strategies (RMS)

Factor	Group	N	M	sd	*t*-value	df	*p*-value
Help Seeking	ES	82	21.34	5.08	0.452	164	p>0.05
	TVSS	84	21.67	4.51			
Peer Learning	ES	82	13.08	3.87	0.601	164	p>0.05
	TVSS	84	13.48	4.69			
Effort Regulation	ES	82	11.53	3.23	0.925	164	p>0.05
	TVSS	84	12.04	3.84			
Time and Study Environment	ES	82	7.96	3.25	1.667	164	p>0.05
	TVSS	84	8.79	3.28			

Mean values for resource management strategies calculated for engineering students are 21.34 (sd =5.08) for help seeking, 13.08 (sd=3.87) for peer learning, 11.53 (sd=3.23) for effort regulation 7.96 (sd=3.25) for time and study environment, and higher education technical vocational school students are 21.67 (sd=4.51), 13.48 (sd=4.69), 12.04 (sd=3.84), and 8.79 (sd=3.28), respectively. Independent-samples *t*-test was conducted to the statistical difference of means between engineering and higher education technical vocational school students for resource management strategies. The differences in the values between the students were not statistically significant for help seeking [df =164, t=0.452, p>0.05], peer learning [df =164, t=0.601, p>0.05], effort regulation [df =164, t=0.925 p>0.05], time and study environment [df =164, t=1.667, p>0.05].

Table 3 demonstrates the findings of learning strategies higher education technical vocational school and engineering students.

Table 3. Descriptive Statistical Values of Higher Education Technical Vocational School and Engineering Students Related to Learning Strategies

Factor	Group	N	M	sd	*t*-value	df	*p*-value
Cognitive and Metacognitive Strategies-CMS-	ES	82	106.59	19.03	1.158	164	p>0.05
	TVSS	84	110.30	22.11			
Resource Management Strategies-RMS-	ES	82	53.91	8.54	1.382	164	p>0.05
	TVSS	84	56.01	10.84			
Learning Strategies	ES	82	159.40	24.97	1.604	164	p>0.05
	TVSS	84	166.32	30.26			

Mean values for learning strategies calculated that engineering students are 106.59 (sd =19.03) for cognitive and metacognitive strategies, 53.91 (sd=8.54) for resource management strategies, 159.40 (sd=24.97) for general learning strategies, and higher education technical vocational school students are 110.30 (sd=22.11), 56.01 (sd=10.84), and 166.32 (sd=30.26), respectively. Independent-samples *t*-test was conducted to the statistical difference of means between engineering and higher education technical vocational school students for general learning strategies. The differences in the values between the students were not statistically significant for cognitive and metacognitive strategies [df =164, t=1.158, p>0.05], resource management strategies [df =164, t=1.382, p>0.05], and general learning strategies [df =164, t=1.604, p>0.05].

CONCLUSION

The cognitive-metacognitive strategies and resource management strategies of higher education technical vocational school and engineering students were examined in this research. The study was performed on 166 volunteer students.

The findings showed that approximately 65% of all students used cognitive and metacognitive strategies while learning. The results were similar for strategies of rehearsal, organization, elaboration, critical thinking, and metacognitive self regulation. There was no significant difference between engineering students and higher education technical vocational school students.

When the findings of the research were evaluated from the survey on cognitive and metacognitive learning strategies, it could be listed as follows: the students (a) do not revisit the fundamental concept(s)/principle(s) of the chemistry needed for rehearsal learning strategy, (b) do not like taking notes, focusing on the main idea of the concept(s) and connecting concepts with the principles needed for organization learning strategy, (c) do not perform deeper learning for the chemistry course, (d) do not comprehend the fundamental principles of the chemistry related with their research area needed for elaboration learning strategy, (e) would prefer to memorize concept(s)/principle(s) than to use critical thinking learning strategies (reasoning, evaluating, problem solving, decision making, etc.), (f) do not plan, monitor, and regulate the process needed for the metacognitive self-regulation learning strategies, (g) only aim getting a good grade instead of learning the course.

60% of the students used resource management strategies while learning. When findings of help seeking, peer learning, effort regulation, and finally time and study environment strategies of students were evaluated, the results were similar. The statistical differences between the engineering students and higher education technical vocational school students were not significant.

When the findings of the research were evaluated from the survey on resource management learning strategies, it could be presented as follows: the students (1) help their peers or classmates regarding the concept/principle when they do not understand the subjects in the class instead of getting assistance from the instructors, (2) use frequently use help seeking and peer learning strategies, (3) regulate their study time and environment for studying based on spare time except of daily necessities (part-time job, transportation, etc.).

In general, approximately 60% of the all students used learning strategies. It is surprising that even though the academic achievement in entrance exam is different for engineering and higher education technical vocational school students, similar trends of learning strategies were found. Findings reflected that the majority of the students did not enjoy learning and studying fundamental courses such as chemistry. Students showed more interest on technical courses than science courses.

RECOMMENDATIONS

It should be noted that the awareness of engineering or technical majored students on the importance of science courses was obtained to be low. The perception of the students could be enhanced by various active learning methods (inquiry based learning, peer led team learning, peer led guided inquiry, peer-instruction, problem-based learning, etc.), educational technologies (applets, simulations, etc.), hands-on activities based on simple chemistry experiment, project competitions on fundamental science, discussion daily-life aspect of the topics on chemistry.

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A PRACTICAL DILEMMA: HIGH SCHOOL STUDENTS' PHYSICS-RELATED PERSONAL EPISTEMOLOGY

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ABSTRACT: This case study explores students' physics-related personal epistemologies in school science practices. The school science practices of nine eleventh grade students in a physics class were taped over six weeks. The students were also interviewed to find out their ideas on the nature of scientific knowledge after each school science practices. Analysis of transcripts yielded several themes which characterize students' ideas about the scientific knowledge in their school science practice. The findings show that students believe that scientific data should be accurate; yet, while they collect data, they can make mistakes that do not change the conclusion of experiments. Traditional, formulation-based, physics instruction might have led students to view physics knowledge as unchanging and isolated pieces of facts, and physics problems as having one single answer. Future implications and directions are discussed.

Keywords: personal epistemology, case study, science practices

INTRODUCTION

Personal epistemology (PE) is defined as what individuals believe about what counts as knowledge, and how knowledge is constructed and evaluated (Hofer, 2008). Therefore, examining students' PEs helps us understand how students evaluate new information, and make fundamental decisions (Hofer, 2001).

Some researchers have argued that students' PEs are tacit and complex, (e.g., Kelly, 2008). Cultural, curricular, and social contexts are considered as important elements interweaving students' PEs (Sandoval, 2009). Some researchers have suggested examining students' school science practices may be an appropriate way to shed light on the complexity of students' PEs (Elby & Hammer, 2010; Sandoval, 2005). Students' practices in school science may reflect their tacit beliefs about the nature of knowledge, the methods by which knowledge is produced, and how it is evaluated (Metz, 2011; Sandoval, 2009). However, there are few studies that have examined students' PEs through students' school science practices (Metz, 2011, Yang & Tsai, 2012). Thus, there is a need to examine how the ideas about the nature of scientific knowledge are interpreted in the social and cultural contexts in schools.

Two perspectives have been used to examine individuals' epistemologies. One perspective is psychological, which views epistemology or beliefs in knowledge as personal, empirical, and contingent (NRC, 2007; Kittleson, 2011). The other perspective is social, which views the beliefs in knowledge as situational and context-dependent (Kelly et al., 2012; Yang & Tsai, 2012). The studies that consider both of these perspectives are rare. Investigating students' PEs from these two perspectives at the same time will help us draw a better picture of the students' ideas about scientific knowledge.

THEORETICAL MODEL

Hofer and Pintrich (1997) define PE as epistemic theories in four identifiable dimensions: (a) *the certainty of knowledge* -focused on the perceived stability and the strength of supporting evidence, (b) *the simplicity of knowledge* -the relative connectedness of knowledge, (c) *the justification of knowledge* -how individuals proceed to evaluate and warrant knowledge claims, and (d) *the source of knowledge* -knowledge resides as an external source or is constructed by learners.

LITERATURE REVIEW

Interviews and surveys are the most popular instruments to probe students' PEs from the psychological perspective in science education research. However, often the questions asked in interviews and surveys are about the nature of scientific knowledge in general and they are decontextualized and abstract (Samarapungavan, Westby, & Bodner, 2006). Some researchers argue that it may be misleading to attribute a particular stance to an individual (Hammer et al., 2005). Furthermore, there is evidence that students' epistemic reasoning is inconsistent across contexts (Driver et al., 1996; Leach et al, 2000; Sandoval & Cam, 2011). These studies suggested that students' epistemologies are complex, and multiple data sources should be used to probe students' PEs (Driver et al., 1996; Leach et al., 2000; Sandoval, 2005; 2009).

Researchers who studied epistemology as social practice asserted that characterizing students' epistemology requires paying attention to both students' PEs and the way in which the context interact with individuals. Some researchers argue that social and cultural contexts influence individuals' ways of thinking and acting (e.g., Kelly et al., 2012; Sandoval, 2005; 2009). In this view, knowledge and issues regarding knowledge are socially constructed (Kelly, 2008). Therefore, rather than paying more attention to the individual consciousness, examining epistemology should focus on the inter-subjectivity processes of a community (Kelly et al., 2012). This implies that epistemic actions of community practice depends on the individual's mind and the reflection of the other members of the community.

A call for more naturalistic studies of PE has been made by several scholars (Sandoval, 2005; 2009; Elby & Hammer, 2001; 2010; Yang & Tsai, 2012). There is evidence, for example, that what students report in a survey or an interview about science is different from what the students do in science learning activities (Leach, 2006; Kelly, 2008; Wickman, 2004). Taking into consideration both social and psychological perspectives on students' practices of science will shed light on our comprehension of students' PEs in classroom settings.

Research Questions:

1) What are the characteristics of students' physics-related PEs in scientific practices?

2) In what ways are students' PEs mobilized in school science practices? (a) In a teacher directed classroom (lecturing)? (b)In laboratory activities?

Design and Participants

In this study, we utilized an instrumental single case study with qualitative methods. Merriam (2009) defines a case study as "an intensive, holistic description and analysis of a single entity, phenomenon, or social unit" (p. 46). This study was conducted at a charter school in South US in Fall 2013. The teacher, Mr. Bryan (pseudonym), has four years teaching experiences. Nine eleventh grade students (16-18 years, 3 girls) participated. During six weeks data collection, the topics covered in this physics class included a force and motion laws unit (15 hours), and work-energy theorem (10 hours). Instructional activities included Mr. Bryan's presentation of topics and whole class problem-solving activities (15 hours). Laboratory activities included *pendulum bob experiment, motion without friction using motion detectors, motion with friction with the spring, the conservation of energy experiment,* and *gravitational acceleration* (10 hours).

METHODS

Data Collection and Analysis

In this study, we used multiple data collection methods including interviews, audio-recording of inquiry activities, field notes, and students' lab reports. All class sessions were audio-recorded and transcribed. Also, post-activity group interviews at the end of inquiry activities were conducted.

One of the researchers observed the classroom activities in person over six weeks. He conducted interviews with the nine students to have an initial idea about their understanding of the nature of scientific knowledge. Interviews were conducted by using a semi-structured interview protocol. Interview questions were based on research on dimensions of PE and the nature of science (Hammer, 1994; Tsai, 1998; Kittleson, 2011; Hofer & Pintrich, 2002). The interviews included the following prompt questions: Do you think that scientific knowledge about [physics subject that being covered] in textbooks (teachers and scientists) is always true? How do you know this equation or etc.? [showing a formula from the textbook)] If you had to teach this equation to someone, how would you do that?

Also, the researcher conducted post-activity group interviews at the end of inquiry activities. During the inquiry activity, students might not verbally speak any dimension of PE, and this would lead to some part of the PEs being left out. Therefore, the purpose of the post-activity interview was to enter into students' perspectives about the activity (Patton, 1990). The post-activity interviews included, for example, the following prompt questions: Do you think that there is anything that you find for sure in your activity? What do you do when your results do not match the expected results from the theory? How do you draw conclusions from the experiment? Interviews were audio-recorded and transcribed.

Audio-recording of students' practices of science was another primary data source. It was used to capture students' conversations during the activity. A voice-recorder device was placed on each desk (a total of four voice-recorders) where students' voices were clear and distinguishable. All lessons (a total of 25 class sessions) were audio-recorded and transcribed. Also, artifacts constructed by students were suggested as important to characterize students' PEs (Sandoval, 2009). Students' lab reports or any artifacts they constructed at the end of the activity were collected.

We utilized Cobb et al. (2001)'s "interpretive framework" to analyze data from both social and psychological perspectives. According to Cobb et al. (2001), practices can be seen as cultural practices that are "emergent phenomenon rather than an already-established- ways of reasoning and communicating" (p.121). The interpretive framework consists of two dimensions: (a) social perspective and (b) psychological perspective. Social perspective, inspired by socio-cultural theory (e.g., Lave, 1998; Rogoff, 1997) refers to "ways of acting, reasoning, and arguing that are normative in the entire classroom community" (p. 118). Psychological perspective, inspired by constructivism and theories of intelligence (Pea, 1992) is "the nature of individual students' reasoning or, in other words, his or her particular ways of participating in those communal activities" (p.119). In this analytical framework, the social and the psychological perspectives are dependent on one another. Thus one cannot exist without the other, and vice versa, so that each forms the background for the other.

The analysis of the psychological perspective is to view the teacher and students as a group of individuals who engage in acts as they interpret and respond to each other's actions (Dohn, 2011). In the social perspective we viewed the teacher and students as members of a local community who jointly establish communal practices (Kelly, 2008).

We employed the constant-comparative method. First, we transcribed all audio-recordings of class sessions and parsed each transcript into an episode (Cobb et al., 2001). Next, we summarized each episode by writing notes about the nature of activity and topic. Then, we identified themes to characterize the topic. We employed open and axial coding followed by the selective coding (Strauss & Corbin, 1990).

FINDINGS AND CONCLUSION

Thick description brings a rich description of students' PEs to the reader (Creswell, 2007). Three themes emerged: a) *can we study physics without experiment*, b) *accuracy and precision of scientific data*, and c) *practicing formula*.

Can We Study Physics without Doing Experiments: A class session Mr. Bryan and the students talked about theoretical physics (Einstein's theory) versus experimental physics (Galileo's theory) in gravity topic occurred. All students were interviewed after the class session to further understand (a) what they thought about theoretical and experimental physics, and (b) what methodology was convincing to them.

Although two students defined scientific theories as an idea needed to be tested at the initial interview, they chose Einstein's theoretical explanation over Galileo's experimental explanation. This result suggests that how students evaluated specific scientific theories is different from how they defined scientific theories in general at the interviews.
Student 1: *I guess Einstein. Because I heard of Einstein's equations through 8 grade years, and I have always heard of it. And I heard Galileo only at the 9^{th} grade. I heard Einstein more than others and that is why it makes more sense.*

The other seven students mentioned that Galileo's experimental explanation is more convincing to them. These students defined the theoretical explanation as an idea, and mentioned that experimenting is a required way to explain phenomena in physics. The findings are consistent with the previous studies on students' ideas about scientific theory and experiment (Ibrahim et al., 2007).

Student 6: *I'd say Galileo because all other ones were what they thought, but Galileo put it in an experiment.*
Student 9: *I think experimental because if you try experimenting how gravity works, it is more likely to be better than just thinking about. Actually doing it is better.*

Accuracy and Precision of Scientific Data: In scientific inquiry students are expected to collect sufficient data and state conclusions that are consistent with their data and the theory. From an epistemological perspective, these expectations underscore how students know if scientific data are accurate and/or precise in scientific inquiry.

The following themes emerged: *scientific data must be accurate but can be precise, accuracy via following the right procedure*, and *accuracy via what the others find*.

Scientific data must be accurate but can be precise: Students are aware of the importance of the precision and the accuracy of scientific data. Students indicated that they might have concern if they did not get the same or close results while they did multiple trials.

Accuracy via following the right procedure: Students believed that their results were accurate if they followed the right procedure and established the right experiment design. Students in this class mentioned that they might have different numbers as scientific data but their interpretation would have to be the same. Students defined project-based investigations as having multiple answers. They mentioned that if an investigation had multiple answers, they did not think that they would get the same answer, suggesting that students are able to differentiate the experiments they do in terms of whether the experiment is simple or complex.

Interviewer: *Do you think your friend should reach the same results that you have found in your experiment?*
Student 8: *If the procedure tells you to do it in a certain way, then it is supposed to be the same results. If the experiment is to drop the pencil off the table, then the result should include the same results. But it is different if it is ending up floor or chair or something. It is important for them to have the same conclusion for you did right or wrong.*

Accuracy via what the others find: Students believed that their friends in the class should reach the same results. Students indicated that if they did the experiment, the other groups should have gotten the same answer with them because the experiment they did mostly have a single answer and they all followed the same exact procedure with their peers.

Interviewer: *Do you think your friend should reach the same results that you have found in your experiment?*
Student 3: *When we do lab experiments, we all get the same results. Sometimes like project, we don't always get the same results. If we drop something, we get 10 second but other groups get 11 second or sometimes we round the number. It is not always we get the exact the same results. Sometimes they have experiments like equation something like that. Sometimes there is only one right answer problem or experiments.*

Practicing Formula: One theme emerged from the students' school science practice in the teacher- directed lectures and in the laboratory activities is practicing formula.

Practicing formula in teacher-directed lectures: Typically, in problem solving activity in this class Mr. Bryan and the students worked together on the physics problems. Mr. Bryan began reading the questions to the students. After the introduction of the question, Mr. Bryan explained the necessary steps to solve the problem. Mr. Bryan's and students' talks in the following excerpts are typical conversations that occurred between him and students in problem solving activities.

Conversation of Energy- 15 Dec 2013
Mr. Bryan: *If we actually knew the mass of the rock, we could compare the mass we got and the mass they say we got. Do you expect our mass will be higher or lower than the reported mass?*
Student 2: *Higher*
Mr. Bryan: *Do you expect to get a higher mass?*
Student 2: *What was wrong?*
Mr. Bryan: *Yeah. The answer we got is 18.99. Do you think the answer that came out would be bigger than the actual reported value?*

Practicing formula in laboratory activities: Mr. Bryan's strategy for using laboratory activities was to emphasize that students should be able to collect data to do the calculations for the formula that was being covered. Sometimes, Mr. Bryan informed the students what results they would get from the experiment at the beginning of the activities. This may explain why students in the class believe that they would get accurate scientific data from an experiment if they followed the right procedure. This study provides evidence of how experiments that were used for refuting scientific theories in physics conceal the epistemological aspects of scientific practice. It also supports the notion that in physics classes traditional teaching strategies that were centered on acquisition of certain and absolute knowledge ignore the process of knowledge production.

Interviewer: *In your class, you do a problem solving activity. Could you tell me how this activity is similar or different from the experiment that you do?*
Student 8*: Problem solving is like what you know and how you basically bring them in paper and show in a piece of paper. Experiment is hands-on, how you show what you know. Together they both were solving the same thing but you get a feeling of hands-on during the experiment. So I think they are the same but in different ways.*

Conclusion: Although the focus of this study was not to classify students' views as naïve or sophisticated, the findings of this study show that the students in this study hold naïve beliefs about the nature of scientific knowledge and knowing. The students viewed a scientific theory as an idea or a thought that needed to be tested. The findings of this study are consistent with the previous studies on students' ideas about the relationship between scientific theory and scientific experiment. Ibrahim et al. (2007) found that, typically, undergraduate physics students viewed the experimental results as more accurate than the theoretical results, and the scientific experiments were required to provide evidence about the phenomena in physics.

One interesting finding from this study is that although Student 1 and Student 7 defined scientific theories as an idea or a thought that needed to be tested, they chose Einstein's theoretical explanation as more convincing than Galileo's experimental explanation. Yet, it should be noted that the reason behind their choice is not whether the explanation is theoretical or experimental. This is notable because this result suggests that how students evaluated specific scientific theories is different from how they defined scientific theories in general at the interviews. This result supports our argument at the beginning of the study as to why interviews may be insufficient to map students' PEs (Leach, 2000).

The students viewed the school science experiment they did as a simple experiment whether it had right or wrong answer. Therefore, they reported that the number in the lab report would be different, but the conclusion would be the same. One interesting finding from this study is that students defined project-based investigations as having multiple answers. They mentioned that if an investigation had multiple answers, they did not think that they would get the same answer. This result suggests that students are able to differentiate the experiments they do in terms of whether the experiment is simple or complex.

Sin (2014) argues that in physics classes traditional teaching strategies that were centered on acquisition of certain and absolute knowledge ignore the process of knowledge production. Furthermore, these strategies fail to have students aware of key sociological aspects of the discipline and the ensuing epistemological implications related to how knowledge claims have come into being and achieved validation (Sin, 2014). The results of this study support the previous studies' results that discuss the problems associated with traditional laboratory activities in high school classroom (Brown et al. 1989; Samaranpungavan et al., 2006; Tobin & Gallagher, 1987). The previous studies documented that typically students described their laboratory activities as simple and highly structured. Students reported that "exactly what needed to be done in the activities was given" to them. Students already knew the outcome of the experiments before they begin conducting it. In addition, the teacher observed in this study provided hints to his students that the teacher thought would help them "correctly" do the calculations.

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LEARNING ABOUT THE BULLWHIP EFFECT USING COLORED PETRI NET SIMULATOR

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ABSTRACT: Colored Petri Net (CPN) simulator for study and analysis of supply chain processes is described in this paper and some experimental results obtained by its use are presented. This CPN simulator is one version of the well-known beer game and overcomes some shortcomings we have noticed playing other beer games. The beer game is a role-play simulation game that lets students (or managers as well) experience typical coordination problems of supply chains. Supply chain consists of four stages (or co-makers): retailer, wholesaler, distributor and manufacturer. The simulator allows calculation of different supply chain performances. It is developed using a timed, hierarchical colored Petri Net and CPN Tools software package. The CPN structure developed and presented in this paper consists of one top page and 17 sub-pages in four hierarchical levels, which models decomposition of observed supply chain in sub-processes. For each stage, demand forecasting methods, replenishment policies, production and delivery times, inventory costs, and customer's demand may be defined and given as input data for simulation run. In CPN Simulator we have used three strategies for demand forecasting. First strategy is based just on the past demand and second and third strategies are based on adaptive time series method: Moving Average and Exponential Smoothing Methods. We conducted three groups of experiments, every group for a different strategy of demand forecasting and for every group we experimented with several different parameters. The simulation results are exported to Excel and its visual presentation and expressive reporting capabilities are used. This package is aimed for evaluation of different management strategies in a supply chain, as well as for educational purposes. This developed model can efficiently be used for teaching the bullwhip effect not only to undergraduate and graduate students, but managers as well.

Key words: supply chain, bullwhip effect, petri net

INTRODUCTION

Very important supply chain (SC) processes are order and delivery of purchased amounts. These are multiple entangled and their disorder can lead to various unwanted effects. One of them is the bullwhip effect. Different chain phases have different calculations on demand quantity, thus the longer the chain between the retailer and wholesaler the bigger the demand variation. A retailer can realize a small variation in customers' demands as a growing trend and purchase from wholesaler more products than he needs. An increased order at wholesalers is larger than at retailers as the wholesaler cannot regularly comprehend the increased order. As the chain grows longer the order is larger. If a retailer plans the product promotion he can increase the order. If a manufacturer comprehends the increased demand as constant growth and in the same manner makes purchases, he will face the problem of inventory surplus at the end of promoting period, (Chopra S. and P. Meindl, 2001). Variation of demands increases production expenses and expenses of the whole supply chain in an effort to deliver the ordered quantity in time. A manufacturer accomplishes demanded capacity and production but when the orders come to a former level, he remains with the surplus of capacity and inventory.

Originally, beer game was created as a board game that demonstrates beer production and distribution as shown in Figure 1, but now there are several electronic games for simulating Beer Game (Li M. and D. Simchi-Levi, 2002; http://beergame.masystem.se:8000/; http://www.forio.com/nearbeer.htm). However, all electronic games for simulating Beer Game we have found allow experiments with the strategies of one SC participant per game. Because of that fact our motivation was to design simulator that allows one participant to simultaneously experiment with the parameters of all SC stages. That type of simulator we have developed using hierarchical Coloured Petri Nets (CPN).

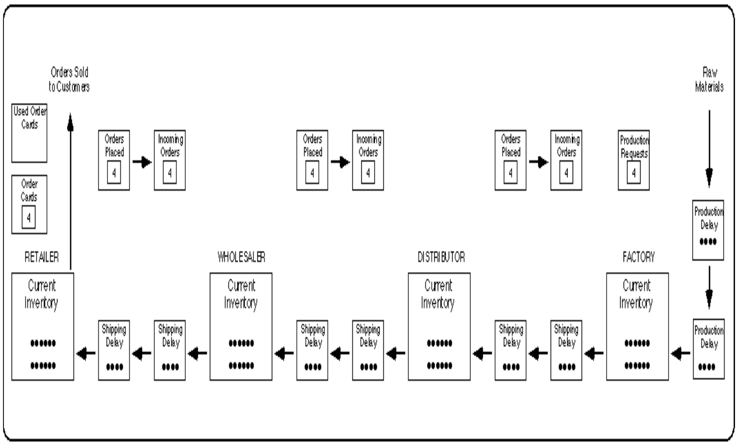

Figure 1. Beer Game Board, Showing Initial Conditions (Sterman J. D., 1992)

Coloured Petri Nets are a modelling language developed for systems in which communication, synchronization and resource sharing play an important role. CP-nets combine the strengths of ordinary Petri nets with the strengths of a high-level programming language. Petri nets provide the primitives for process interaction, while the programming language provides the primitives for the definition of data types and the manipulations of data values. CPNs have an intuitive, graphical representation, which is appealing to human beings (Makajic-Nikolic et al., 2006). A CPN model consists of a set of modules (pages) which each contains a network of places, transitions and arcs. The modules interact with each other through a set of well-defined interfaces, in a similar way as known from many modern programming languages. The graphical representation makes it easy to see the basic structure of a complex CPN model, i.e., understand how the individual processes interact with each other (Jensen K., 1997). It is shown that CPN can handle concepts of dependencies and coordination mechanism as well as by use of decomposition and specialization concepts in an easy way (Makajic-Nikolic D., Vujosevic M., 2002; Malone, T.W., Crowston, K., Lee, J., Pentland, B. et al., 1999).

Numerous papers give examples for the Petri Net usage in modelling and SC analysis. Van der Vorst, et. al. (2000) have considered SC as a business process, which is to be redesigned, and in that case many different redesign scenarios are to be tested. PN is used to support a decision-maker in choosing the best-fit scenario. Supply chains in food industry are also modelled in Bhushan N. and K. Gummaraju (2002). The authors propose supply chain management of perishable items combining the TTI and Wireless technologies. They compare the proposed futuristic SC with the existing situation using simulation of Generalized Stochastic PN. An approach to SC Process Management (SCPM) based on high-level Petri-nets, called XML-nets, is presented in *von Mevius M. and R. Pibernik (***2004)**. Computer Integrated Manufacturing Open System Architecture (CIMOSA) based process behavior rules and Object-oriented PN (OPTN) are used in [Dong M. and F.Frank Chen (2001) to model the routing structures of a typical SC process. In Kemper P. (2000) author show how Generalized Stochastic PN bridges the gap between application formalism like process chains and analysis methods for concurrent systems like PN analysis methods. In Landeghem R.V. and C.-V. Bobeanu (2002) the authors propose an implementation of an incremental approach to modeling discrete events systems at the structural level of systems specification. They consider the entire system and coordinate decisions at each stage of the supply chain. Using the example of the Beer Game, a systematic method supports the bottom-up construction of reusable models of supply chains in the Petri nets domain. The paper Makajić-Nikolić D, B. Panić and M. Vujošević (2004) describes a simulation model designed for teaching the bullwhip effect. It explains a simulation model, where all participants behave in the same way, using a timed, hierarchical CPN and software package CPN Tools for the simulation and performance analysis of such a chain.

Supply chain which contains sub suppliers, e.g. suppliers that are hired by the subcontractors, is modeled with PN in (Zegordi and Davarzani, 2012). The authors emphasize the importance of disruptions modeling in the supply chain, especially when these disorders are caused by inter-state relations. These relations can affect on the relationships between subcontractors, manufacturers and retailers from different countries.
PN that models the “quality conflict” between supplier and producer is introduced in the paper (Liu, Fang, Fang and Hipel, 2012). This conflict is caused by the extreme situations that can affect prior made business deals. Methodology which can help the decision maker to develop the PNCA - Petri Net for Conflict Analysis in order to make the right decisions in these conflict situations is presented in this paper.

Zhang and Cheng (2014) propose use of specific class of PN – fuzzy PN for risk modeling and with a possibility to warn of the risk in the supply chain.

CPN MODEL OF SUPPLY CHAIN

We have observed simplified SC, with one participant per each phase – a retailer, wholesaler, distributor and manufacturer. The two main activities of each of the participants are:

Delivery of purchased products. At the moment of receiving the order it has to be checked if the inventory stores the needed products. Total amount of the ordered products is delivered if the inventory shows sufficient amounts of products. Otherwise, if the inventory amounts do not suffice the chain participants deliver incomplete orders and form backorder for fulfillment when the next delivery comes.

Forming one's orders according to new orders. Since a certain amount of products is delivered from a personal inventory, new orders are made from the next SC participant in order to keep the needed level of inventory. We have considered and modeled three different ordering strategies based on three demand forecasting methods: last period demand (LPD), moving average with weighted periods (MAW) and simple exponential smoothing (EXP). If the inventory stores enough products (forecasted trend and safety inventory), the chain participant doesn't order. If the inventory shows a shortage of products, the amount, that recharges forecasted trend and safety inventory level is ordered.

Top Page and First Level Sub-pages

The described SC was modelled by timed Hierarchical Coloured Petri Nets (Jensen K., 1997), and then performed simulation using the software package CPN Tools (http://wiki.daimi.au.dk/cpntools). The net structure consists of one top page and 17 sub-pages in four hierarchical levels, which models decomposition of observed supply chain in sub-processes. The top level of the model is the whole supply chain: a customer and the four mentioned phases, and one sub-page that generate customer's demands. Figure 2 shows the top-level CPN and *demand generating* sub-page as well as hierarchical structure of the whole CPN at the left side of the CPN Tools environment.

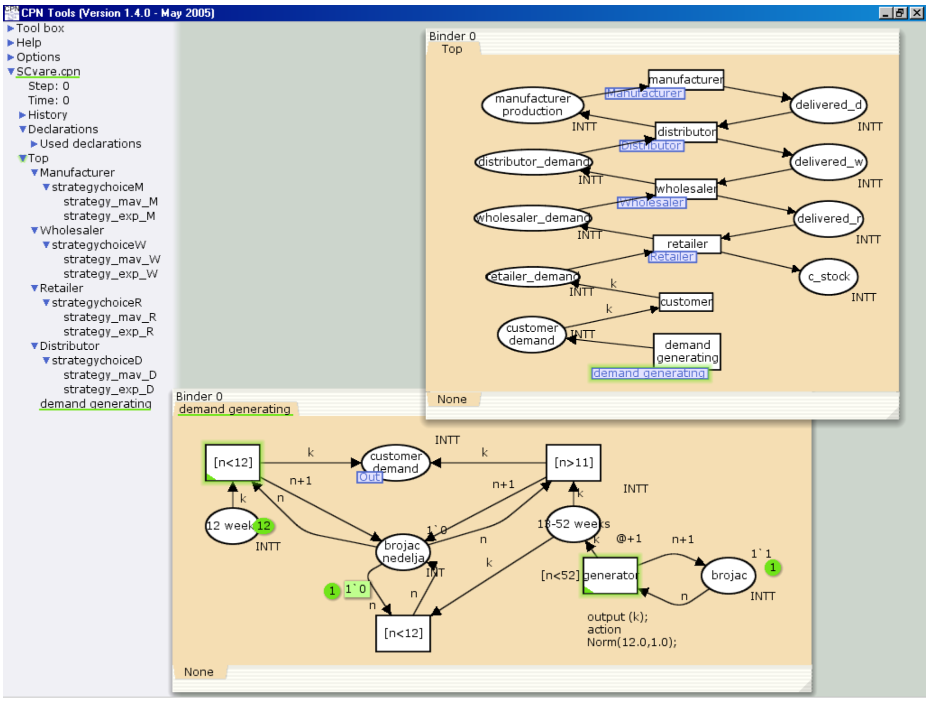

Figure 2. Top-level CPN of Simplified Supply Chain

A customer is presented by a place named customer whose initial marking represents demand in time initiate. The four phases (participants), a retailer, wholesaler, distributor and manufacturer are presented by means of substitution transitions. A sub-page (i.e. sub-nets: Retailer, Wholesaler, Distributor and Manufacturer) models each participant. The processes modeled by those sub-pages are the specializations described delivery of purchased products and forming one's orders according to new orders processes. Figure 3 shows sub-pages Retailer and Manufacturer.

CPNs, which model Retailer, Wholesaler, Distributor (i.e. suppliers) are the same. However, a manufacturer is the last SC link and, in a way, he acts in the same manner as suppliers, with the difference that instead of making an order for the next chain participant, he decides what amounts to produce in the following period. Sub-pages for suppliers and manufacturer are detailed explained in Makajić-Nikolić D, B. Panić and M. Vujošević (2004).

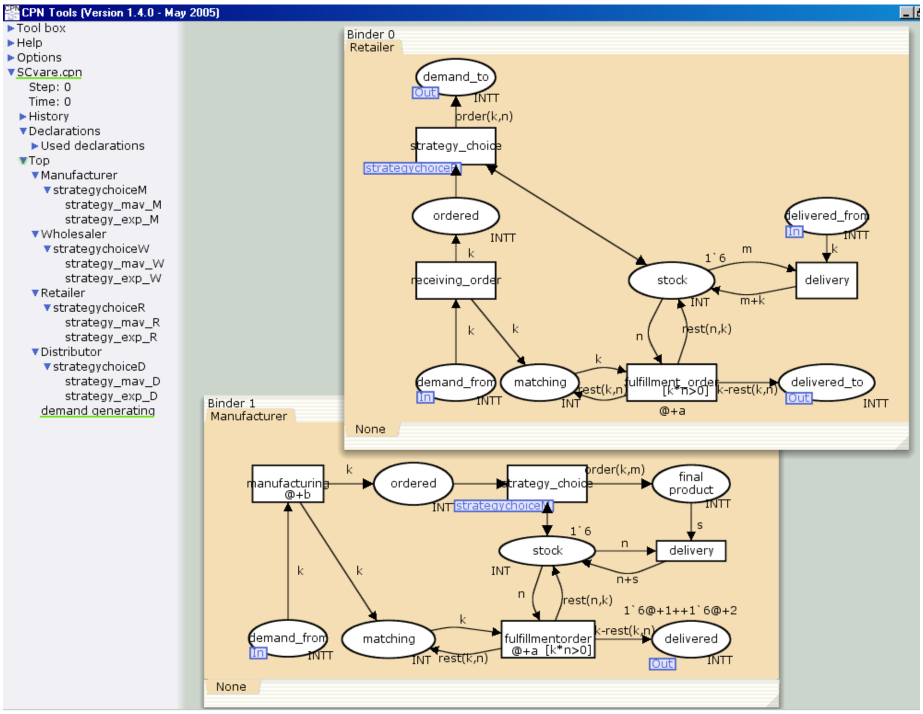

Figure 3. Retailer and Manufacturer Sub-pages

Demand Forecasting Strategies Sub-pages

In CPN Simulator we have used three strategies for demand forecasting. First strategy is based just on the past demand. Second and third are based on adaptive time series method: Moving Average and Exponential Smoothing Methods (Chopra S. and P. Meindl, 2001). Hereafter, CPN models of those methods will be explained, as well as the choice one of them during experiments.

Each sub-page at first level has one substitution transition of type strategy_choice (see sub-pages in Figure 3). These substitution transitions are presented by sub-pages type strategy_choice which model choice of forecasting methods for each SC participant. The top sub-page on Figure 4 shows retailer's sub-page strategy_choice.

We have designed a CPN, which allows each SC participant to choose one of three mentioned strategies. Sub-page strategy choice models this choice using parameters in Declarations at the left side of CPN Tools environment in Figure 4, and guard functions.

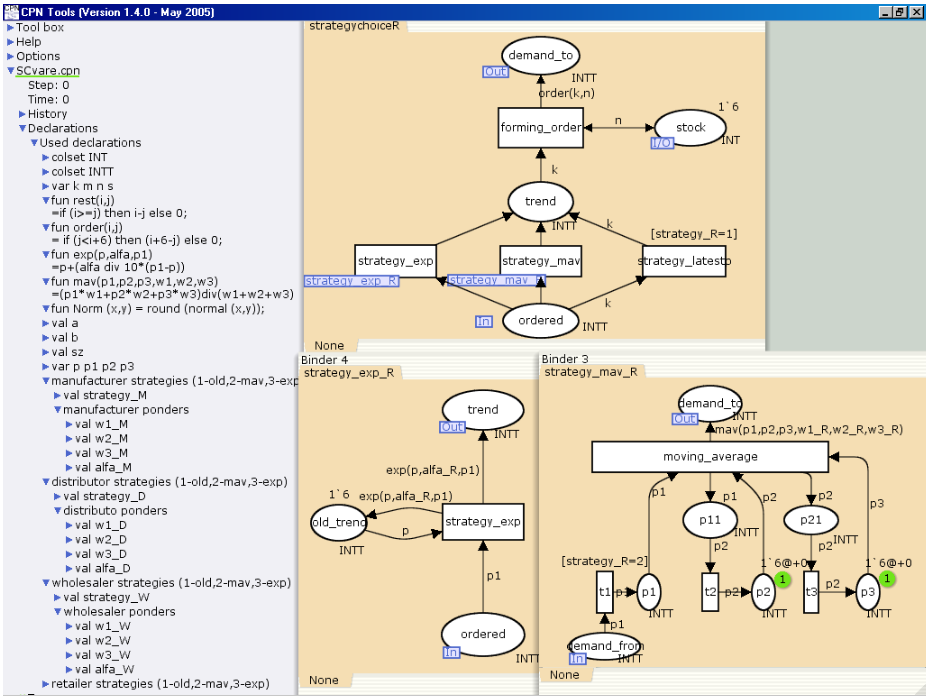

Figure 4. Sub-pages for Strategy Choice and Moving Average Methods

The last period demand method is presented by means of transition strategy_latestp on sub-page strategy choice and with guard function [strategy_R=1], which means: this transition may occur only when the value strategy_R in declaration is set to 1. Declaration also shows that the value strategy_R=2 refers to choosing of Weighted Moving Average method, and strategy_R=3 means that Exponential Smoothing method is choisen. R in the name of this parameter refers to the Retailer. Other SC participant has analogous parameters for strategy choice: strategy_W for a wholesaler, strategy_D for a distributor and strategy_M for a manufacturer. Those two strategies are presented by means of sub-pages.

Figure 4 also shows sub-page moving average (at the bottom-right side). In **Weighted Moving Average Method** we estimate the level of trend in period *t* as the average demand over the most recent *N* periods. We assign weights w_t to each period. We assign weights w_t to each period. This represents a *N*-period moving average. Thus, we have the following:

$$L_t = \left(p_t \cdot w_t + p_{t-1} \cdot w_{t-1} + \ldots + p_{t-N+1} \cdot w_{t-N+1}\right) / (w_t + w_{t-1} + \ldots + w_{t-N+1}) \qquad \textbf{(1)}$$

After observing the demand for period *t+1*, we revise the estimates as follows:

$$L_{t+1} = \left(p_{t+1} \cdot w_{t+1} + p_t \cdot w_t + \ldots + p_{t-N+2} \cdot w_{t-N+2}\right) / (w_{t+1} + w_t + \ldots + w_{t-N+2}) \qquad \textbf{(2)}$$

In sub-pages type strategy_maw function mav is assigned to the transition moving_average. This function is defined in declaration shown at the left side of the figure 4.

fun mav(*p*1,*p*2,*p*3,*w*1,*w*2,*w*3)=(*p*1**w*1+*p*2**w*2+*p*3**w*3)div(*w*1+*w*2+*w*3) **(3)**

We use 3 last periods for calculate average, and it is possible to define weights for those 3 periods (see declaration in Figure 4).

At the bottom-left side of the Figure 4 CPN model of the **Exponential Smoothing Method** is shown. In this method the initial estimate p_t of demand is taken to be the average of all historical data. Demand in the next period is demand forecast for last period p and part of error in the last period $p_t - p$:

$$p_{t+1} = p + \alpha\left(p_t - p\right) \qquad \textbf{(4)}$$

where α is a smoothing constant, $0 \le \alpha \le 1$.

In sub-pages type strategy_exp, function exp is assigned to the transition strategy_exp. It is defined in declaration shown at the left side of the figure 4.

fun exp(p,alfa,p1)=p+(alfa *(p1-p)) div 10 (**5**)

(This modification of this function is done because of the fact that CPN Tools deal only with integer numbers.)

Inventory Replenishment Policies Modeling

After using one of the three strategies, the trend is forecasted. Then, in accordance with this trend, inventory level and function order(i,j) (6), each SC participant calculate one's order according to new orders.

fun order(i,j)= if (j<i+ls) then (i+ls-j) else 0 (**6**)

Variables i and j represent received order and the inventory, respectively. Function order(i,j) behaves as explained at the beginning of this section. In order experiment with different inventory replenishment policies, level of safety inventory (ls) is given as a parameter.

SIMULATION RESULTS

CPN we have formed is the simulator, which allows easy experimenting with four different parameters:

Demand forecasting methods. Each player can choose one of three predefined and modeled demand-forecasting methods and define their parameters and weights. Trend of orders is calculated using these methods.

Inventory control policy. Our CPN simulator allows defining different delivery function. It also allows defining of different behavior CS participants in forming one's orders according to new orders, calculated trend and the needed level of inventory.

Customer's demands in time.

The times needed for creating personal orders, the production and delivery procedures. Those times can be deterministic or stochastic.

CPN Tools enables saving of simulation report in the files which can be opened using MS Excel. This report involves all data about simulation flow, i.e. transition firings: simulations step, time and used tokens. However, from such a format of report it is very difficult to extract and analyze the data. This is why we use MS Excel macros for the transformation and analysis of simulation reports. According to the simulations results we can measure different performances whose changes are the consequences of player's decisions: reactions of participants to sudden changes in customer demands (the bullwhip effect), changes in inventory in a time, surplus of inventory goods, changes in inventory costs and backorder costs in a time, inventory level at the end of simulated period, total costs of each SC participants and of the entire SC.

Experimental Results

Using CPN simulator we have made three groups of experiments. In each group we observe the four mentioned parameters (demand forecasting methods, inventory control policy, customer's demands and the lead times) and vary one of them. All simulations are replicated 30 times, and then the average values are calculated.

I group of experiments – four different parameters for Exponential Smoothing Method

Demand forecasting method: Exponential Smoothing Method, α={0,1, 0,2, 0,3, 0,4}.
Inventory control policy. fun order (i,j)= if (j<i+60) then (i+60-j) else 0.
Customer's demands. For first 12 weeks demand is: 60, 60, 60, 60, 120, 150, 180, 170, 180, 150, 200, 170. For the rest of the year (40 weeks) customer's demands are generated using function *fun Norm* (120,10) and sub-net *demand generating*.

The lead times: 2 weeks

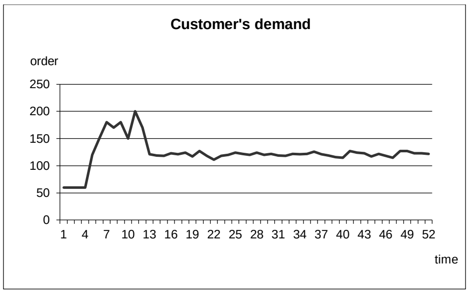

Figure 5. Customer's Demands

Results:

Table 1. SC Costs for four different parameters for Exponential Smoothing Method

α	Average SC inventory costs	Average SC backorder costs	Average SC total costs
0,1	8356,6	10179,3	18536,0
0,2	12754,0	9917,4	22671,4
0,3	13728,3	9973,3	23701,6
0,4	14144,5	9920,4	24064,8

The table 2 shows that the costs of entire supply chain are minimal for $\alpha = 0,1$. That is the reason way the rest of the experiments are made for $\alpha = 0,1$ when the Exponential Smoothing Method is used.

II group of experiments – different demand forecasting methods

Demand forecasting methods:
The last period demand method (LP)
Weighted Moving Average Method (MAW) for 3 periods and weights: $w_1 = 0,1, w_2 = 0,3, w_3 = 0,6$
Exponential Smoothing Method (EXP), α=0,1
Inventory control policy. fun order (*i*,*j*)= if (*j*<*i*+60) then (*i*+60-*j*) else 0.
Customer's demands. For first 12 weeks demand is: 60, 60, 60, 60, 120, 150, 180, 170, 180, 150, 200, 170. For the rest of the year (40 weeks) customer's demands are generated using function *fun Norm* (120,10) and sub-net *demand generating*.
The lead times: 2 weeks

Results:

Table 2. Average Order's Peaks for SC Participants

Demand	Retailer's average peak	Wholesaler's average peak	Distributor's Average Peak	Manufacturer's Average peak
LP	354,3	309,0	279,1	239,6
MAW	309,8	285,7	257,8	232,5
EXP	250,4	235,4	212,9	182,0

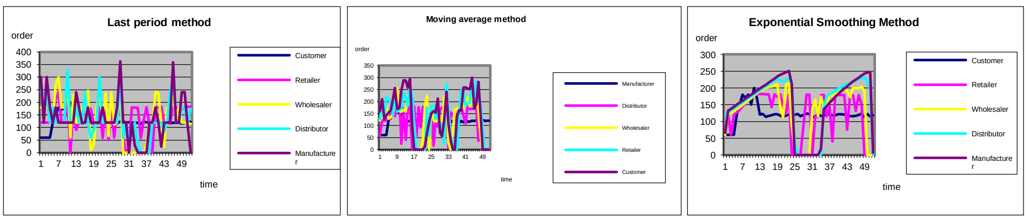

Figure 6. Bullwhip effects for different demand forecasting methods

Table 2 and Figure 6 show the expected results: the last period demand method gives the biggest bullwhip effect, and the exponential smoothing method gives the lowest bullwhip effect. However, table 3 shows unexpected result: all methods give the similar costs.

Table 3. Average İnventory And Backorder Costs For SC Participants

Average costs		Manufacturer	Distributor	Wholesaler	Retailer	SC
LP	Inventory	2230,45	2651,33	2210,92	1023,93	8116,63
	Backorder	2663,07	2894,13	2497,30	2009,77	10064,27
	Total	4893,52	5545,47	4708,22	3033,70	18180,90
MAW	Inventory	2101,82	2894,82	2231,67	1188,35	8416,65
	Backorder	2818,70	2679,50	2503,73	1865,27	9867,20
	Total	4920,517	5574,317	4735,4	3053,617	18283,85
EXP	Inventory	1689,85	2886,77	2519,03	1260,97	8356,62
	Backorder	3165,83	2618,43	2595,77	1799,30	10179,33
	Total	4855,68	5505,20	5114,80	3060,27	18535,95

III group of experiments – different lead time

Demand forecasting method: Exponential Smoothing Method (EXP), α=0,1
Inventory control policy. fun order (i,j)= if (j<i+60) then (i+60-j) else 0.
Customer's demands. For first 12 weeks demand is: 60, 60, 60, 60, 120, 150, 180, 170, 180, 150, 200, 170. For the rest of the year (40 weeks) customer's demands are generated using function *fun Norm* (120,10) and sub-net *demand generating*.
The lead times: 2 weeks and 1 week

Results

Table 4. Average Inventory and Backorder Costs

Average costs		Manufacturer	Distributor	Wholesaler	Retailer	SC
Lead time 2	Inventory	1689,85	2886,77	2519,03	1260,97	8356,62
	Backorder	3165,83	2618,43	2595,77	1799,30	10179,33
	Total	4855,68	5505,20	5114,80	3060,27	18535,95
Lead time 1	Inventory	1450,42	1346,60	1199,72	896,70	4893,43
	Backorder	2114,33	1897,50	2060,33	1606,90	7679,07
	Total	3564,75	3244,10	3260,05	2503,60	12572,50

Table 4 and Figure 7 show the expected results: longer lead time results in higher costs and bigger bullwhip effect.

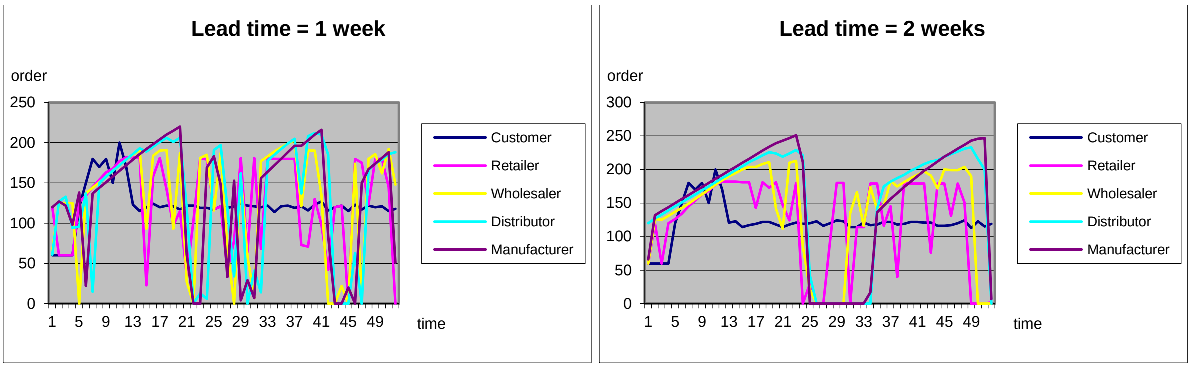

Figure 7. Bullwhip Effects For Different Lead Times

CONCLUDING REMARKS

The paper describes how we have modeled CPN simulator of order and delivery processes of the purchased amounts processes in a supply chain. We have designed simulator that allows one participant to simultaneously experiment with the parameters of all SC stages. Furthermore, using this simulator, a player can define in advance the rules of demand forecasting and inventory control policy. According to the results of simulations we can measure different performances whose changes are the consequences of player's decisions: reactions of participants to sudden changes in customer demands (the bullwhip effect), changes in supply level in a time, surplus of inventory goods, the costs of SC participants and of the entire SC, etc. This simulator is developed using hierarchical Coloured Petri Nets (CPN). We have made three groups of experiments and obtained some expected but also some unexpected results. We have shown that it is possible to form a CPN model of a supply chain, which allows easy experimenting with different parameters and strategies of all SC stages.

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PRESERVICE SCIENCE TEACHERS' CONCERNS FOR EDUCATING STUDENTS WITH SPECIAL NEEDS IN THEIR FUTURE CLASSROOMS

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ABSTRACT: In this study, the authors examined senior preservice science teachers' (PSTs) concerns for educating students with disabilities in science classrooms. Eight PSTs were involved in the study. The constant comparative data analysis was performed. PSTs' concerns for inclusive education were categorized into two themes: PSTs' concerns about themselves and PSTs' concerns about students with disabilities. Under each, there existed several sub issues. For the first category, data analysis yielded that PSTs were concerned about being unable to cope with extra workload by accepting students with disabilities; lacking of enough training for educating those students; insufficient pedagogical knowledge; and scarce knowledge about disabilities. PSTs' concerns about students with disabilities included three sub-issues which were: not devoting enough time for disabled students' science learning; not to be able to achieve their science learning in terms of science content and science process skills, and not to be able to help them develop positive attitudes toward science. The results were discussed and implications for teacher education were made.

Key words: inclusive education, science education, students with special needs

INTRODUCTION

In recent years, teaching students with special needs in general education classrooms has been a common goal of education researchers. With simplest words, this approach is called as *inclusive education*. "The practice of serving students with a full range of abilities and disabilities in the general education classroom with appropriate in-class support" is defined as inclusion (Roach 1995, p. 295). The supporters of inclusive education express that all students with disabilities should be placed in regular school classrooms in which they receive support services (Nielsen 2002). An individual with a disability is defined as a person who differs from the average or normal person in "mental characteristics, sensory abilities, communication abilities, behavior and emotional development, or physical characteristics" (Kirk, Gallagher, Coleman, & Anastasiow, 2012, p. 3). However inclusive education raises many concerns in terms of general education teachers. The recent reforms in inclusion evoked the need of the change in teacher education programs with the purpose of training preservice teachers (PTs) to be able to educate students with special needs in regular schools (Peebles & Mendaglio, 2014). This change in teacher education programs was required because many countries have accepted the inclusion within the goal of their education systems (de Boer, Pijl, & Minnaert, 2011). Herein, teachers are accepted as the key persons for successful and effective inclusive education in regular schools (de Boer, Pijl, & Minnaert, 2011). Therefore, eliciting their concerns about inclusive education is important for successful implementations.

Teachers' Concerns about Inclusive Education

Teachers' concerns can have an impact on the implementation of inclusion in terms of quality of instruction which students receive in inclusive classrooms (Leyser & Tappendorf, 2001; Sharma & Desai, 2002). Especially general education teachers who think that they are not prepared for teaching in inclusive classrooms may display disappointment and, in turn, negative thoughts toward inclusion (Peltier, 1997). Other factors such as the resource and personnel availability, family involvement, and support from administrative staff also affect teachers' practices in inclusive classrooms (Leatherman & Niemeyer, 2005; Odom & McEvoy, 1990; Rose & Smith, 1993). These factors may also increase teachers' concerns. Teachers' concerns should be investigated and opportunities should be provided for reducing their concerns.

METHODS

Research Purpose

This study examined senior preservice science teachers' (PSTs) concerns for educating students with disabilities in science classrooms.

Research Design, Participants and Data Collection

For this study we employed a case study framework. Eight PSTs agreed to participate in this study voluntarily. Their ages ranged from 21 to 23. They were in their last semester of elementary science teacher education program. They all completed subject matter courses (e.g., physics, biology, chemistry) and pedagogical courses (e.g., teaching methods, measurement and evaluation, classroom management). Additionally, they completed practicum (courses completed were School Experience and Teaching Practice) in cooperating schools during the fall and spring semesters of their last year. Semi-structured interviews were conducted by one of the authors to reveal the concerns of PSTs in terms of inclusion.

Data Analysis

In data analysis of a qualitative study, the researchers' role is to make sense of data gathered through interviews, observations and documents. Moreover, they interpret the data and the interpretation of the data is reported in terms of categories, themes, theory or models (Merriam, 1998). For this study constant comparative method was used to analyze the data. It was developed by Glaser and Strauss (1967). They stated that "the analyst starts by coding each incident in his data into many categories of analysis as much as possible, as categories emerge or as the data emerge that fit an existing category" (p. 105).

RESULTS AND FINDINGS

The focus of this research was to investigate PSTs' concerns for inclusive education. Constant comparative method of data analysis revealed that PSTs held concerns related to themselves and related to students with disabilities.

PSTs' concerns about themselves

Under this category, there emerged four sub-issues: being unable to cope with extra workload by accepting students with disabilities; lacking of enough training for educating those students; insufficient pedagogical knowledge; and scarce knowledge about disabilities.

All participating PSTs were concerned about the workload increased by accepting students with disabilities. The following are several common statements of PSTs about this issue.

It [accepting students with disabilities) will really increase the work that teachers have to complete.

Science teachers already have a lot to do. They [students with disabilities] will increase their duties and so they may not be effective.

Additionally all PSTs in this study stated that they did not get any training during teacher education for educating students with disabilities.

Teaching students with disabilities is another whole world. I am not educated for it.

We did not get any course about teaching science to those students. How can I teach science to them?

Half of the participating PSTs referred to insufficient pedagogical knowledge for educating students with disabilities.

I think that there should be specific science teaching methods for teaching science to students with disabilities.

I do not know how I can use the teaching methods that I learned for those students. They are special and the way they learn science can be different. I also do not know how to assess their learning.

Seven of PSTs mentioned that they do not have enough knowledge about disabilities.
When you say students with disability, it does not mean a lot to me. I do not know what those kids can do or cannot do.

PSTs' concerns about students with disabilities

In addition to the PSTs' concerns about themselves, they were also concerned about students with disabilities. There existed three sub-issues under this category. These are: not devoting enough time for disabled students' science learning; not to be able to achieve their science learning in terms of science content and science process skills, and not to be able to help them develop positive attitudes toward science.

All PSTs complained about lack of time to teach science to students with disabilities. Sample statements are:

A class hour is 40 minutes. It is difficult to devote extra time for students with disabilities. I can only focus on other students' science learning.

I am not sure I can teach the topic to all students in the classroom. Disabled students require extra time and there is not time.

Five of PSTs held concerns about not to be able achieve science learning in terms of science content and science process skills.

It is really difficult for me to teach them science content and specific science process skills, for example observation or conducting experiments. It seems really difficult...

Teaching science is related to science content and science process skills. For me to be a successful teacher, students should have both. But I am not sure whether those special students could have.

A majority of PSTs (6 PSTs) were concerned about not to be able to help students with disabilities develop positive attitudes toward science.

I have really concerns if I cannot help them [students with disabilities) like science and science related jobs.

I am not sure whether they [students with disabilities) feel positive attitudes toward science in my classroom.

CONCLUSION

This study aimed to find out the concerns preservice science teachers held for educating students with special needs in their future science classroom together with non-disabled students. Results revealed that they had concerns about themselves related to inclusive education. They were concerned of being unable to cope with extra workload by accepting students with disabilities; lacking of enough training for educating those students; insufficient pedagogical knowledge; and scarce knowledge about disabilities. They were also concerned about students with disabilities in their general science classrooms. They were concerned about whether they can devote enough time for disabled students' science learning, they can teach them science content and science process skills and they can help them develop positive attitudes toward science. As results showed, PSTs hold serious concerns about educating students with disabilities in general science classrooms. Inclusive education is quite common in nowadays, thus they probably may have such students in their classrooms. However, their concerns may lead to frustration and they may feel unsuccessful in educating those students.

RECOMMENDATIONS

In Turkey inclusive education was legislated in 1983. It was 1992-1993 school-year when disabled students were included in pre-college regular classes for the first time. Since then, Ministry of National Education (MoNE) repeatedly articulated one of its mission as to educate disabled individuals with their peers in public and private schools from pre-school to secondary education (e.g. MoNE, 2000; 2010). However, teacher education programs in Turkey do not offer inclusive education courses except the ones that train PTs in special education. As a result, a majority of PTs are not equipped with sufficient pedagogical and practical skills for inclusion in teacher education programs. For that reason, the authors of this study recommend that teacher education programs, regardless of major area, should offer several courses including basic training in special education.

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THE CHALLENGES FACED BY PRESERVICE SCIENCE TEACHERS DURING TEACHING PRACTICE

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ABSTRACT: This study investigated the challenges of teaching preservice science teachers (PSTs) articulated within the context of their practice teaching in mentor schools. Six PSTs were interviewed at the end of their fourth year in science teacher education program. All PSTs completed their practice teaching in the same mentor school. They observed two different science teachers in six, seven, and eight grade science classrooms as well as teach in those classrooms. The constant comparative method was used to analyze their interview data. The results indicated that PSTs encountered five main challenges during their teaching practice. All PSTs expressed that there were students with disabilities in the mentor school and they were not trained for teaching science in inclusive classrooms. As a result, those disable students were not involved in classroom activities. The next problem PSTs identified was that they were not allowed to make enough teaching practice in mentor schools due to mentor teachers' concerns about covering the curriculum. The third one they clarified was that they do not have enough pedagogical content knowledge. Preservice science teachers also experienced problems with classroom assessment and classroom management due to lack of enough training. Although they took one course for measurement and evaluation, they thought they were not knowledgeable enough for assessing science learning effectively. In terms of classroom management, they believed that they learned the theory but they lacked practice. Results were discussed and implications were made for teacher education programs.

Key words: teaching practice, teacher education, preservice science teachers, science education

INTRODUCTION

Teaching practice is central element of teacher education programs because it provides student-teachers first-hand experience (Maphosa, Shumba, & Shumba, 2007; Ngidi & Sibaya, 2003; Perry 2004; Quick & Sieborger, 2005). Teacher education is related to how and what teachers should know about subject matter and pedagogy; how they thought and how they learned in preservice programs and schools (Cochran-Smith, 2004). This is critical for well-prepared and effective teachers. The quality of teaching in schools depends on the quality of training student-teachers receive during teacher education program. Feiman-Nemser (2001) emphasized that policy makers and educators are realizing that what students learn in schools is directly connected to what and how teachers teach which, in turn, depends on the knowledge, skills, and commitment they gain during teacher education. Moreover she argued that not only students require powerful learning in schools, but also teachers need powerful learning before starting their professions. Although teachers receive training during teacher education, they may still face difficulties in performing their profession due to some problems in teacher education. There is important evidence in the literature that the success of teachers does not only depend on theoretical knowledge, but also on practical experience (e.g. Lingam, 2002; Williams, 1994). Therefore, researchers should focus more on the classrooms in which practical experience take place. Crookes (2003) pointed out that much of what is happening in the classroom taught by preservice teachers remains unknown. With this in mind, this study aspired to investigate what difficulties preservice science teachers experience in real classroom environment during their teaching in cooperating schools. More specifically the following research question was investigated: "What are the challenges preservice science teachers face in trying to meet the expectations of real classroom environment?"

METHODS

The Participants and Study Context

The main aim of this investigation is to find out the challenges preservice science teachers (PSTs) face in their teaching practice in mentor schools. Six PSTs were interviewed at the end of their fourth year in science teacher education program. All PSTs completed observing elementary schools (School Experience Course) during fall semesters of their last years in teacher education program. In the course of this experience, they observe school and classroom environment, the way mentor teacher instructs science in 6, 7 and 8 grades. However they do not experience practice teaching in science within the scope of this course. In the spring semester, however, in addition to observation, they also practice teaching science in mentor schools. The PSTs in this study completed their teaching practice in the same mentor school. They observed two different science teachers in six, seven, and eight grade science classrooms. This course, namely Teaching Practice Course, aimed to provide student teachers with the opportunities for obtaining experience in observing and participating actively in all the diverse educational activities in the school. This course included finishing a minimum of 6 hours of classroom observation and participation each week in mentor schools.

Research Design, Data Collection and Data Analysis

The research was conducted using a case study approach and qualitative data gathering methods. Data collection focused on answering the research problem of the study which was exploring the problems which challenge PSTs in doing their professions. The data source included semi-structured interviews with participants individually about the problems and difficulties they had during their visit in mentor school. Data analysis focused on the identification of common patterns that emerged from the semi- structured interviews without using a pre-established system of categories or codes.

RESULTS AND FINDINGS

Our close analysis of data through the constant comparative method revealed that preservice science teachers' problems during their teaching practice could be collected under five main categories. These were *lack of training for teaching science to students with disabilities in inclusive classrooms, insufficient teaching practice in mentor schools, lack of pedagogical content knowledge, lack of training for classroom assessment* and, the last one, *lack of training for classroom management*.

All PSTs expressed that there were students with disabilities in the mentor school and they were not trained for teaching science in inclusive classrooms. As a result, those students were not involved in classroom activities. For example the following PST stated that

What can I do with a student having mental disability in my science classroom? How can I teach science to her or how can she learn? I do not know.

Another PST stated that

When students are working in a group and doing an experiment, the student with disability could not participate and I felt bad because I did not know what to do. I just told him sit and wait until the end of the group activity.

All PSTs also referred to the insufficient teaching practice in mentor schools due to mentor teachers' concerns about covering the curriculum. The next quote exemplifies this.

We are required to teach at least two times in mentor schools by university instructors and mentor teachers obey this. However this is not enough. I should experience teaching more. Our mentor teacher complains about lack of time and not to be able to cover the topics in the curriculum.

The third prevalent problem among PSTs was the lack of pedagogical content knowledge. For example the PST's statement below illustrates this;

Sometimes I know the subject but I do not know how to teach it so I just try to cover the topic.

Another PSTs noted that

I am confused about using teaching methods. Not all methods are appropriate for all topics.

Preservice science teachers also experienced problems with classroom assessment.

I just ask questions whether students remember what I told. For example in my last practice teaching, at the end of the lesson I asked "what force is, whether it has direction"... some of them answered some not. I think this is not effective.

Lastly, PSTs had difficulty for classroom management due to lack of practice in courses they took during teacher education.

I could not control the students. We took a course about it but we just made lots of readings without understanding what classroom management really means. Our instructors didn't let us practice it.

CONCLUSION

This study aimed to find out the problems and difficulties preservice science teachers experienced after they completed school experience course in their teacher education program. Five main categories were identified as a result of data analysis. These were lack of training for teaching science to students with disabilities, insufficient teaching practice in mentor schools, lack of pedagogical content knowledge, lack of training for classroom assessment and, the last one, lack of training for classroom management. It was not surprising that all PSTs stated that they do not know how to teach science to a student with disability because there is not such a concern in teacher education programs. There is not a compulsory course for this purpose in elementary science teacher training program in Turkey. However, this is important because the vision of science curriculum in Turkey is set to educate all students scientifically literate without considering individual differences. The second problem, insufficient teaching practice stated by participants, was also expected since teaching only two times for a whole semester is not enough for a teacher candidate. This is the only opportunity that PSTs get before they graduate and start teaching as a profession. The mentor teachers do not allow more because they are concerned about curriculum. However, PSTs are also concerned due to lack of practice in teaching. Classroom assessment is usually ignored by many teachers and we believe that this also does not get enough importance in teacher education programs. As a result, participants in this study neither used classroom assessment strategies nor they used it very simply. Similarly, classroom management was not so emphasized in teacher education programs and PSTs do not get enough practice for it.

RECOMMENDATIONS

The fundamental goal of teacher education programs should be prepare competent teacher candidates. Cochran-Smith (2004) stated that the goal of teacher preparation programs was to design the social, organizational, and intellectual contexts wherein prospective teachers could develop the knowledge, skills, and dispositions needed to function as decision makers. Teacher preparation is important because they are responsible for student learning in classrooms. Therefore teacher educators should pay attention to the problems explored in this study and those programs should be redesigned to address them.

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DETERMINING AND COMPARING THE PHYSICS ATTITUDE STATE AT A SOCIAL SCIENCE HIGH SCHOOL: AN EXAMPLE OF DENIZLI IBRAHIM CINKAYA SOCIAL SCIENCE HIGH SCHOOL

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ABSTRACT: The purpose of this study is to investigate and determine the Physics Attitude Level of Social Science Secondary High School students, to compare them based on gender and grade variables and to determine correlation between physics achievement and physics attitude.

The sample of the study was selected as an accessible population by using sample of convenience way. It covers 409 students of preparatory, ninth, tenth and eleventh grade levels, 246 were female and 163 were male, attending at Social Science Secondary High School in Denizli.

Survey method, the most common descriptive study methods of quantitative approach, was used. There was only one instrument to get data, Physics Attitude Questionnaire, consisting of thirty questions. It was applied to subjects and analyzed with SPSS 17.0. In the analysis of the data, independent sample t-test for comparisons based on gender and class variable, one way ANOVA test for comparisons based on class variable and Pearson correlation were used.

As a result of the study, average level of physics attitude was found at all the grade levels. According to gender variable, significant difference was found in favor of boys in general and for ninth and tenth grade levels. According to class level variable, significant difference was found between both eleventh and ninth and eleven and preparatory grade levels in favor of preparatory and ninth grades. In addition to them, correlation between physics achievement and physics attitude was found significant in general and for ninth grade students.

Key words: physics attitude, social science high school, gender, class level

INTRODUCTION

Personal attitude level of a person plays very significant role in his or her interest and response to science and technology issues (OECD, 2013). Therefore, one of the major goals of physics education is to support students' motivation (Peşman, 2012), because interest is an important for deep conceptual understanding and students have some problems with physics lessons (Çapri, 2013). The less interest students have towards science, the less motivation they have and the less successful they are. If students are interested and motivated in learning physics, it may improve their learning of science (Peşman, 2012).

Nowadays, because of technological developments and advances, science and technology have a significant effect on people's living and lifestyle. This shows us how much the science and science education are important for the people's daily life. In every aspects of daily life, people can see the effects of technology and science on their living, because science, especially physical science, not only provide these technological advances and devices for us but only provides us to understand these technological developments, our world we are living on and events.

Science and its applications have particular value in improvement of both the quality of personal life and communities (OECD, 2013). So students have to get some scientific knowledge and skills to understand the life and use their knowledge of science related to science and technology. The main purpose of physical science education is to make people see the science everywhere in their living, understand the life is physics itself, solve problems by using scientific methods and foster scientifically literate person (MEB, 2011; MEB, 2013). In order to reach aims and gains above, physics lessons are to be made more understandable and effective. It mostly depends on students' interest and attitude (Nalçacı, Akarsu and Kariper, 2011), because attitude is one of the most important factors that has an important effect on the students' success in physics (Çapri, 2013).

However, education is a lasting process in order to shape pupils' behavior and attitudes (Korur, 2001). Therefore, investigation of attitude level may be a good guide to make school education more effective and fruitful. This research aims at developing physics teaching by determining and showing attitude level and the relationship between achievement and attitude.

The purpose of this study is to investigate and determine the Physics Attitude States of Social Science High School students and compare them based on gender and class level variables and investigate correlation between physics achievement and physics attitude.

METHODS

This research is a quantitative research. In the research, the questionnaire method which is one of the mostly used methods is used for data collection (Fraenkal, Wallen and Hyun, 2012).

Problem Statement

What are the physics attitude levels of Social Science High School students and correlation between physics achievement and physics attitude?

Research Group

The accessible population of the study is decided as all the students at Denizli İbrahim Cinkaya Social Science High School. The sampling method is convenience sampling. The research group is a total of 409 students including 246 girls (60,1%) and 163 boys (39,9%). They are from four classes of preparation, ninth, tenth and eleventh grades. Number of the female students is higher than number of the male students. Descriptive statistics are shown at Table 1 below.

Table 1. Participants Of The Research Group

Variables		F	M	N	%
Grades	Preps	76	40	116	28,4
	9	68	50	118	28,9
	10	56	32	88	21,5
	11	46	41	87	21,3
TOTAL		246	163	409	100%

In the research, convenience sampling technique, which is one of the nonrandom sampling methods, is used to determine accessible population which is reachable (Fraenkel, Wallen and Hyun, 2012).

Data Collection Tool

Physics Attitude Questionnaire

In the research, Physics Attitude Questionnaire, which was developed by Nalçacı, Akarsu and Kariper (2011) and has Cronbach Alpha relability coefficient ,940, was used as data collection tool. In the research Cronbach Alpha reliability coefficient was found as ,923. It consists of twelve negative and eighteen positive totally thirty five-point likert type questions. In the questionnaire, “Absolutely Agree”, “Agree, “Undetermined”, “Disagree”, “Absolutely Disagree” expressions were used. Scores for positive attitude items are scored as 5 for “Absolutely Agree”, 4 for “Agree”, 3 for “Undetermined”, 2 for “Disagree” and 1 for “Absolutely Disagree”. For negative attitude items, scoring is done reversely.

After the participants were informed about the importance of the research and application and sincerely given answers were wanted from the students, students were given 15-20 minutes to answer the questionnaire.

Data Analysis

After the application process, questionnaires were checked one by one and erroneous or incomplete data sets were removed and discarded. Remaining data sets were analyzed by SPSS 17.0 packet program. In order to make necessary decisions, one way ANOVA, independent sample t-test and Pearson correlation were used.

RESULTS AND FINDINGS

The results and findings of the research are presented here.

Results For Gender Variable
In this part data is analyzed in terms of gender differences at two parts. First part is about Physics Attitude Questionnaire and the second part is about physics achievement.

Physics Attitude Questionnaire

To determine the significance of the difference of means of Physics Attitude Questionnaire points in terms of gender variable, independent samples t-test is used. Firstly data is analyzed in terms of all students at school in general and secondly in terms of grade levels.

The result of the independent samples t-test in terms of all the students at school in general is given at Table 2 below.

Table 2. T-test For Gender Variable For All Students

Gender	N	X	S. D.	T	df	p
Female	246	2,79	,715	-2,531	407	,012*
Male	163	2,97	,655			

* *The mean difference is significant at the level ,05*

As it is seen at Table 2, the difference between the means of Physics Attitude Questionnaire points in terms of gender variable is found significant in favor of male students (p<,05). That means, boys have significantly higher attitude points than girls at Physics Attitude Questionnaire.

The result of the independent samples t-test in terms of grade levels is given at Table 3 below.

Table 3. T-test For Gender Variable For Grade Levels

Grade	Gender	N	X	S. D.	t	df	p
Prep	Female	76	2,95	,756	-,913	114	,363
	Male	40	3,06	,530			
9	Female	68	2,85	,669	-2,511	116	,013*
	Male	50	3,15	,619			
10	Female	56	2,66	,601	-2,161	86	,033*
	Male	32	2,94	,559			
11	Female	46	2,60	,785	-,438	85	,663
	Male	41	2,67	,783			

* *The mean difference is significant at the level ,05*

According to Table 3, the difference between the means of Physics Attitude Questionnaire points in terms of gender variable is found significant for ninth and tenth grade levels in favor of male students (p<,05). That means, boys have significantly higher attitude points than girls at ninth and tenth grades at Physics Attitude Questionnaire.

Physics Achievement

To determine the significance of the difference of the means of first term physics points in terms of gender variable, independent sample t-test is used. Firstly data is analyzed in terms of all students at school in general and secondly in terms of grade levels. At social science secondary high school, only ninth and tenth grades students are studying physics and their first term physics points are taken and used. At preparation and eleventh grade levels, physics is not studied and so there can't be any result and finding about these classes.

Table 4. T-test Of Physics Achievement For Gender Variable For All Students

Gender	N	X	S. D.	t	df	p
Female	124	74,56	9,276	2,693	204	,008*
Male	82	70,94	9,696			

* *The mean difference is significant at the level ,05*

The result of the independent samples t-test in terms of all the students at school in general is given at Table 4 below.

According to Table 4, the difference between the means of first term physics scores in terms of gender variable is significant in favor of girls (p<,05). That means, girls have significantly higher attitude score than boys.

The result of the independent samples t-test in terms of grade levels is given at Table 5 below.

Table 5. T-test Of Physics Achievement For Gender Variable For Grade Levels

Grade	Gender	N	X	S. D.	t	df	p
9	Female	68	71,76		1,071	116	,286
	Male	50	73,00				
10	Female	56	74,33		2,970	86	,004*
	Male	32	67,73				

** The mean difference is significant at the level ,05*

According to Table 5, the difference between the means of first term physics scores in terms of gender variable is significant for tenth grade in favor of girls (p<,05). That means, girls have significantly higher attitude scores than boys at tenth grade.

Physics Attitude Questionnaire Results For Grade Level Variable

To determine the significance of the attitude test results in terms of grade levels variable, One Way ANOVA test is used. In order to use One Way ANOVA, firstly the equality of variances was checked by Levene's Statistics. Its result is given at Table 6.

Table 6. Test Of Homogeneity Of Variances

Levene Statistics	df1	df2	p
	163	2,97	,060

According to Levene's Statistics for grade levels, equality of variances is provided (p>,05). After equality of variances is provided, One Way ANOVA test is done. Its result is given at Table 7.

Table 7. One Way ANOVA For Grade Levels

Variables		N	X	S.D.	Df	F	P
Grades	Preps	116	2,99	,064	3	6,248	,000*
	9	118	2,98	,663	405		
	10	88	2,77	,599	408		
	11	87	2,64	,780			

** The mean difference is significant at the level ,05*

According to One Way ANOVA results, average levels of attitude level were found for each class level. The difference among the means of Physics Attitude Questionnaire in terms of grade levels is significant (p<,05). In order to decide the tendency among grade levels, Tukey HSD is used as Post Hoc Test.

Table 8. Multiple Comparisons For Grade Levels

TUKEY HSD		Mean Difference	Std. Error	p
Preps	9	,015	,089	,998
	10	,226	,097	,092
	11	,356*	,097	,002*
9	Preps	-,015	,089	,998
	10	,211	,096	,128
	11	,341	,097	,003*
10	Preps	-,226	,097	,092
	9	-,211	,096	,128
	11	,130	,103	,590
11	Preps	-,356*	,097	,002*
	9	-,341	,097	,003*
	10	-,130	,103	,590

** The mean difference is significant at the level ,05*

Its result is given at Table 8 above.

According to Multiple Comparisons test for grade levels, the difference between prep grade and eleventh grade classes and between ninth grade and eleventh grade classes were found significant in favor of lower grade levels (p<,05). Also it was seen that attitude scores were getting lower when grade levels went up.

Correlation Between Physics Achievement and Physics Attitude
To determine the between physics achievement and physics attitude, Pearson Correlation was used. For this, firstly correlation is measured for all the students at school in general and secondly for grade levels.

Pearson Correlation for all the students at school in general is given at Table 9. According to Table 9, there is a significant correlation between physics achievement and physics attitude (p<,05).

Table 9. Correlation Between Physics Achievement and Physics Attitude

Pearson Correlation	N	p
,148	206	,033*

** The mean difference is significant at the level ,05*

Pearson Correlation for grade levels is given at Table 10.

Table 10. Correlation Between Physics Achievement and Physics Attitude

Grade	Pearson Correlation	N	p
9	,184	118	,047*
10	,073	88	,497

** The mean difference is significant at the level ,05*

According to Table 10, there is a significant correlation between physics achievement and physics attitude for only ninth grade level (p<,05).

CONCLUSION

At İbrahim Cinkaya Social Science Secondary High School, an average level of attitude was found. According to data analysis, for each grade level and for school, students' attitude level is between 2,60 and 3,15 points. Despite it is a social science secondary high school, students have positive ideas about physics course. It may be because they are generally successful and selected students by secondary schools enterance exam and they are really interested in their courses like a science secondary schools.

In terms of grade levels, lower grades have significantly higher attitude scores and the higher grade students are at, the lower points at Physics Attitude Questionnaire they have. Aktamış, Çalışkan and Aktamış (2012) found that attitude level is going down while grade level goes up.

Science education researches show that the gender may have influence on attitude towards science (Demirci, 2004). In this study, in terms of gender variable, male students have higher attitude scores than female students. That means, boys have more positive attitude level than girls at physics lessons. Peşman (2012) revealed clearly that males were observed to have significantly higher levels of attitudes towards physics. It is also found that boys have higher attitude points than girls by some other researches in the literature (Aktamış, Çalışkan ve Aktamış, 2012; Peşman, 2012; Demirci, 2004). It may be because of cultural expectations of parents, teachers and peers on males and females (Peşman, 2012).

Significant correlation is found except for tenth grade level. But in terms of physics achievement, female students have higher achievement points, while male students have higher attitude scores. Keskin (2008) found that there is no significant correlation between achievement and correlation.

RECOMMENDATIONS

In this study, it wasn't possible to make a research at other schools. It may be helpful and meaningful to do this study at different schools and school types.

In the literature, there weren't more studies about attitude and achievement levels in terms of gender difference. It can be studied in order to make clear the relationship between them at different grade levels.

In this study, it wasn't possible to make a research about the reasons of high or low physics attitude levels. It can also be studied in order to make physics courses more likable than now, because everybody may be in the need of knowledge of physics anytime.

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REVIVAL OF DEMONSTRATION EXPERIMENTS IN SCIENCE EDUCATION

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ABSTRACT: Experiments play an essential role in science research and also in science education. The first experiments were part of science teaching/learning at universities already at the beginning of the nineteenth century. The effectiveness of science education through students engaging in practical activities was preferred by some but doubted by others. The contemporary constructivist approach in science education promotes students' experimentation because students have a greater share in activity and inquiry. Not only are student experiments important for teaching/learning science, but also demonstration experiments play an important role as well. The goal of our design-based research is to answer the question: Does the demonstration experiment have a place in today's constructivist science teaching/learning? What innovations are appropriate for the implementation of demonstration experiments in today's constructivist science teaching/learning? As a result of our design-based research we found several principles for the effective implementation of demonstration experiments in teaching/learning science: an emphasis on the objective of demonstration experiments, controlled observation of demonstration experiments, and development of students´ thinking and creativity in demonstration experiments. The appropriate implementation of these demonstration experiments in science education can lead to a better understanding of the nature of experiments, as well as to a better understanding of science concepts, phenomena, science processes and science laws and to increasing the required educational objectives. The next student gain is acquaintance with the experimental skills needed for their own meaningful experimentation under the guidance of a teacher. These skills include the ability to observe consistently and accurately, to use the apparatus correctly, to measure, to create and to test hypotheses of observed phenomena, to analyse results of experiments and to draw conclusions.

Keywords. constructivism, demonstration experiment, science education

INTRODUCTION

Experiments have been used as an irreplaceable instrument in science education for more than two hundred years. From the perspective of contemporary constructivist educational theory there has been an increase in the importance of students´ experimentation, which is the basis of students´ activity as a foundation for the active creation of their knowledge and skills acquisition. Demonstration experiments carried out by teachers are not at the centre of interest now. But these experiments had a significant role in science education in the past and in our opinion they still have this role. It is important to determine the place of demonstration experiments in science instruction nowadays and whether the time of their revival is coming.

The permanent significance of demonstration experiments has been indicated in some studies (Hodson, 1990, 1993; Milner-Bolotin, Kotlicki, & Rieger, 2007; Zimrot & Ashkenazi, 2007) where it has been verified that students remember and understand appropriate demonstration experiments more than "recipe-following" student experiments, in which students follow prescribed procedures and hope to achieve the right answer (known by the teacher in advance).It is necessary to analyse the role of the student and the demonstration experiment in constructivist teaching/learning science. Sokoloff and Thornton (1997) have developed a learning strategy called the Interactive Lecture Demonstration based on students´ prediction and observation of demonstrations in a peer-based environment. They speak about the active learning environment and implementation of these demonstrations has shown a dramatic improvement in student attitudes and understanding.

Experts and especially teachers sometimes do not consider the role of demonstration experiments to be very important. Even their incentive effect is questioned. Properly implemented demonstration may help overcome misconceptions and can prevent the emergence of misconceptions (Risch, 2014; Roth, McRobbie, Lucas, & Boutonne, 1997; Thornton & Sokoloff, 1990; Sokoloff & Thornton, 1997). We try to identify the advantages and disadvantages of demonstration experiments and to modify their implementation. Based on a study of literature and using design based research we have developed recommendations for the performance of demonstrations and have applied them in science education. The evidence shows that students of all ages learn science better by actively participating in the investigation and the interpretation of science phenomena and that well-designed demonstration experiments allow students to gather, analyse and communicate data and can help students to better understand science (Mazzolini, Daniel, & Edwards, 2012). Therefore, students need to be motivated for demonstration experiments and to be engaged in observation and discussion. In our study we try to explain why now is the right time for a revival of demonstration experiments in science education.

RATIONALE

We have mentioned the reasons why it is necessary to pay attention to demonstration experiments, not only students' ones. The basis of our considerations could be the history of the implementation of demonstration experiments in science education. This historical analysis can yield significant findings about the factors and conditions that have led to a different emphasis on student and demonstration experiments.

History of Demonstration Experiments

The first demonstration and student experiments were part of science education at universities from the beginning of the nineteenth century. For example, the first laboratory chemistry course in the UK was implemented in 1807 by T. Thomson at the University of Edinburgh (Morrel, 1969, 1972). This approach was gradually reflected in education at primary and secondary school levels. It was considered important to allow students to perform experiments in England in the late 19th century. In 1899, school experimentation was established as a basic requirement for teaching science at most schools in England (Gee & Clackson, 1992). At that time, experiments played a crucial role as confirmation of the theory. A similar process of implementation of experiments took place gradually in many countries. The first hundred years of science experimentation was focused on the support of transmissive teaching. Yet it is possible to recognize some approaches emphasizing the importance of student experiments, especially for promoting understanding of science phenomena. The effectiveness of science education through practical students' activities was also doubted. This caused the first discussions about the relationship between student and demonstration experiments and their roles in education. For example in the beginning of the 20th century Armstrong spoke in favour of students´ experimentation, which he preferred to demonstration experiments carried out by teachers (Hodson, 1990).

This debate, however, was affected by factors of efficiency and economics of school experimentation. Student experiments were expensive and time consuming. A significant disadvantage of student experiment was the cognitive inefficiency that arose when an experiment was performed exactly following the guidelines without thinking and without the cognitive activity of the students. These student experiments did not bring about the expected results (Hodson, 1990, 1993) in the understanding of teaching contents. Therefore, in the 1930s in Britain, and similarly in the world, more attention was paid to demonstration experiments (Hodson, 1993).

The discussion about the importance of student and demonstration experiments has continued. Recently, a number of studies have dealt with the effectiveness of practical students' activities in relation to achieving educational objectives (Hofstein & Mamlok-Naanam, 2007). The significance of demonstration experiments, their effectiveness and proper implementation in instruction have been discussed by a number of authors (Bowen & Phelps 1997; Johnstone & Al-Shuaili, 2001; Bodner, 2001; Zimrot & Ashkenazi, 2007). There are no evident research results demonstrating a clear relationship between students´ experience of experimentation (especially in laboratories) and their learning (Blosser, 1980; Bryce, & Robertson, 1985; Hodson, 1993; Hofstein & Lunetta, 1982, 2004; Lazarowitz & Tamir, 1994).

In the second half of the last century there has been shift towards student experiments in connection with the implementation of constructivist theory into science education. This situation still remains. Students´ experimentation has a crucial role in the currently preferred educational strategy IBSE (Inquiry-based Science Education). The widely held constructivist view of learning advocates student engagement via interactivity. However, some studies point to a lack of student engagement in some students´ experimentation. Some authors (Hodson, 1993) ask the question what students´ activity is developed if they work according to precise instructions and passively fill in the obtained data in prepared charts or relationships in worksheets. Such activity does not contribute to active knowledge and understanding of phenomena, because the majority of students do not know what they are doing and why. Research findings document (Shrama et all, 2010; Wieman, Perkins, & Gilbert, 2010) that after only passively doing an experiment students come away with an incorrect interpretation of the verified phenomenon! Contrary to common belief, demonstration can be based on a constructivist view of learning. For example the above mentioned specific strategy for physics education, the Interactive Lecture Demonstration (Laws, Sokoloff, & Thornton, 1999; Thornton & Sokoloff, 1990; Sokoloff & Thornton, 1997), has been developed to enhance conceptual understanding. According to Shrama et all. (2010), the Interactive Lecture Demonstration is designed for large lecture classes and, if measured using specific conceptual surveys, is purported to provide learning gains of up to 80%.

We can conclude that all efforts of educators were (and we think always will be) aimed at improving students gains. There is agreement among experts that the way to do this is through the engagement of students. Well-designed demonstration experiments can engage more than "recipe-following" laboratory exercises.

Advantages and Disadvantages of Demonstration Experiments

Based on our analysis we have determined the advantages and disadvantages of demonstration experiments. Among the major advantages are that it is highly important for students to acquire the essential skills for experimentation under the guidance of teachers. These skills are needed for their own meaningful experimentation. These student competences include the ability to observe consistently and accurately, to use the apparatus correctly, to measure, build and test hypotheses of observed phenomena, to analyse the results of experiments and to draw conclusions.

Demonstration experiments are performed by teachers individually or in cooperation with one or more students, in front of the whole class. The advantage is that all students have the opportunity to observe the experiment in progress intently and at the same time. Therefore, it is usually less expensive and time-consuming than student experiments. The teacher can significantly affect students´ attention focused on a particular part of the experiment, which could be disturbed by a strong, but less significant stimulus if performing student experiments.

Students learn how to identify the causes of natural processes, connections and relationships between them, to ask questions (How? Why? What happens if?) and to search for answers, to explain the observed phenomena, to look for and solve cognitive or practical problems, and to understand the importance of learning regularities of natural processes in order to predict or influence them.

Demonstration experiments have a completely irreplaceable role in the demonstration of dangerous phenomena and materials such as chemicals, fire, boiling water, electricity, etc. Many experiments are difficult to implement (Brownian motion, etc.), they take a long time (plant growth, etc.) or are economically difficult (expensive chemicals, etc.).

The biggest disadvantage of demonstration experiments is the reduced activity of students and limited perception of experiment through more senses. During the performance of student experiments we can speak about the complex interconnection of hands on and minds on activities of students but during demonstration experiments especially hands on activities are reduced. But it is possible using an appropriate procedure to activate minds-on activities. It is possible to reduce or even eliminate the disadvantages of the demonstration experiment,

RESEARCH QUESTIONS AND METHODS

The objective of our design-based research is to answer the questions: Does a demonstration experiment have a place in today's constructivist science teaching/learning? What innovations are appropriate for the implementation of demonstration experiments in today's constructivist science teaching/learning? Our study presents an example of an appropriate method of implementation of demonstration experiments in science education which combined students' and teacher's activities.

We used design-based research (Reeves, 2006) as a development research method which can be described as a cycle: analysis of a practical problem, development of solutions, evaluation and testing of solutions in practice, and reflection and production of new design principles.

In our case these steps have the following form:
(1) Analysis of practical problems: we identified the existing problems in the implementation of demonstration experiments in science education.
(2) Development of solutions with a theoretical framework: we created a method (model) of the implementation of demonstration experiments with the use of interaction: teacher - students.
(3) Evaluation and testing of solutions in practice: our co-researchers - science teachers used action research for testing these model of implementation of demonstration experiments in science lessons.

(4) Documentation and reflection to produce "Design principles": the final stage of our research was the documentation and establishment of the three design principles for the implementation of demonstration experiments in science education.

RESEARCH RESULTS AND DISCUSSION

The result of our design-based research is the conclusion that demonstration experiments play an important role also in constructivist teaching/learning. There is a lot of discussion about different ways of implementing demonstrations and their effectiveness in promoting student understanding of science concepts. Contrary to the common belief that seeing a demonstration experiment makes students understand or at least remember the phenomena C. Wieman, Nobel Laureate in Physics states, based on his experiences of lectures, that passive observation of a demonstration experiment has educational effects similar to experiments not seen at all (Wieman, Perkins, & Gilbert, 2010). The research findings of Crouch, Fagen, Callan, & Mazur (2004) and Di Stefano (1996) are in agreement with this statement, but their research also shows that learning and understanding is enhanced by increasing student engagement. Based on findings that students may fail to learn from demonstrations if they lack opportunities to discuss what they "saw" and what it meant, experts recommend discussion (Roth, McRobbie, Lucas, & Boutonne, 1997; Laws, Sokoloff, & Thornton, 1999). According to research findings (Milner-Bolotin, Kotlicki, & Rieger, 2007; Moll, & Milner-Bolotin, 2009) students remembered not what they saw, but what they expected to see. Therefore, students need to discuss the presented phenomenon, their observations and conclusions. In this case teachers have the possibility to correct their mistakes and conceptual understanding.

Using our design-based research (Reeves, 2006), we have come to a few important principles for the implementation of demonstration experiments in science teaching/learning: emphasis on the objective of demonstration experiments, controlled observation of demonstration experiments and development of students´ thinking and creativity in demonstration experiments (Trnova, Trna, & Novak, 2013). On the basis of these established principles we have compiled a model of implementation of the demonstration experiment in science teaching/learning.

Emphasis on the Objective of Demonstration Experiments

Teachers must state a clear educational objective they want to achieve through a demonstration experiment. Regarding initial motivation, a surprising experiment is enough. Educational objectives can be understanding of science concepts, phenomena and laws or developing skills associated with experimentation such as designing experiments, setting up experimental apparatus, analysing and presenting outcomes of the experiment and drawing conclusions etc. According to the selected objective the teacher should define appropriate involvement of students in the performance of demonstration experiments.

A very important educational objective of demonstration experiments is developing skills associated with designing experiments, setting up the experimental apparatus, etc. These skills are very important for students' experimentation. Many problems with low effectiveness of students' experimentation are connected with the low level of these skills. For example in chemistry or physics lessons students very often have problems with setting up the experimental apparatus, which is the "starting point" for the experiment. Consequently, the gains of students´ activities are unsatisfactory. Demonstration experiments provide a convenient means for acquisition of the necessary skills. Teachers can ask students for suggestions regarding the apparatus and correct and explain their mistakes.

Controlled Observation of Demonstration Experiments

Observation (cognition) is of great importance for understanding natural objects, phenomena and laws. Observation results are often an important starting point and the foundation of students´ knowledge and skills. When performing a demonstration experiment it is very important for the teacher to distinguish between mere perception (i.e. passive perception of stimuli from the environment) and observation (i.e. intentional and active perception of stimuli from the environment directly connected with mental activity) with respect to age and individual characteristics of students. When preparing a demonstration experiment the teacher must consider how to achieve the best students´ controlled observation.

The main activities of the teacher in fostering students' observation include:
(a) Determining the exact target of observation (students must know exactly what, how and why they are observing an experiment)

(b) Teaching students how and what to observe, what to notice and in what order
(c) Establishing appropriate observation tasks (neither too easy nor too difficult - with respect to age and individual characteristics of students)
(d) Connecting observation with comments, verbal description of the observed object or phenomenon
(e) Encouraging students to be consistent, independent and patient and to develop a set of the necessary communication skills
(f) Summarizing observations and drawing conclusions (the emphasis is put on essential characteristics)
(g) Drawing students´ attention (appropriate duration of the experiment, stimulating students´ attention with questions, etc.)
(h) Making sure the experiment can be observed by all students in the classroom

Controlled observation and comments on the ongoing experiment allow students to create the right ideas about the presented phenomena and object features. Compared with student experiments the teacher can check more efficiently whether students draw the right conclusions.

Development of Students' Thinking and Creativity in Demonstration Experiment

The school environment and the teachers are among the most important factors for the development of students´ thinking and creativity. To support divergent thinking in students, the teacher should pay attention to students' original, innovative, and unusual ideas and encourage them to become creative individuals. Well-designed demonstration experiments can help to create an appropriate environment and atmosphere for problem solving and other creative activities and they tend to change the role of students from being only spectators to being participants. During well-designed demonstration experiments the following creativity components (Amabile, 1996) can be developed:

- Resourcefulness: students create a wide flow of ideas about the presented concept, phenomenon or law.
- Readiness, perceptiveness: students modify ideas or jump from one idea to another in the context of the demonstration experiment.
- Originality (unusualness of ideas): students create original ideas for solving problems in the context of the demonstration experiment and verify them in practice.
- Imagination: students produce ideas that are not obvious at first sight.
- Endeavour: creativity is not only inspirational, but also hard work; if current ideas are not enough, students come up with new ideas or approaches.

Based on our findings of design based research, it is good practice to divide students into groups. Each student can participate in designing the experimental apparatus, in the procedure for the performance of the demonstration experiment and in searching for answers, explaining the observed phenomena, looking for and solving cognitive or practical problems. Each group presents the results of its work to the other classmates. The teacher can support students' discussion, can correct misconceptions and verify conceptual understanding (Risch, 2014).

Model of Implementation of Demonstration Experiments

Based on the above mentioned principles and analysis of literary sources we developed a model of implementation for demonstration experiments (Trnova, Trna, & Novak, 2013). We recommend using the following procedure for each demonstration:

(1) Before the demonstration the teacher asks students to record individual predictions.
The best activity for the development of thinking and creativity is predicting the progress and outcomes of the experiment. Students create and record their own opinions of how the experiment should develop and why.
(2)Teacher prompts students to discuss with classmates.
The students consult their opinions with their peers in the group. This leads to required confrontation of students' concepts. The teacher can specify students´ ideas during the presentation of individual groups, point out any misconceptions and correct them. He/she can also add missing information.
(3) *The teacher (maybe in cooperation with one or more students) carries out the demonstration*.
When performing experiments students confront their ideas with the real progress of the experiment. As mentioned above, the teacher teaches students to observe, and points out important phenomena, process, changes, etc.
(4) The teacher asks students to discuss the results in the context of the demonstration.
After the demonstration, the students first discuss the results in groups. They compare their predictions with reality. After that, each group presents their findings. The degree of the teacher's involvement is given by the

level of students' knowledge and skills. The teacher can monitor whether the students know what has happened in the experiment and why, and check the level of educational outcomes. At a low level of knowledge the students can just be involved in anticipating the progress of the experiment and there can be an explanation after the implementation by the teacher himself/herself. It is always advisable to let students express their opinion so that the teacher knows whether they understood the presented phenomenon correctly.
(5) The teacher encourages discussion about analogous situations that are based on the same concept.
For the teacher, this step may be an indicator of the extent to which students understand the demonstrated phenomenon. It is also very important for the development of thinking and creativity in students.

Such students' involvement in demonstrations corresponds to constructivist teaching/learning fully and minimizes the differences between student and demonstration experiments. According to research (Hofstein & Mamlok-Naanam, 2007; Laws, Sokoloff, & Thornton, 1999), students are motivated by such activities more than by laboratory work, which often limit activity. According to experts (Milner-Bolotin, Kotlicki, & Rieger, 2007; Laws, Sokoloff, & Thornton, 1999; Crouch, Fagen, Callan, & Mazur, 2004; Di Stefano, 1996; Roth, McRobbie, Lucas, & Boutonne, 1997) the gain of a demonstration experiment like this is understanding of concepts and phenomena.

Example of a Model Demonstration Experiment

We present an example of a model of demonstration experiment preparation and collection of carbon dioxide CO_2 in different liquids when students verify its properties. We describe our procedure during the demonstration based on the above mentioned model recommendations:

The teacher, in collaboration with the students, sets up 3 gas collection apparatuses using a descriptive image of the apparatus (Figure 1) as a guideline. As mentioned above it is necessary to revise knowledge about setting up chemical apparatus, to explain and show the procedure.

Instructions for implementation of the demonstration experiment:
Pour 20 cm^3 of 10% hydrochloric acid HCl solution into the separation funnel and put 3 g of calcium carbonate $CaCO_3$into the distilling flask. Shut the graduated cylinder filled to the brim with a selected liquid (water or lime water or saturated solution of NaCl) with a stopper, dip under the same liquid in the glass tub and then open it again. Slowly drop by drop add HCl from the separation funnel, which immediately reacts with $CaCO_3$ to give a colourless gas CO_2 that collects in the graduated cylinder. Observe and compare reactions in each apparatus and explain (see Figure 1).

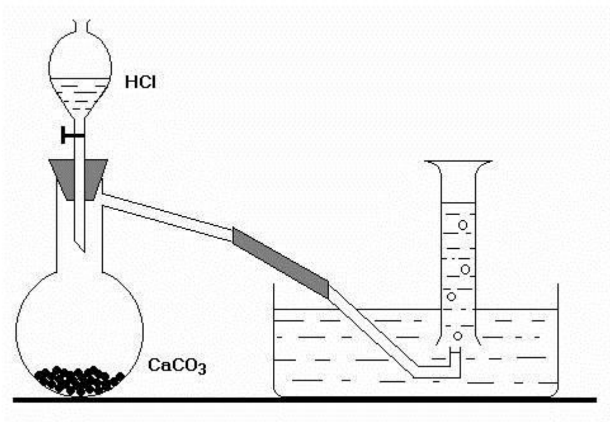

Figure 1. Preparation and Collection of CO_2

(1) Before carrying out the experiment the teacher asks students to record individual predictions of chemical reactions. Students predict the reactions in individual apparatuses and justify their suggestions based on the properties of CO_2, which is soluble in water and is acidic oxide. Therefore, the reactions occurring in the individual apparatuses, where CO_2 is collected in different liquids, are different. They predict chemical changes during individual chemical reactions.

(2) Students discuss the chemical reactions in individual chemical apparatuses.
The teacher prompts students to discuss their individual predictions of chemical reactions with their nearest classmates. Students discuss their predictions of how the chemical reactions will perform, they justify their

statements and write down the estimated chemical process using chemical equations. If necessary the teacher is in the role of counsellor.
They come up with a chemical reaction that can be used for the preparation of CO_2 and they write it down in the form of chemical equations.
The following chemical reaction was suggested for the presented demonstration experiment:

$$CaCO_3 + 2\,HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

(3) The teacher (maybe in cooperation with one or more students) carries out the demonstration.
The students observe the chemical process. According to the level of student knowledge the teacher comments on the ongoing experiment.

The teacher's comments during the experiment:
- If water has been used, CO_2 dissolves in water partially, but the remaining CO_2 extrudes water from the cylinder and accumulates in it. The volume of the liquid in the cylinder is reduced.
- If lime water has been used, it reacts with CO_2 to form a milky colour caused by insoluble $CaCO_3$. The carbon dioxide reacts with $Ca(OH)_2$ in the cylinder and the glass tub and extrudes it. The volume of the liquid in the cylinder remains unchanged (or changes very little). Mixing pure carbon dioxide with lime water makes the lime water milky white at times. This chemical reaction (sometimes called the lime water test) is used to detect the presence of CO_2.
- In the case of a saturated solution of NaCl all the liquid is extruded from the cylinder because CO_2 does not react with NaCl solution and it is not soluble in it. If students can calculate the amount of CO_2 produced, they can verify whether the volume produced during the reaction corresponds to reality and compare it with the alternative when CO_2 was collected into water.

(4) The teacher asks a few students to describe the chemical reactions, especially changes in individual graduated cylinders. Students can compare their own observation with their classmates, which is important for the acquisition of the right knowledge. Then students discuss the real chemical process results in the context of the demonstration. Students compare their predictions with the actual course of the reaction and the correct explanation of the reaction. During this confrontation, the students come to an understanding of the relationship between theoretical knowledge about CO_2 and practical experience. Students can repeat individual reactions as student experiments and they will know what they are doing and why in experimentation. If necessary the teacher can explain to help understanding.

(5) The teacher encourages discussion about analogous situations that are based on the same concept. For example students suggest how to prepare CO_2 using substances that are common at home. One possibility is the reaction of sodium bicarbonate and vinegar.

The students' gains from this demonstration experiment are knowledge about properties of CO_2 and understanding of its reaction with different chemical substances.

We verify that students who had the opportunity to participate in the preparation of CO_2 did not follow passively what chemical compounds the teacher used and were able to influence the choice actively. The course of reactions was observed with more interest, because students wanted to verify the accuracy of their predictions about the course of the reactions. The teacher presented the demonstration experiment and commented on the course of the reactions, highlighting significant moments (or letting students comment).

CONCLUSIONS

Demonstration experiments are considered classical but also modern ways of science teaching/learning. Their effectiveness is sometimes unfairly questioned in the context of the constructivist learning approach. As our design-based research and experience have proved the demonstration experiment, when suitably implemented and activating students, is a very good way to develop students´ knowledge, skills and interests.

Each experiment, if properly planned and implemented, plays a vital role in understanding natural phenomena. It is necessary especially for younger students to integrate experiments into lessons because their thinking is closely connected with material activity and object handling. Students can understand relationships between phenomena better. They gradually acquire knowledge and its arrangement in the system. This method of learning does not create isolated concepts, for which it is very difficult to determine their essential characteristics, making it difficult for students to characterize, understand and classify them in the structure of acquired knowledge and skills. The best way to achieve this is through students´ own practical, explorative and experimental experience.

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WHICH ONE IS BETTER; JIGSAW II VERSUS JIGSAW IV ON THE SUBJECT OF THE BUILDING BLOCKS OF MATTER AND ATOM

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ABSTRACT: In this study, the effect of using Jigsaw II and Jigsaw IV techniques on the subject of "Atoms-The Basic Unit of Matter" in science course of 6^{th} grade on academic achievement was examined. Pre-test post-test control group research was used in the study. Study population is all secondary schools in Turgutlu district of Manisa province and the sample group was determined from "Samiye Nuri Sevil Secondary School" among 20 secondary schools in Turgutlu district through cluster sampling method. The experiment and control groups of the research were constituted from two branches based on the results of pre-test and there are 48 persons in total of which 24 are in experiment and 24 are in control group. In the study, the subject of "Atoms- the Basic Unit of Matter" was taught to the experiment group by using Jigsaw IV technique and it was taught to the control group by using Jigsaw II technique. In this research, Science achievement test consisting of 12 multiple-choice items which were developed by the researcher was used. T-test was used for the analysis of data obtained as a result of achievement test. In paired samples t-test (dependent group) conducted for achievement pre-tests and post-tests of the control and experiment group a significant difference was found, while no significant difference in terms of statistics in favor of the experiment group was found in independent samples t-test (independent group) conducted for post-tests of the control and experiment groups. At the end of the research, although the effect of Jigsaw II and Jigsaw IV techniques on the achievement in Science course was found to be positive on students learning, no statistical differences were found in these two techniques.

Keywords: cooperative learning, jigsaw ii technique, jigsaw iv technique,

INTRODUCTION

In today's information age, the primary goal in our education system should be gaining the skills to the students to reach knowledge rather than transferring. This is possible with high-level thinking process skills. In other words, it requires meaningful learning, rather than memorizing, and problem solving and scientific process skills. Science course is the leading course to gain such abilities (Buzludağ, 2010; Kaptan and Korkmaz, 2001).

Science can be defined as to examine the observed nature and natural phenomena in a systematic manner and efforts to estimate the unobserved phenomena. As it is understood from this definition, science is the product of the efforts of humankind to understand the nature (and oneself) (Ayna 2009; Turgut et al., 1997). Science was born due to the desire of humans to explain the natural phenomena. Science education began with the observations of the ancient people and to transfer their knowledge and observations to others (Gürdal et al., 1998).

Primary education has a special place and importance in our education system because primary education is an education phase preparing students for life, informing them on natural and social environment and providing guidance (Gürdal and Yavru, 1998). Science has a significant place due to this characteristic of the primary school. Along with latest developments in education, one of the methods and techniques which are primarily used in science education is cooperative learning method. According to Açıkgöz (2008), cooperative learning method can be simply described as the learning process that students study in small groups and help each other (etc. Doğru, 2012). In this context, cooperative learning method is a group study. However, constitution and implementation of cooperative learning groups differ from group studies (Bozdoğan et al., 2006, p.26). A group study only becomes a cooperative learning when the students in the group make effort to bring the learning of them and other students in the group to the top level. In order to perform cooperative learning, the students in a group should help each other by interaction and should produce a joint study rather than working on a particular part of the work independently. Thus, "educational activity, in which the students participate personally, helps them to understand the subject better and not to forget it easily" (Küçükahmet, 1997, p.59). "Students in the class in which cooperative learning environment is obtained, study within positive cooperation; each member has a particular and explicit role; joint study process is important and the group members analyze and discuss their work" (Lee et al., 1997, p.3). "Achievement of the group depends on the performance of the group members. For this reason, individuals have to help each other in order to achieve their individual goals" (Slavin, 1980, p.21; Lejik and Wyvill, 1996, p.270). "Group of members aware of the requirement of the group achievement in order to achieve their individual goals helps other members. More importantly group members encourage each other" (Johnson and Johnson, 1989, p.7). In cooperative learning approach, each student takes on several duties.

There are 8 sub-techniques commonly used in cooperative learning method so far. One of them is jigsaw technique. This method was developed by E. Aranson (1978). These procedures are followed in Jigsaw technique. First of all, students are divided into 3-7 person jigsaw groups and the subject is divided into segments. Then, the students are divided into individual groups and constitute the expert groups with other students who assigned to the same segment. Students in expert groups work by helping each other to develop strategies to learn and teach their segments to other group members. Such expert groups return to their jigsaw groups after they complete their studies and become ready for the segment. They give lecture to the group members on what they have learned about their segment. Following the presentation of the chapter or the subject by the group members in this way, the whole class is given an individual quiz on relevant material. The results of the quiz are evaluated individually (Yılayaz, 2012; Açıkgöz, 1992). After Aronson, educational researchers studying on Jigsaw technique made new arrangements and developments in Jigsaw technique starting from the flexible applications of this technique. In Table 1 below, Jigsaw techniques developed by several researchers are compared:

Table1.Comparison of Jigsaw Techniques*

Step	Jigsaw II	Jigsaw III	Jigsaw IV
1.			Introduction
2.	Experts sheet assigned to expert groups	Same as Jigsaw II	Same as Jigsaw II
3.	Group answers expert questions prior to returning to home teams	Same as Jigsaw II	Same as Jigsaw II
4.			Quiz on material in the expert groups checking for accuracy
5.	Students return to home teams sharing their information with team mates	Same as Jigsaw II	Same as Jigsaw II
6.			Quiz on material shared checking for accuracy groups
7.		Review process whole group by Jeopardy, or Quiz Bowl etc.	Same as Jigsaw III
8.	individual assignment and grade	Same as Jigsaw II	Same as Jigsaw II
9.			Re-teach any material missed on assessment as needed.

* Adapted from Holliday (2002, p. 4).

When Table 1 is examined; It is seen that Jigsaw II and Jigsaw IV techniques diverse in 1st, 4th, 6th, 7th and 9th steps. Accordingly;

In first step; the first difference is seen in Jigsaw IV. In this technique, as different from Jigsaw II, the teachers conducts activities such as movie screening, discussion platform, brainstorming, problem solving, lecturing to all groups, and presentation of the lesson plan or using other methods for the introduction of the lecture regarding the chapter or material to be studied by the class (Holliday, 2000). This implementation is an activity conducted to catch the students' attention on the chapter before the study when they are in their jigsaw groups.

In fourth step; unlike Jigsaw II, in Jigsaw IV, a test is applied in order to check whether the students studying in expert groups have learned the information in relevant chapters. Correct answers and the level of understanding are checked with this test application. With the assistance of the instructor and facilitation of the studies, agreement between the students in expert groups on the answers is provided. Then, students in expert groups return back their jigsaw groups (Holliday, 2002).

In sixth step; there is difference between Jigsaw applications. In this step, unlike Jigsaw II, a second test is applied in order to check whether the students in jigsaw groups learn the whole chapter or material in Jigsaw IV (Holliday, 2002,).

In seventh step; unlike Jigsaw II, in Jigsaw IV technique, several tests, activities and forms are used to reexamine the study processes of all groups. In this process, before passing to individual evaluations, the state of learning the course, chapter or relevant material is submitted for the examination of whole class. This examination period is very important in terms of forming a basis for students to study the relevant chapters for the second or third time (Holliday, 2000).

In ninth step; unlike Jigsaw II, in Jigsaw IV, the instructor completes the study by summarizing and teaching the unanswered questions or unlearned parts of the chapters as a result of evaluations. However, this practice is optional. In the case of students gain required behaviors, practices in this step are not necessary. The practices in this step are very important especially for students with low level of achievement before passing to the next chapter (Holliday, 2002).

The positive effect of using cooperative learning method -Jigsaw techniques on academic achievement is supported by several researches. As a result of the study titled "The Effect of Education with Cooperative Learning (Jigsaw Technique) on student achievement for the Chapter of 'Reproduction Growth and Development in Living Beings' of 6th Grade Science and Technology Course" and conducted by Buzludağ (2010), it was found that cooperative learning-Jigsaw technique positively affect the achievement in Science and Technology course. In the study carried out by Doğru (2012) named "The Effect of Jigsaw Technique on Self-efficacy, Anxiety and Memorability Levels of Students in Mathematics Education", it is determined that Jigsaw technique has more beneficial effects on self-efficacy, anxiety and memorability levels when compared with the traditional education method. In another study titled "The Effects of Group Study with Cooperative Learning Methods on Achievements, Attitudes for the Course and Memorability of the Learned Subjects" and conducted by Oral (2000), it was found that cooperative learning (Jigsaw II) activities has more beneficial effects on achievement levels at the end of the course, memorability of the learned subjects and attitudes of the students for study period when compared with group studies. Slavin and Karveit (1979) revealed that cooperative learning (Jigsaw II) activities improve achievement compared to the traditional education method in their study in which they examine the academic achievements, affective behaviors like attitude, anxiety and self-respect of primary school students. Shafiuddin (2010) revealed that Jigsaw technique improves achievement more efficiently when compared with the traditional education method in his study with experimental design.

In this study, an answer was sought for the question "Is there any effect of Cooperative learning method-Jigsaw II and Jigsaw IV techniques on the education of 'Atoms- the basic unit of matter' subject of primary school 6th grade Science and Technology course?". Three questions were determined for the solution and answers were sought. These questions are: "Is there any significant difference between pre-test and post-test scores of the experiment group?", "Is there any significant difference between pre-test and post-test scores of the control group?" and "Is there any significant difference between post-test scores of the experiment and control groups?"

METHOD

Research Model

In the research, pre-test – post-test control group research design was applied. One of two equivalent branches was designated as experiment group and control group randomly and, pre-test and post-test measurements were carried out on both groups and shown in the Table 2 as follows.

Table 2.Pre-Test Post-Test Experiment Design With Control Group

Group	Pre-test	Experimental Process	Post-test
G1	T1	Cooperative Learning Method (Jigsaw IV)	T2
G2	T2	Cooperative Learning Method (Jigsaw II)	T2

G1: The experimental control group to which Jigsaw IV method is applied
G2: The experimental control group to which Jigsaw II method is applied
T1 and T2: Achievement tests on "Atoms- the basic units of matter"

Population and Sampling

Study population is all secondary schools in Turgutlu district of Manisa province and the sample group was determined from “Samiye Nuri Sevil Secondary School” among 20 secondary schools in Turgutlu district through cluster sample selection. Pre-test was conducted on all branches of 6th grade in order to determine the experiment and control groups of the research. The experiment groups (24) and control groups (24) which are constituted from two equivalent branches according to pre-test results of the students are composed of 48 students. The t-test was used to determine whether there is a significant difference between the groups. Results of the analysis are given in the Table 3.

Table 3.The Average Pre-test Scores for Group Accreditation, Results of the t-test

Group	N	$\bar{X}$	Ss	t	P
Experiment	24	5,45	2,39	-1,142	0.259
Control	24	6,20	2,14		

$p > 0.05$

According to Table 3, mean and standard deviation scores of the experiment group were determined as 5.45 and 2.39 respectively in the achievement pre-test conducted before intervention. The mean and standard deviation scores were determined as 6.20 and 2.14 respectively. No statistically significant difference ($p>0.05$) was observed in the independent-samples t-test conducted for achievement pre-tests of the control and experiment group. According to this result, the pre-test success of the experiment group is within the same standard deviation range as the pre-test success of the control group. This indicates that both the experiment and control groups are equivalent.

Data collection instruments

In the research, the following assessment instrument was used to determine achievements of the students on “Atoms- the basic units of matter” which is a 6th grade science course.

<u>Achievement Test of Science Course</u>: The achievement test used in the research was prepared by the researcher. In order to develop this test, all acquisitions on the subject of “Atoms- the basic units of matter”, 6th grade were determined based on primary science education program (MoNE, 2010), some of the questions were selected from among the assessment questions of the textbooks used in the schools currently and the questions within the open education lecture notes, whereas some of the questions were prepared by the researcher so that there will be a question on each acquisition. The 17-questions test was checked by experts (from university) and 5 questions were excluded. Pilot execution of the test was performed on the 7th grade students in the school where the research is conducted (because the students have already learned the subject) and reliability of the test was measured. So, reliability of the test was found 0.66. Than the test was conducted as pre-test and post-test.

Application

Two equivalent branches (6A= experiment, 6D=control) were selected with respect to the results of pre-test. The lesson was provided to the experiment group by means of the education program prepared in accordance with the Jigsaw IV technique of the cooperative learning method whereas in the control group Jigsaw II technique of the cooperative learning method was applied to teach subject. In both experiment and control groups, teaching activities were conducted by the researcher.

<u>Applications in the Experiment Group</u>

The researcher informed the students in the experiment group that the subject of “Atoms- the basic unit of matter” will be taught by the Jigsaw IV technique of the cooperative learning method. Then information on the approach was provided. Heterogeneous groups of 6 students were created by the researcher by taking into consideration interest, ability and achievement levels of the students in the classroom before the intervention. The classroom was organized to allow the group work to be performed. Before the intervention, the science achievement test was implemented as a pre-test in order to assess prior knowledge of the students in the experiment and control groups. After the students understood the studies to be performed, the intervention was initiated and the Jigsaw IV technique of the cooperative learning method was implemented. The students in groups completed their studies. The researcher provided guidance during the intervention and ensured the study to be performed in accordance with its purpose.

Applications in the Control Group

The subject of "Atoms- the basic unit of matter" was taught by means of the Jigsaw II technique of the cooperative learning method. The students were informed about the approach and heterogeneous groups of 6 students were created by the teacher. The science achievement test was also implemented as a pre-test in the control group. At the end of the study, the science achievement test was implemented as post-test in both experiment and control groups. Such applications performed with control and experiment groups last for 2 weeks.

Analysis of Data

Comparisons were made on data from the Science Achievement Test on the subject of "Atoms- the basic units of matter" between experiment and control groups by means of SPSS software package. For pre-test and post-test comparisons of experiment and control groups, the independent samples t-test was used. The pair samples t-test was used for pre-test post-test comparison of the experiment group and pre-test post comparisons of the control group. Significance level was accepted as at least 0.05. The results of analysis were interpreted individually by tabulating.

FINDINGS

Table 4.Reliability Coefficient for Science Achievement Test

Reliability Coeff.	N	R
Cronbach Alfa	24	0,66

The Table 4 includes the reliability coefficients for the Science Achievement Test performed in the control and experiment groups. Cronbach's alpha coefficient for reliability was found as 0.66. Such results obtained show that the reliability of the test is 66% and this result is reliable statistically. Findings for the First Sub-Problem: The first sub-problem was "Is there any significant difference between pre-test and post-test scores of the experiment group?" Mean scores of pre-test and post-test and standard deviations of the experiment group were calculated. The t-test was used on dependent groups in the SPSS statistic software package in order to determine significance of the difference between averages of the pre-test and post-test scores in the experiment group. Results are shown in the Table 5.

Table 5. Result of the Dependent Group T-Test performed for Achievement Pre-test and Post-Tests of the Experiment Group

Experiment Group	**N**	$\bar{X}$	**Ss**	**t**	**P**
Pre-test	24	5,45	2,39	-3,646	0.001
Post-test	24	7,12	2,36		

$P<0.05$

According to Table 5, the mean score of the achievement pre-test of the experiment group and standard deviation was found as 5.45 and 2.39 respectively. The mean score of the post-test of the experiment group and standard deviation was found as 7.12 and 2.36 respectively. A statistically significance difference at level of 0.05 was found in the dependent group t-test carried out for achievement pre-test and post-test of the experiment group. This difference occurred in favor of the post-test. As it is understood from this result, implementation of the Jigsaw IV technique of the cooperative learning method enhanced the student achievement. Findings for the Second Sub-Problem: The second sub-problem was "Is there any significant difference between pre-test and post-test scores of the control group?" Mean score of pre-test and post-test and standard deviations of the control group were calculated. The t-test was used on dependent groups in the SPSS statistic software package in order to determine significance of the difference between averages of the pre-test and post-test scores in the control group. Data are shown in the Table 6.

Table 6. Result of the Dependent Group T-Test performed for Achievement Pre-test and Post-Tests of the Control Group

Control Group	**N**	$\bar{X}$	**Ss**	**t**	**P**
Pre-test	24	6,20	2,14	-3,095	0.005
Post-test	24	7,95	1,92		

$P<0.05$

According to Table 6, the mean score of the achievement pre-test of the control group and its standard deviation was found as 6.20 and 2.14 respectively and, the mean score of the post-test of the control group and its standard deviation was found as 7.95 and 1.92 respectively. A statistically significance level of 0.05 was found in the dependent group t-test carried out for achievement pre-test and post-test of the control group. This difference occurred in favor of the post-test. As it is understood from this result, implementation of the Jigsaw II technique of the cooperative learning method enhanced the student achievement.

Findings for the Third Sub-Problem: The third sub-problem was “Is there any significant difference between post-test scores of the experiment and control groups?” Mean score of total post-test scores of both the experiment and control groups and standard deviations were calculated. The t-test was used on independent groups in the SPSS statistic software package in order to determine significance of the difference between averages of the post-test scores of the groups. Data are shown in the Table 7.

Tablo 7.Results of the Independent Group T-Test performed for Achievement Post-Tests of the Control and Experiment Group

Groups	**N**	$\bar{X}$	**Ss**	**t**	**P**
Experiment	24	7,12	2,36	-1,340	0.187
Control	24	7,95	1,92		

$p>0.05$

According to Table 7, the mean score of the achievement post-test of the experiment group and its standard deviation was found as 7.12 and 2.36 respectively. The mean score of the post-test of the control group and its standard deviation was found as 7.95 and 1.92 respectively. A statistically significant difference at level of 0.05 was not obtained in the independent group t-test performed for the achievement post-tests of the control and experiment groups. Accordingly, post-test achievement of the experiment group is in the range of the same statistically significant standard deviation as post-test achievement of the control group. The Jigsaw IV technique and Jigsaw II technique of the cooperative learning methods have shown equally success on the science achievement post-test. This represents same impact of the Jigsaw IV and Jigsaw II techniques of the cooperative learning method on the student achievement.

CONCLUSION AND SUGGESTIONS

In this study, it was aimed to show the effects of the Jigsaw IV and Jigsaw II techniques of the cooperative learning method on teaching of the subject “Atoms- the basic units of matter” in the Science Class of primary 6th Grade. The results showed that both these techniques increase the academic success of students. The results of the research, which was made by means of the Jigsaw techniques at different fields and different class levels, show parallelism with the results of this study (Buzludağ, 2010, Doğru, 2012, Oral, 2000, Slavin and Karveit, 1979, Shafiuddin, 2010). The cooperative learning method ensure active participation of the students to learning process. The students interact with class mates, thus efficiency in learning and students' interests in the course increase. Therefore, employment of the cooperative learning techniques in the Science subjects should be expanded at all levels of education in our country. The classrooms in the schools should be organized in compliance with cooperative method and provided with necessary facilities for this method.

The following suggestions were made by taking into account the findings form the research and the results obtained.

1. The research is restricted with the use of the Jigsaw technique (Jigsaw IV and Jigsaw II) of cooperative learning method. Otherwise, researches which compare other cooperative learning techniques or cooperative learning and other modern learning methods may be conducted.

2. This research is restricted with a Science course provided to 48 students from 6th grade for two course hours per week, a similar research may be conducted on larger groups at different class levels within different courses for a longer time.

3. Variables taken under the research are restricted with the achievement level. Besides, affective variables may be researched.

4. If the cooperative learning method and its techniques are introduced to pre/in-service teachers practically by in-service training activities, this may make such method and techniques applicable by teachers in other classes as such in the Science class.

5. The researchers or teachers who desire to use the Jigsaw IV and Jigsaw II technique should make some preparatory works by taking into account the students who are not familiar to such techniques and have no information on the steps of such techniques before such techniques are implemented. Such works may include the introduction of the techniques to students, providing information on differences of this technique from other Jigsaw techniques, implementation steps of the techniques, assessment process, and time proposed for the technique.

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A COMPUTER SOFTWARE FOR THE EDUCATION OF COMPLEX NETWORK ANALYSIS

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ABSTRACT: Complex network analysis is an attractive tool for capturing the self-organizing principles underlying the social, physical or biological communities. Several software are developed for either analyzing or generating complex networks, including the visualization utilities. We developed an open source software in Microsoft .NET platform for generating networks based on the most common models as Barabasi-Albert, Erdos-Renyi, Watts-Strogatz including the analyzing utilities defining the network like average separation, degree distribution, clustering coefficient etc. In contrast with the well-known software, this software aims to contribute the understanding of the underlying mechanisms of complex networks. It also forms a basis to further developments that should provide an extensive view to network construction. As an open source software, the opportunity of editing the core functions about network dynamics offer a pedagogical approach to learn more about self-organizing networks.

Key words: complex networks, software, small world, scale free networks

INTRODUCTION

Complex networks are conceptually used to define the dynamic systems in nature and society. These structures are observed in a variety spanning social, biologic, ecologic, transportation, computer, scientific collaboration or citation networks (Albert and Barabási, 2002). A network can be described by a set of nodes (vertices) and links (edges) which can be displayed by an NxN matrix where N denotes the number of vertices (Newman, 2001).

Understanding the structure of complex networks is primarily significant for understanding how knowledge, disease, culture, viruses etc. spread in the complex systems (Perc, 2010). The evolution of complex systems was traditionally assumed to be driven by randomly wiring processes which result a so-called random network. But recent studies in the past two decades show that these systems yield some self-organizing principles that are different from the random networks (Albert and Barabási, 2002).

In fact, these organizing principles are the main facts that result the network topology and dynamics, which in turn effects how knowledge or viruses diffuse in that network. Thus, capturing these principles is the main goal of complex network analysis to form a basis of how network modeling should be done programmatically. The wide corpus of scientific papers subjecting complex network analysis by the beginning of this century handles this issue, each stating out the generic organizing principles of specific networks in nature and society (Perc, 2010).

On behalf of the above mentioned part of the network science namely “complex network analysis”, another area of interest grows scoping the modeling counterpart. Employing the output supplied by the first part, modeling networks aims to capture the main mechanisms that affect the evolution of the network, providing a broad range of experiments with several organizing principles along with tunable parameters (Barabasi et.al, 2002).

Generic principles of complex networks

For modeling a network, the generic principles of real networks should be determined as the ingredients of the algorithm. The first property that a real network should hold is the “small-world” phenomenon. The most popular manifestation of small worlds is the ‘‘six degrees of separation’’ concept, uncovered by the social psychologist Stanley Milgram (1967), who concluded that there was a path of social connections with a typical length of about six between most pairs of people in the United States (Kochen, 1989).

Small-world property is observed in many real networks like www (Albert et.al, 1999), online social networks (Leskovec & Horvitz, 2008), scientific collaboration networks (Barabasi et.al, 2002; Newman, 2001b; Newman, 2001c; Perc, 2010, Cavusoglu & Turker, 2013, 2014), movie actor networks (Amaral et.al, 2000) etc. Barabasi explains being small-world as finding relatively small paths between two randomly chosen nodes, while this phenomenon is valid for most of the node pairs in that network. A characteristic measurement of node distances is “average separation” that stands for the average value of the distances between all node pairs in a network.

Another principal ingredient of real world networks is the scale-free property. A large variety of results of real network analysis demonstrate that many networks are scale free, that is, their degree distribution follows a power law for large k. That means, the probability of having degree k for a network follows the equation $P(k) = k^{-\gamma}$. This distribution can be validated by drawing the degree distribution in a log-log scale, resulting a straight line having negative slope (Clauset et.al, 2009). The generic mechanism underlying this property is “preferential attachment” that means that a new node connecting the network, connecting to more popular (i.e. having more connections) links displays higher probability than connecting to the less popular ones (Barabasi and Albert, 1999; Albert et.al, 2002).

Scale-free property promotes the emergence of a little portion of nodes with high degrees (connections), that can be named as supernodes or hubs. In such a network, if a node gets more popular in the beginning of the network construction, these “first-mover advantage” causes it to have more and more connections later. This fact is known as the Matthew “rich get richer” effect, promoting the occurrence of a small number of popular nodes, while the new connecting nodes or some mid-life nodes of the network have smaller degrees of connections. The above given relation of power-law degree distribution is a result of this mechanism, that can be observed in most of the real networks.

The third important network parameter that measures network clustering and describes symmetry of interaction among trios of actors is the clustering coefficient. It shows the probability of a node’s neighbors to have connections among each other, excluding the links coming from the starting (or center) node. Topologically, it shows the density of the triangles in a network, a triangle being formed when two of one’s neighbors connect with each other (Newman, 2004; Çavuşoğlu & Türker, 2013).

Clustering coefficient gets values in the interval of 0 to 1, where the values close to 1 indicate dense connections between neighbors. Averaging this parameter is averaged over the network, average clustering coefficient can be found to have an idea about the network’s interconnectedness. Real networks display high clustering coefficients compared to random networks, i.e. your followers in a social network follow each other in a high rate, representing a clique of friendships.

Most common network models

Erdos-Renyi (ER) Model

In their classic first article on random graphs, Erdos and Renyi define a random graph with two parameters as N (number of nodes) and p (probability of connecting), as N labeled nodes connected by n edges, which are randomly chosen from the $N(N-1)/2$ possible edges. Programmatically, it can be explained as starting with N nodes, find the number of links by the formula $pN(N-1)/2$ and wire the N nodes with n links calculated by the above formula, as seen in Fig.1 (Erdos & Renyi, 1959; Albert and Barabasi, 2002).

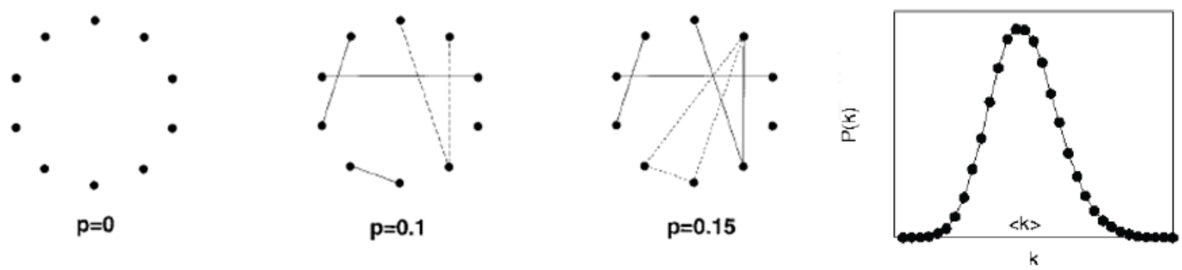

Figure 1. Random graphs generated with different *p* values. The right side plot is the degree distribution (Albert and Barabasi, 2002)

The expected degree distribution of a random graph is “binomial distribution” which converges to a “Poisson distribution” with large N and small p, demonstrating node degrees having closer values to an average degree and not deviating more than a few percents from that average value. Since the links are generated randomly, the relations between a node’s neighbors are not strong as real networks, resulting a very small average clustering coefficient for the network. on the other hand, long range random links provide short paths between distant nodes, resulting a relatively small average separation (distances) between nodes.

The network parameters mentioned above are not in good consistency with real networks since real networks do not display poisson-like degree distributions and have considerably higher clustering coefficients that random networks have. The only common-point between random networks and real networks is the short average path length between nodes.

Watts-Strogatz (WS) Model

Above mentioned disparity in the topologic properties of random and real networks pioneered the studies of more realistic modeling of real networks. In 1998, Watts and Strogatz proposed a model interpolating between a regular lattice and a random graph (Watts and Strogatz, 1998; Albert and Barabasi, 2002). Their model starts with constructing a regular lattice. Then the only tunable parameter p is used as a probability to decide if an edge (link) will be rewired, preserving the source node and altering the target node with a new one in a random process. If the p parameter converges to 0, the network stays regular, while it gets a completely random one as p converges to 1. For some moderate values of p (for ex. p=0.01), Watts and Strogatz showed that there is a regime that the network displays high clustering coefficient and low average distance (separation) as if in the real networks. This is the small-world regime of the network, capturing the similarity with the real network by the means of clustering coefficient and average separation (Fig.2).

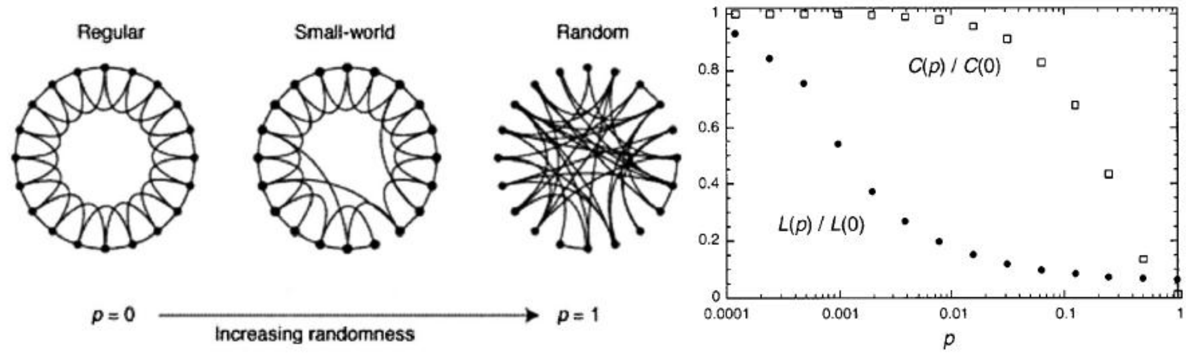

Figure 2. Watts-Strogatz (1998) network structure with varying *p* values. The right side plot demonstrates the deviation of clustering coefficient and average separation with increasing p values.

The limitation of the WS network is the lack of capturing the degree distribution of a real network. It produces a network having a similar degree distribution like Erdos-Renyi type network, having the advantage of adding small-world property to the structure.

Barabasi-Albert (BA) Model

The model proposed by Barabasi and Albert (1999) was the first in capturing the power-law degree distribution observed in most of the real networks. They suggested that the organizing principles of real networks should be imitated to maintain the generic scale-free property. Thus, a network grows continuously by the addition of new nodes, and the new nodes likely prefer to connect to the nodes of higher degrees (i.e. popular nodes) rather than the ones with lower degrees. The former property is known as growing, while the latter property is known as preferential attachment.

They modeled growing property by starting with a small number (m_0) of nodes and add a new node with $m(\leq m_0)$ edges (links) that connect the new node to m different nodes already present in the system, at each time step.

To define the connectivity function including preferential attachment, Barabasi and Albert used Eq.1 as the probability for a new node to connect to node i. As seen in Eq.1, the node having higher degree (connections) has a higher attractiveness to have connection with a new node.

$$\Pi(k_i) = \frac{k_i}{\sum_j k_j} \tag{1}$$

Successfully capturing the organizing principles of real networks, BA model provides a perfect power-law degree distribution together with small-world properties as if in the WS network as in Fig.3 (Albert and

Barabasi, 1999). In this perspective, it forms a basis for realistic modeling of networks with the opportunities of adding some variations for capturing the alternations from perfect power-law observed in real networks.

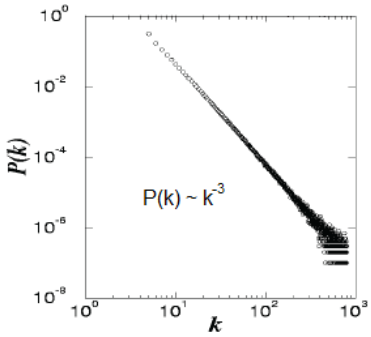

Figure 3. Power-law degree distribution of a Barabasi Albert network model (Barabasi and Albert, 1999).

METHODS

We developed a software that generates networks of ER, WS and BA models (Fig.4). The inspiration of the development depend on both supplying a pedagogical view on the understanding of complex networks in the post-graduate education, and also to form a basis for the further studies in network modeling giving the opportunity of editing the core functions about network dynamics.

Network parameters are the output of the organizing principles that take part in network construction. The tendencies of node selection of the current nodes for making new connections are the main fact that drives the resulting parameters or distributions of that network. By this view, tuning the input parameters or the opportunity of editing the core functions of node selection takes a significant part in the understanding of how networks grow and organize.

Another pedagogical output of this software is the visualization of the network constructed, whereas the main output parameters like degree distribution, average separation, clustering coefficient etc. are also supplied.

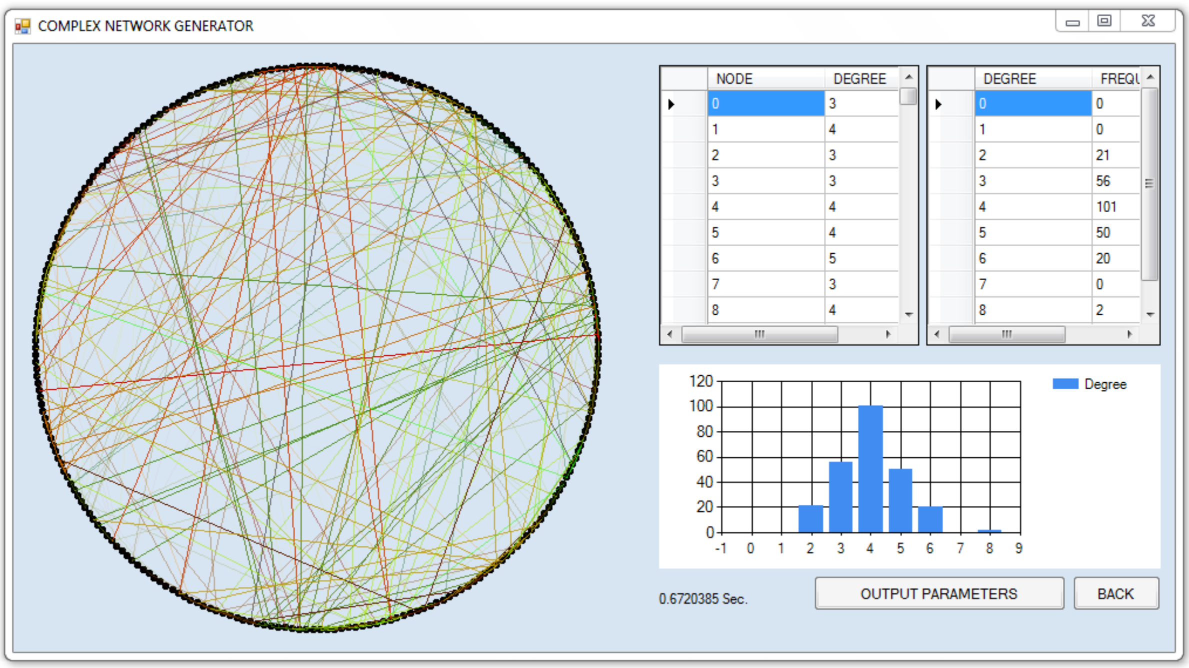

Figure 4. The user interface of the software.

The software is developed in the Microsoft .NET platform using C# language and standard form controls. While executing the network generation or calculating the output parameters, the most readable code and algorithms were used in order to enhance the understanding of complex networks. That is, fast execution is sacrificed in some functions in order to increase readability.

To enable further plotting opportunities in Matlab, R, etc., the node degrees are displayed in a datagrid control together with the node frequencies that are used to plot degree distribution. This is a necessity not only for generating graphics in semi-log or log-log plots, but also curve fitting to test if a degree distribution follows exponential, power-law, binomial, Poisson or some mixed variations of these functions.

The software is ready-to-use for the systems having .NET Framework 4.0 or later, and can be downloaded via *http://www.ilkerturker.com/cn/nwmodel/*.

RESULTS AND FINDINGS

The three network models mentioned above have different topologies that can be observed in the output parameters. Degree distribution plots as seen in Fig.5 are as consistent with the theoretic expectations. Since the power-law consistency of BA network in linear plot is not obvious, we exported the degree distribution data to Matlab and showed the power-law fitting in log-log scale with the exponent -3.

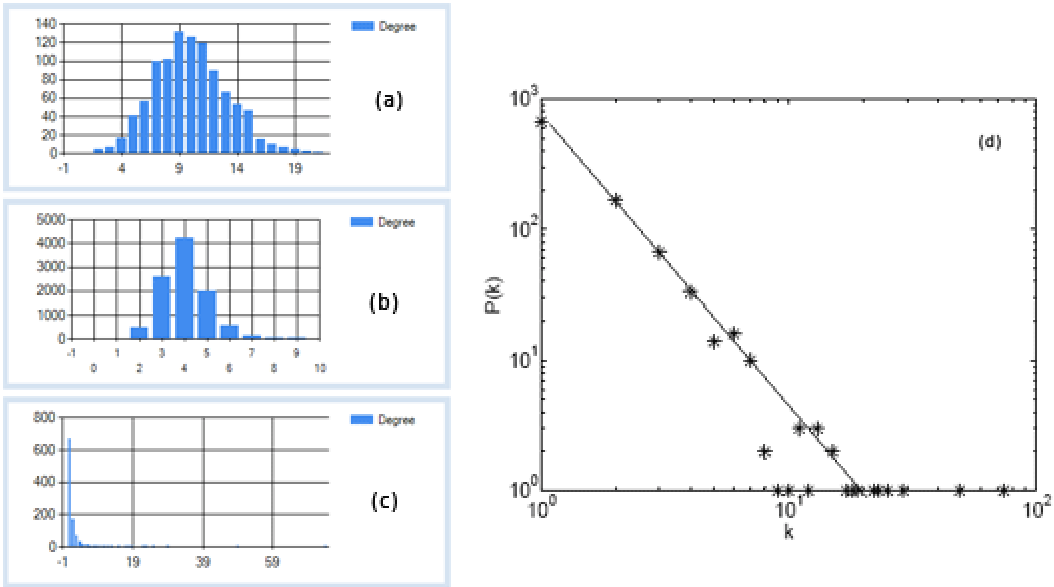

Figure 5. Degree Distribution Plots Of The Three Network Models. (A) ER Model, (B) WS Model, (C) BA Model, (D) BA Model Data Plotted In Log-Log Scale In Matlab To Show Power-Law Consistency.

Similar with the degree distributions, the output parameters (average clustering coefficient, average separation and average degrees) are consistent with the theoretic expectations as well.

CONCLUSION

Both analysis and modeling of complex networks aim to uncover the underlying mechanisms in the self organization processes of complex systems. Getting the analytical feed from the analysis section, the modeling section consists of simulations in generating networks with variable principles and parameters. By this point of view, our software employing basic and robust network models can be an initial point for the researchers who want to make further modeling simulations. The basic output measurements supplied in the software will also provide a rapid start to modeling projects, especially in post graduate studies.

RECOMMENDATIONS

The development process of the software will move along by adding new enhancements in the future, and will be shared in the same URI supplied above. Researchers who want to construct networks of different algorithms can feel free to modify and share the source code.

Especially a challenging area in network modeling is “spreading”. In real world, the network structure plays a significant role on spreading of information, epidemics, opinions and has various impacts on the evolution of science, sociology, health etc. Introducing a realistic spreading model to our software should provide a broad range of experiments on spreading. Also the impact of breaking some kinds of links on spreading is another novel subject to investigate. These opportunities are the forward stage of this software open for all researchers.

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TASKS AND META-TASKS TO PROMOTE PRODUCTIVE MATHEMATICAL DISCOURSE IN COLLABORATIVE DIGITAL ENVIRONMENTS*

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ABSTRACT: Rich tasks can be vehicles for productive mathematical discussions. How to support such discourse in collaborative digital environments is the focus of our theorization and empirical examination of task design that emerges from a larger research project. We present the theoretical foundations of our task design principles that developed through an iterative research design for a project that involves secondary teachers in online courses to learn discursively dynamic geometry by collaborating on construction and problem-solving tasks in a cyberlearning environment. In this study, we discuss a task and the collaborative work of a team of teachers to illustrate relationships between the task design, productive mathematical discourse, and the development of new mathematics knowledge for the teachers. Implications of this work suggest further investigations into interactions between characteristics of task design and learners mathematical activity.

Key words: collaboration, dynamic geometry, mathematical discourse, task design, technology

INTRODUCTION

Mathematical tasks shape significantly what learners learn and structure their classroom discourse (Hiebert & Wearne, 1993). Such discussions when productive involve essential mathematical actions and ideas such as representations, procedures, relations, patterns, invariants, conjectures, counterexamples, and justifications and proofs about objects and relations among them. Nowadays, these mathematical objects and relations can be conveniently and powerfully represented in digital environments such as computers, tablets, and smartphones. Most of these environments contain functionality for collaboration. However, in such collaborative, digital environments, the design of tasks that promote productive mathematical discussions still requires continued theorization and empirical examination (Margolinas, 2013). To theorize and investigate features of tasks that promote mathematical discussions, we are guided by this question: What features of tasks support productive discourse in collaborative, digital environments? Knowing these features will inform the design of rich tasks that promote mathematical discussions so that engaged and attentive learners build mathematical ideas and convincing forms of argumentation and justification in digital and virtual environments.

In virtual collaborative environments, the resources available to teachers to orchestrate collaboration and discourse among learners are different from those in traditional presential classroom environments. The salient difference is that in presential classroom environments the teacher is physically present, whereas in a virtual learning environment the teacher is artificially present; that is, the teacher exists largely as an artifact of digital tools. Consequently, the design of the tasks that are to be objects of learners' activities in virtual environments need to be constructed in ways that support particular learning goals such as productive mathematical discourse.

We share Sierpinska's (2004) consideration that "the design, analysis, and empirical testing of mathematical tasks, whether for purposes of research or teaching, is one of the most important responsibilities of mathematics education" (p. 10). In this paper, we focus on the design of tasks that embody particular intentionalities of an educational designer who aims to promote and support productive discourse in collaborative, digital environments. Our work employs a specific virtual environment that supports synchronous collaborative discourse and provides tools for mathematics discussions and for creating graphical and semiotic objects for doing mathematics. The environment, Virtual Math Teams (VMT), has been the focus of years of development by a team led by Gerry Stahl, Drexel University, and Stephen Weimar, The Math Forum @ Drexel University, and the target of much research (see, for example, Stahl, 2008; Stahl, 2009). Recently, research has been

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conducted on an updated VMT with a multiuser version of a dynamic geometry environment, GeoGebra, (Grisi-Dicker, Powell, Silverman, & Fetter, 2012; Powell, Grisi-Dicker, & Alqahtani, 2013; Stahl, 2013, 2015). Our tasks are designed for this new environment—VMTwG. Though the environment and its functionalities are not the specific focus of this paper, we will later describe some of its important features to provide context for understanding our design of tasks. Our focus here is to describe how we address challenges involved in designing tasks to orchestrate productive mathematical discourse in an online synchronous and collaborative environment. We first describe the theoretical foundation that guides our design of tasks to promote potentially productive mathematical discourse among small groups of learners working in VMTwG. Afterward, we describe our task-design methodology and follow with an example of a task along with the mathematical insights a small team of teachers developed discursively as they engaged with the task. We conclude with implications and suggestions areas for further research.

THEORETICAL PERSPECTIVE

The theoretical foundation of our perspective on task design for collaborative digital environments to promote productive mathematical discourse rests on a dialogic notion of mathematics (Gattegno, 1987), a view of mathematics curriculum (Hewitt, 1999), what we call epistemic tools (Ray, 2013), the co-active infrastructure of dynamic mathematics environments (Hegedus & Moreno-Armella, 2010), and a sociocultural theory both of task and activity (Christiansen & Walther, 1986) and of instrument-mediated activity (Rabardel & Beguin, 2005).

Our notion of productive mathematical discourse rests on a particular view of what constitutes mathematics. From a psychological perspective, Gattegno (1987) posits that doing mathematics is based on dialog and perception:

> No one doubts that mathematics stands by itself, is the clearest of the dialogues of the mind with itself. Mathematics is created by mathematicians conversing first with themselves and with one another. Still, because these dialogues could blend with other dialogues which refer to perceptions of reality taken to exist outside Man…Based on the awareness that relations can be perceived as easily as objects, the dynamics linking different kinds of relationships were extracted by the minds of mathematicians and considered *per se*. (pp. 13-14)

Mathematics results when a mathematician or any interlocutor talks to herself and to others about specific perceived objects, relations among objects, and dynamics involved with those relations (or relations of relations). For dialogue about these relations and dynamics to become something that can be reflected upon, it is important that they not be ephemeral but rather have residence in a material (physical or semiotic) record or inscription. On the one hand, through moment-to-moment discursive interactions, interlocutors can create inscriptions and, during communicative actions, achieve shared meanings of them. On the other hand, inscriptions can represent encoded meanings that—based on previous discursive interactions—interlocutors can grasp as they decode the inscriptions. Thus, inscriptive meanings and the specific perceived content of experience are dialectically related and mutually constitutive through discourse.

Voiced and inscribed mathematical meanings arise through discursive interactions, discussions. Pirie and Schwarzenberger (1988) define a mathematical discussion involving learners this way: “It is purposeful talk on a mathematical subject in which there are genuine pupil contributions and interaction” (p. 461). From a sociocultural perspective, we understand “purposeful talk” as goal-directed discourse and “on a mathematical subject” as about mathematical objects, relations and dynamics of relations. In the setting of VMT with interlocutors—teams of pupils, students, or teachers—collaborating and usually without the contemporaneous presence of a teacher, the discursive contributions and interactions genuinely emanate from the interlocutors. As such, we define productive mathematical discourse to be goal-directed discursive exchanges about mathematical objects, relations, and dynamics of relations, including questioning, affirming, reasoning, justifying, and generalizing.

Through discourse, interlocutors among themselves construct or from others become aware of mathematical content. As Hewitt (1999) posits, mathematical content intended for learners to engage can be parsed into two essential categories. The first category pertains to content that is arbitrary in the sense that it refers to semiotic conventions such as names, labels, and notations. These conventions are historical and cultural, examples of which are the Cartesian axes, coordinates, names of coordinates, and notational rules. These conventions could have been otherwise and hence are arbitrary. Moreover, they cannot be constructed or appropriated through attentive noticing or awareness but rather must be known through memorization and association.

The second essential category concerns mathematical content that is necessary. These are ideas or properties that can be derived by attending to and noticing relations among objects as well as dynamics linking relations. For instance, when two planar, congruent circles have exactly two points of intersection, then an isosceles triangle can always be formed by choosing its vertices to be the circles' centers and one intersection point. This conclusion, once known can be considered a cultural tool, is derivable, could not be otherwise, and therefore necessary. Relations among objects, dynamics of relations, and properties that can be worked out are necessary mathematical content. These particular mathematical ideas are historical and cultural tools and can be appropriated through awareness.

Whether particular necessary mathematical content is appropriated depends on awarenesses already possessed and attentive noticing. Awareness and noticing are elements that need to be accounted for in the design of tasks. As Hewitt (1999) notes

> If a student does have the required awareness for something, then I suggest the teacher's role is not to inform the student but to introduce tasks which help students to use their awareness in coming to know what is necessary. (p. 4)

Within this pedagogic paradigm, if students do not have requisite awareness, then they are invited to engage tasks that enable them to construct the required awareness. Constructing the awareness involves thinking mathematically. The teacher informs them of those cultural tools that are arbitrary and, by definition, do not entail mathematical reasoning and invite them to use their existing awareness to notice and reason about necessary relations and relations of relations so as to appropriate new mathematical ideas through their discursive interaction.

To increase the probability that the discourse of interlocutors is mathematically productive, it is useful that they employ individual and collaborative discursive means to make sense of mathematical situations. For this purpose, we invite interlocutors to employ particular epistemic tools. That is, to ask questions of themselves and of their interlocutors that query what they perceive, how it connects to what they already know, and what they want to know more about it. Specifically, these tools include three questions that interlocutors explicitly or implicitly engage: (1) What do you notice? (2) What does it mean to you? (3) What do you wonder about? The first and third questions come directly from work of The Math Form @ Drexel University (see, Ray, 2013). The second question is one that we have added. The purpose of these questions is to foster generative discussions within small groups of interlocutors that are grounded in their attention on perceivable, not necessarily visible, contents of experience that can be described as objects, relations among objects, and dynamics linking different relations. Using the epistemic tools, interlocutors' responses become public, relevant, and accountable. The idea is for interlocutors' to practice consciously these epistemic tools and over time become incorporated into their mathematical habits of mind.

The epistemic tools, among other things, are useful for enabling reflection on perceived infrastructural reactions of a dynamic geometry environment to interlocutors' actions in the environment. As they drag (click, hold, and slide) a base point of an object in a constructed figure, the environment redraws and updates information on the screen, preserving constructed geometrical relations among the figure's objects. This reaction to learners' dragging establishes a dialectical co-active relationship as the learner and the environment react to each other (Hegedus & Moreno-Armella, 2010). As learners attend to the environment's reaction, they experience and, since it responds in ways that are valid in Euclidean geometry, may become aware of underlying mathematical relations among objects such as dependencies.

Another role of the epistemic tools is to scaffold interlocutors' activity directed to understand and solve a mathematical task. We view tasks and activity from a sociocultural perspective. Within this perspective, Christiansen and Walther (1986) distinguish between task and activity in that "the *task* (the assignment set by the teacher) becomes the object for the student's activity" (p. 260). A task is the challenge or set of instructions that a teacher sets. An activity is the set of actions learners perform directed toward accomplishing the task. The activity is what students do and what they build and act upon such as material, mental, or semiotic objects and relations among the objects. The task initiates activity and is the object of students' activity.

Given the new digital, collaborative environments in which teaching and learning can occur, we find it theoretically useful to extend Christiansen and Walther's (1986) distinction of task and activity beyond analog environments: The purpose of a mathematical task in collaborative digital environments is to initiate and foster productive mathematical, discursive activity. The discursive activity is what learners communicate and do, what they build and act upon such as material, mental, or semiotic objects and relations. The digital, mathematical task is the object of learners' collective and coordinated activity.

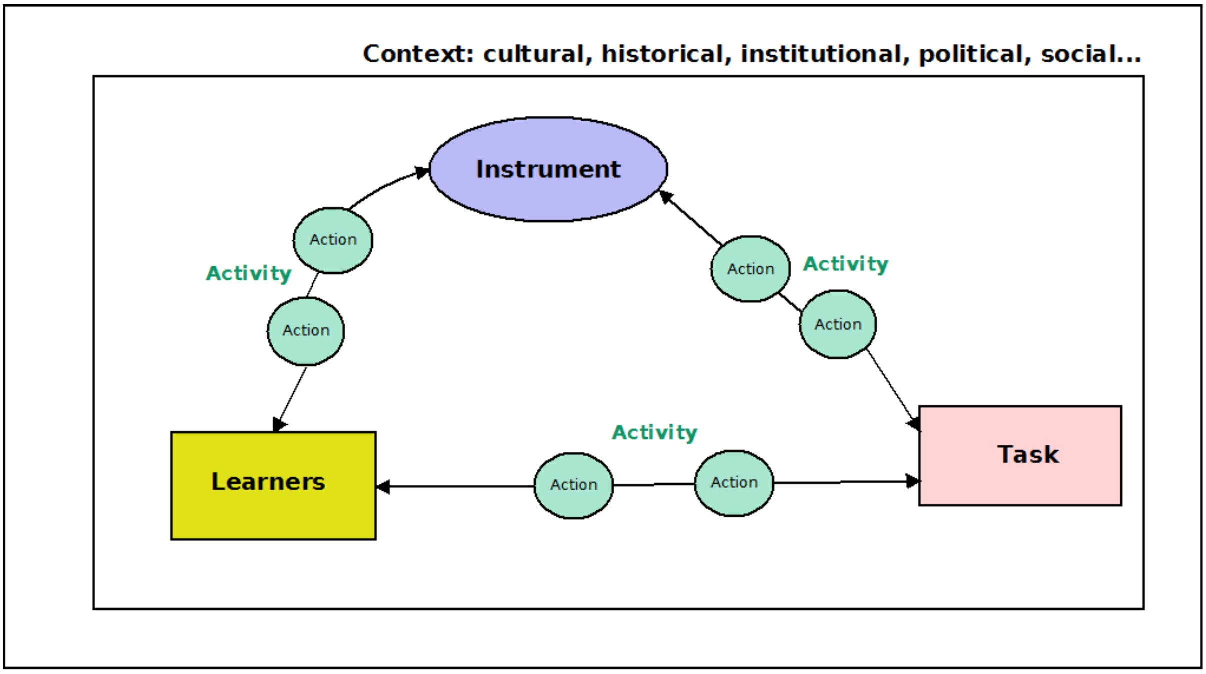

Figure 1. Relational Model Of Learners Engaged In Instrument-Mediated Activity Initiated By A Task.

Learners' activity directed toward a task is mediated by instruments. Before an instrument achieves its instrumental status, it is an artifact or tool. According to Rabardel and Beguin (2005) "the instrument is a composite entity made up of a tool component and a scheme component" (p. 442). The scheme component concerns how learners use the tool. Therefore, an instrument is a two-fold entity, part artifactual and part psychological. The transformation of an artifact into an instrument occurs through a dialectical process. One part accounts for potential changes in the instrument and the other accounts for changes in learners, respectively, instrumentalization and instrumentation. In instrumentalization, learners' interactions with a tool change how it is used, and consequently, learners enrich the artifact's properties. In instrumentation, the structure and functionality of a tool influence how learners use it, shaping, therefore, learners' cognition (Rabardel & Beguin, 2005). The processes of instrumentalization, instrumentation, and activity as well as the interaction of learners with themselves and the task reside within a particular, evolving context that is cultural, historical, institutional, political, social, and so on (see Figure 1).

In what follows, we present our design methodologies for mathematical tasks and a category of specialized tasks and provide examples of each.

TASK-DESIGN METHODOLOGY

Our methodology of task design embodies particular intentionalities for a virtual synchronous, collaborative environment, such as VMTwG, that has representation infrastructures (GeoGebra, a dynamic mathematics environment) and communication infrastructures (social network and chat features). The intentions are for mathematical tasks to be vehicles "to stimulate creativity, to encourage collaboration and to study learners' untutored, emergent ideas" (Powell et al., 2009, p. 167) and to be sequenced so as to influence the co-emergence of learners instrumentation and building of mathematical ideas. To these ends, rooted in our theoretical perspective and sensitive to the infrastructural features of VMTwG, we developed and tested the following seven design principals for digital tasks that are intended to promote productive mathematical discourse by encouraging collaboration in virtual environments around constructing necessary mathematical content (Hewitt, 1999):

1. Provide a pre-constructed figure or instructions for constructing a figure.
2. Invite participants to interact with a figure by looking at and dragging objects (their base points) to notice how the objects behave, relations among objects, and relations among relations.
3. Invite participants to reflect on the mathematical meaning or consequence of what they notice.
4. Invite participants to wonder or raise questions about what they notice or the mathematical meaning or consequence of it.

5. Pose suggestions as hints or new challenges that prompt participants to notice particular objects, attributes, or relationships without explicitly stating what observation they are to make. Each hint has one or more of these three characteristics:
   a. Suggest issues to discuss.
   b. Suggest objects or behaviors to observe.
   c. Suggest GeoGebra tools to use to explore relations, particularly dependencies.
6. Provide formal mathematical language that corresponds to awarenesses that they are likely to have explored and discussed or otherwise realized.
7. Respond with feedback based on participants' work in the spirit of the following:
   a. Pose new situations as challenges that extend what participants have likely noticed, wondered, or constructed or that follow from an earlier task and that involve the same awarenesses or logical extensions of awarenesses they have already acquired.
   b. Invite participants to revisit a challenge or a task on which they already worked to gain awareness of other relationships.
   c. Invite participants to generalize noted relationships and to construct justifications and proofs of conjectures.
   d. Invite participants to consider the attributes of a situation (theorem, figure, actions such as drag) in order to generate a "what if?" question and explore the new question.

The purpose of the hints is to maintain learners' engagement with a task and to encourage them to extend what they know. The hints support participants' discourse by eliciting from them statements that reveal what they observe and what they understand about the mathematical meanings or consequences of their observations. The challenges are available to provide opportunities for participants to further their exploration by investigating new, related situations. Hidden initially, the hints and challenges can be revealed by learners clicking a check box.

These design principals guided how we developed tasks in our research project, a collaboration among investigators at Rutgers University and Drexel University. We employed VMTwG, which contains chat rooms for small teams to collaborate with tools for mathematical explorations, including a multi-user, dynamic version of GeoGebra. Team members construct geometrical objects and can explore them for relationships by dragging base points (see Figure 2). VMTwG records users' chat postings and GeoGebra actions. The project participants are middle and high school teachers in New Jersey who have little to no experience with dynamic geometry environments and no experience collaborating in a virtual environment to discuss and resolve mathematics problems. The teachers took part in a semester-long professional development course. They met for 28 two-hour synchronous sessions in VMTwG and worked collaboratively on 55 tasks, Tasks 1 to 55.

Using our design principles, we developed dynamic-geometry tasks that encourage participants to discuss and collaboratively manipulate and construct dynamic-geometry objects, notice dependencies and other relations among the objects, make conjectures, and build justifications.

TASK EXAMPLE

We present the work of a team of two teachers on a task. The task, Task 10, is one that the research team posed. While the teachers worked on it, they posed a wondering that led us to provide feedback of type 7a, inviting them to explore that wondering. Our analysis reveals how using the epistemic tools the teachers noticed and discussed geometric relations and completed a construction task, wondered about the necessity of a foundational object of the construction, and in the following session resolved their wondering, all through the use of the epistemic tools.

In the fourth week of the professional development course, the team worked on Task 10. Employing procedures of Euclid's second proposition (Euclid, 300 BCE/2002), the task engaged the team in constructing the copy of a line segment, without using the built-in compass tool, only using line segments, rays, and circles. The task also requested that they discuss dependencies and other relations among the objects (see Figure 2).

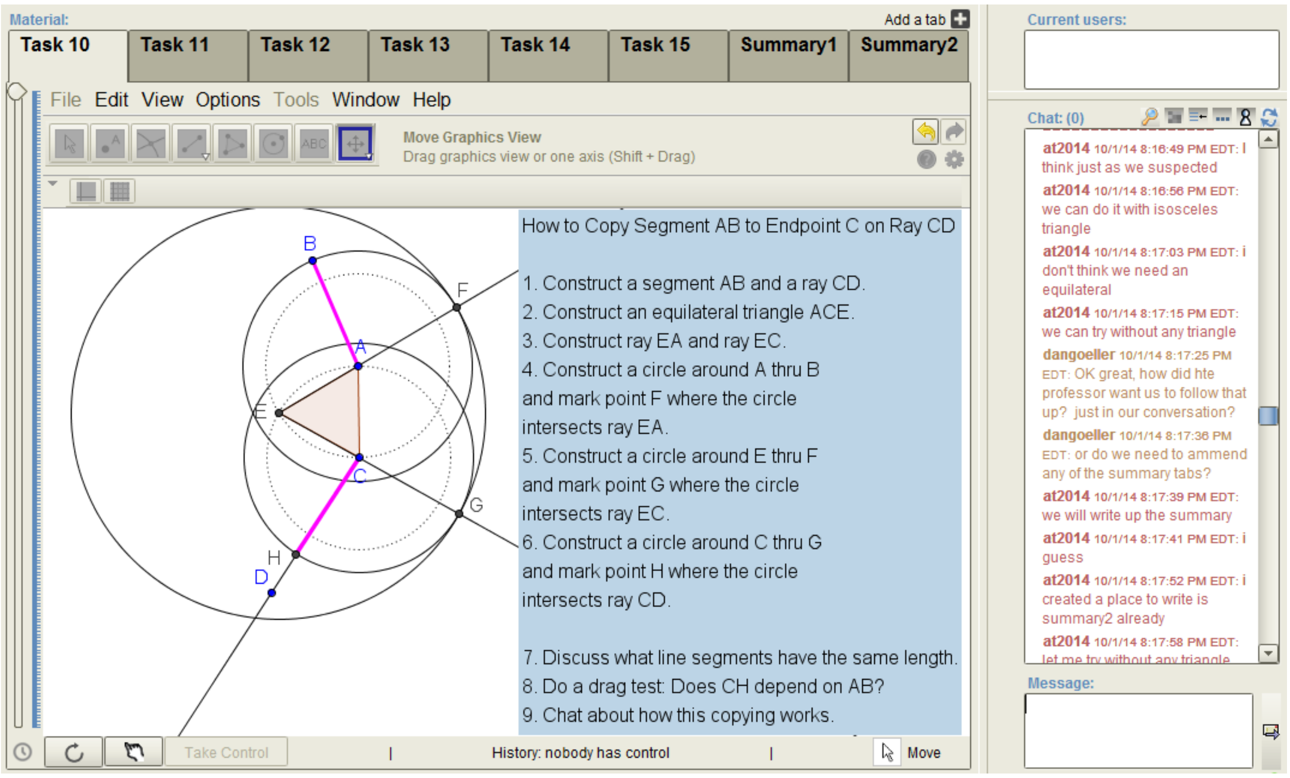

Figure 2: Task 10: Copying A Line Segment.

In the first synchronous session, the teachers successfully followed the construction instructions to copy segment AB onto ray CD. They used the epistemic tools to respond to this task and were attentive to co-active responses of VMTwG to their actions. In their noticings, they chatted about constructed dependencies and other relations among the geometric objects that they constructed. Below, an excerpt of the teachers' discussion illustrates their use of the epistemic tools and how they trigged productive mathematical discourse about a foundational aspect of the construction:

155	at2014:	o what we wonder about
156	at2014:	let's talk about it before we move on
157	at2014:	i am still trying to understand so i am not quite sure whether the equilateral triangle is necessary
158	at2014:	o maybe it does
159	dangoeller:	i agree lets get the others done before sketching this one again
160	at2014:	to get that big circle
161	at2014:	ok
162	dangoeller:	thats a good question
163	at2014:	i am not sure why the equilateral triangle is necessary if it is at all
164	dangoeller:	it appears that it is, but the "why" behind it is unclear to me
165	at2014:	that would be the question for us to put in what we wondered about

In this excerpt, they employed the epistemic tools by wondering about whether an equilateral triangle is necessary in the construction procedure to copy a line segment (see lines 157, 163, and 164). In their session summary, they explicitly stated "We wonder whether the equilateral triangle is necessary or not and if it is necessary, why is it so." In our written feedback, their wondering encouraged us to invite them to explore it in their next synchronous session. In that session, they explored copying a length with an equilateral triangle, an isosceles triangle, and without using any specific type of triangle, which was essentially using a scalene triangle (see Figure 3).

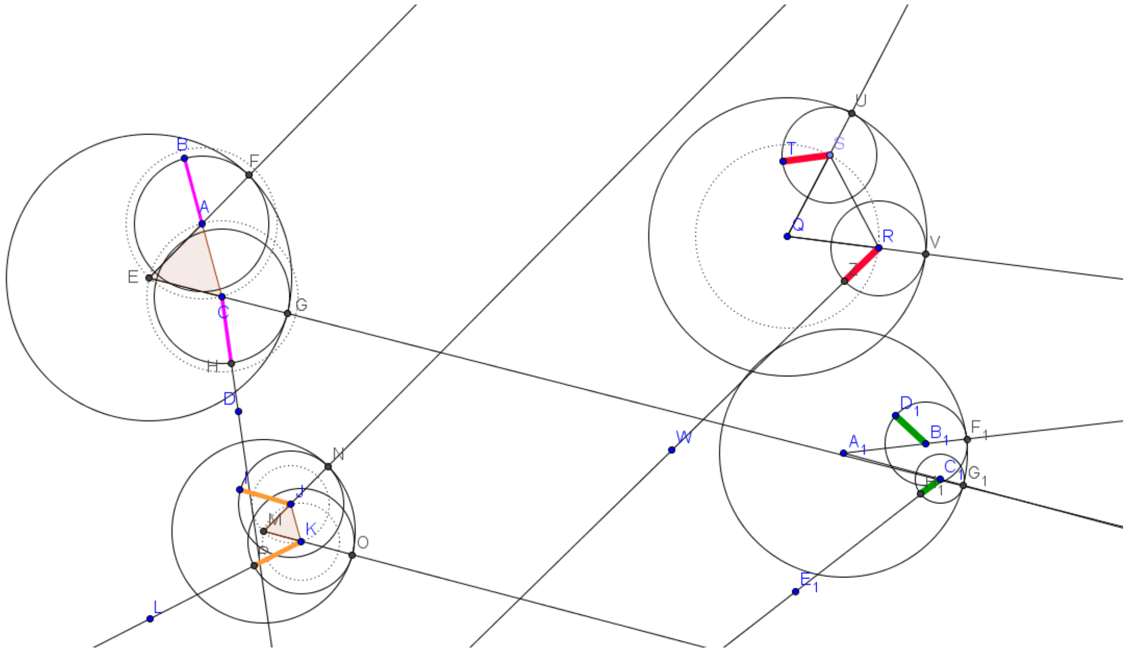

Figure 3: Teachers' Investigation Of Minimal Condition For Copying A Segment Length.

The teachers wrote in their session summary that after conducting drag tests on their constructions, "we found out that if we want the length of one segment to be dependent on another, we need at least the isosceles triangle". Their constructions in Figure 3 include copying a length with an equilateral triangle (lower left corner), using an isosceles triangle (top right corner), and "with no triangle" (lower right corner). They justified their findings by discussing the dependencies each construction has. They make the point that having an equilateral triangle "is only keeping points A and C apart a certain distance, and we can do without it." That is, they demonstrated that to copy the length of the segment AB the distance between A and C is immaterial and that only two congruent sides of a triangle matter.

META-TASK-DESIGN METHODOLOGY

We extend our methodology of task design that promotes productive mathematical discourse to include the design of specialized tasks that encourage reflection on the process and content of mathematical discourse that occurred in prior tasks. We term these specialized tasks, which are reflections on tasks, as meta-tasks. They invite interlocutors of a team to consider and analyze their logged discursive interactions, each time for particular process or content issues such as collaborative norms or mathematical practices. Figure 4 depicts the reflective process in which teams of interlocutors are invited to engage, using the technological structure of VMTwG.

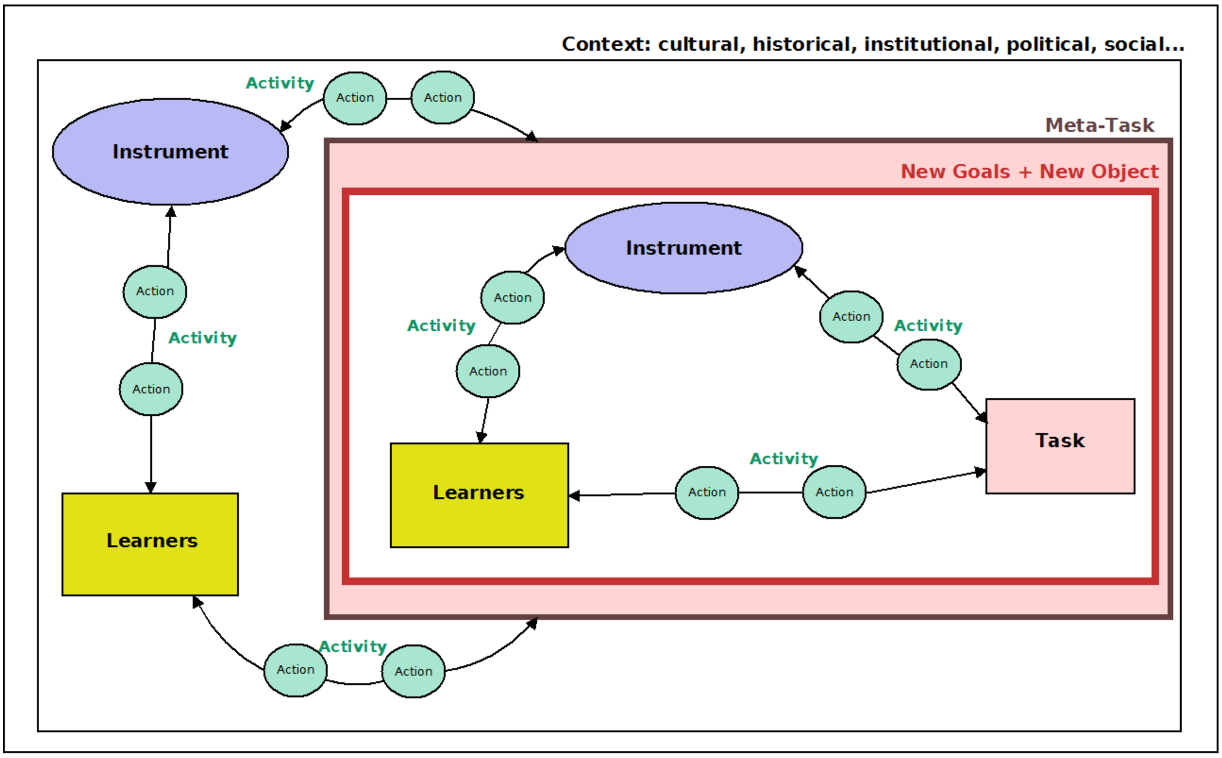

Figure 4. Relational Model Of Learners Engaged In Instrument-Mediated Activity Initiated By A Meta-Task.

In the context of our professional development project, to provide theoretical substance and structure to the meta-tasks, teachers read individually and then in their teams discussed articles about collaboration (Mercer & Sams, 2006; Rowe & Bicknell, 2004), mathematical practices (Common Core State Standards Initiative, 2010), Accountable Talk (Resnick, Michaels, & O'Connor, 2010), technological pedagogical content knowledge or TPACK (Mishra & Koehler, 2006), structures of technology-based mathematics lessons (McGraw & Grant, 2005), and validation of dynamic-geometry constructions (Stylianides & Stylianides, 2005). Teams analyzed previous logs of their VMTwG interactions to examine, reflect, and modify in one meta-task their collaborative norms and in other meta-tasks their mathematical practices and Accountable Talk.

META-TASK EXAMPLE

Part of the goal of professional development project is to promote reflective practices, among teachers' and in turn among their students. During a 14-week semester, given the course readings, the teams of teachers were invited multiple times to reflect on their own VMTwG work. In the second week of the semester, each team was asked to develop their collaborative norms. In the following week, for the first meeting, each team worked for two hours on a mathematical task. In the second meeting that week, each team was asked to select and discuss excerpts from their first meeting that illustrate its collaborative norms. Each team was also invited to modify its norms if team members felt the need to do so. In the fourth week, each team was asked to read about mathematical practices of Common Core State Standards and review its previous work to see where team members employed those practices. Similarly, each team was asked to read about Accountable Talk in the sixth week and review its discourse and discuss whether and how its discursive interactions showed any of the three categories of Accountable Talk.

In this example, we present an excerpt from a team's work and, particularly, their reflection on their collaboration norms. Each team had posted its collaborative norms to an electronic discussion forum in Blackboard, an online course management system that the project uses. Team members then were able to read the norms of other teams. As each team reflected on its discursive interactions, team members became further aware of particular collaborative actions that they felt would be helpful. For instance, after a team discussed and agreed upon their collaborative norms, the team implemented their norms in the following session. For that session, the following is an excerpt of the team members' interactions:

17	sophiak	As we suggested, what should we do first? I am thinking we should make sure we have our norms & then from there we could do this task.
18	sophiak	Just a suggestion & I am open.
19	sabrenam_21	okay great idea i am going to copy and pase the norms suggested that is posted on black board, one second
20	sophiak	Did we post our norms on blackboard? I didn't see them but then again I am not that familar with blackboard & often find myself not sure how to find everything.
21	gouri	I believe the norms were posted by nadine yesterday
22	sophiak	Okay, I didn't see them. I did see her summary of the articles but not the norms. Since we have time Gouri, would you like to take control & comment on what you are doing & understanding about the diagram? This would save a bit of time?
23	sabrenam_21	1. listening while another is talking 2. respect other's opinions 3. respond with respect whether you agree or disagree with group members reasoning 4. Stick to the topic of the talk , some of which are the norms we identified with in team 3.
		.
		.
		.
77	sophiak	Please tell us what you d o Gouri so we can learn from you. This should be a norm too...it is helpful so that we learn from each other. (I think I read this as another groups norm)

The team members started the session by agreeing to state the norms that they established in the previous session (see lines 17-21 and 23). This team's norms include "listening while another is talking", "respect other's opinions", "respond with respect whether you agree or disagree with group members reasoning", and "Stick to the topic of the talk" (line 23). In line 22, sophiak asks Gouri to communicate what she does in the GeoGebra window and what understands about the given figure. Implicit in sophiak's request is the idea that she would find it helpful for Gouri to enact a norm of communicating to other team members what actions (for example, dragging base points) she performs on the figure and what she understands about the figure (such as properties and relations) from the co-active responses of the GeoGebra portion of the VMTwG environment. Later in the session, sophiak requests that the team member in control to of the GeoGebra window communicates to the team the GeoGebra actions she performs (line 77). In the same line, sophiak then suggests that communicating one's GeoGebra actions should be add to the team's norms and gives credit for this norm to another team.

This excerpt illustrates that team members not only reflected on logged interactions but also monitored and negotiated the team's collaboration during the session. It also yields two other results about the meta-task on collaborative norms. First, the course readings and the team's reflection and development of collaborative norms enable team members to make each other accountable to norms of the team. Second, from reading norms of other teams and attending to their work on a new task, a team member suggested new norms that the team considered helpful for the team's geometrical learning. Our meta-task design is aimed to help participants to be more reflective on their own collaboration, mathematical practices, and Accountable Talk. This reflective practice can help individuals be more aware of their own actions and the actions of other interlocutors as well.

DISCUSSION

In this paper, our aim was to describe how we address task-design challenges to promote productive mathematical discourse among interlocutors working in an online synchronous environment. For the purpose of promoting productive mathematical discourse in collaborative digital environments, we detailed our design principles for constructing tasks as well as meta-tasks. In our virtual environment—VMTwG, a classroom teacher or facilitator is present largely as an artifact of the environment's digital tools and most specifically in the structure and content of tasks and meta-tasks. An important feature of our task design is the questions of our epistemic tools since when collaborating interlocutors respond to them they generate propositional statements that can become the focus of their discussions. Their discussions are mathematically productive as their noticings, statements of meaning, and wonderings involve interpretations, procedures, patterns, invariants, conjectures, counterexamples, and justifications about objects, relations among objects, and dynamics linking relations.

Concerning meta-tasks, interlocutors consider and analyze their logged discursive interactions, each time focusing on a particular process or content issue such as collaborative norms or mathematical practices. With tasks, our guiding design principles aim to engage learners in productive mathematical activity through inviting them to explore figures, notice properties, reflect on relations, and wonder about related mathematical ideas. The design provides support through hints and feedback to help learners with certain parts of the tasks. The tasks also include challenges that ask the participants to investigate certain ideas and extend their knowledge. The first example provided above shows that the teachers moved from conjecture to justification through the use of our epistemic tools. They constructed ideas that were new to them. Further investigation is needed to understand how the task-design elements, the affordances of collaborative digital environments, and learners' mathematical discourse interact to shape the development of learners' mathematical activity and understanding.

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THE ROLE OF TEACHER AND CURRICULUM IN INTERVENTIONS IN DAILY LESSONS

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ABSTRACT: The demand of interventions in daily lessons is high in the classroom, and curriculum programs make an effort to include resources for such interventions. Yet, there is no clear theoretical and practical guidance on daily interventions for both teacher and curriculum. This study examines interventions that are offered in written lessons from a range of elementary mathematics curriculum programs and those that teachers actually incorporate into instruction, aiming at understanding the nature of interventions embedded in daily lessons and the role of teacher and curriculum in classroom interventions. The results of the study highlight the importance of intervention resources in the curriculum and teacher role in recognizing the affordances of resources to provide appropriate interventions toward the mathematical point of the lesson.

Key words: intervention, curriculum, teacher knowledge, elementary

INTRODUCTION

This study focuses on interventions *within* daily lessons that are designed to support students when they have difficulty understanding the instructional material or completing the assigned task. Teacher reactions to student difficulties can be based on planned or on-site decisions. In either case, these interventions provide short, prompt support situated within regular ongoing lessons along with the curriculum being used, as opposed to a long-term program segregated from daily lessons. The demand of interventions in daily lessons is high in the classroom, and curriculum programs make an effort to include resources for such interventions. Yet, there is no clear theoretical and practical guidance on daily interventions for both teacher and curriculum. This study examines interventions that are offered in a range of curriculum programs in the US and those that teachers incorporate into instruction, in order to understand the nature of interventions embedded in daily lessons and the role of teacher and curriculum in these classroom interventions. Specific research questions are:

1. What kinds of interventions are provided in the written lessons from a range of elementary mathematics curriculum programs?
2. Which interventions do teachers use among those available in the written lessons and in what ways?
3. What do teachers do when no interventions regarding observed student difficulty are available in the written lessons?

THEORETICAL PERSPECTIVES

Often, interventions are interpreted as special courses of instruction, usually with long duration, to promote important learning goals that typical classroom practice has had difficulty in supporting (Stylianides & Stylianides, 2013). These interventions are usually designed and tested through teaching experiments (e.g., Blanton, Stephens, Knuth, Gardiner, Isler, & Kim, 2015; Thomas & Harkness, 2013), and such interventions utilize existing research and innovative approaches to redesign instruction for a particular topic and/or a specific pedagogical aim. In contrast, while steering daily instruction, teachers provide interventions moment by moment in order to accomplish lesson goals when they observe students struggling in understanding and using a particular concept to complete an assigned task or to solve a problem. Alibali, Nathan, Church, Wolfgram, Kim, and Knuth (2013) call this latter type of intervention a *micro-intervention* in that it occurs “as a lesson unfolds” at the micro level. Timely interventions are critical in enacting lessons productively, and our field needs to understand the nature of these interventions embedded in daily lessons.

There has been little research examining the nature of micro-interventions. Although they examined micro-interventions, Alibali et al.’s (2013) focus was mainly on non-verbal teacher actions in trouble spots, such as gestures. Other studies investigated some general approaches to interventions, such as student interactions and levels of mathematical content (e.g., Dekker & Elshout-Mohr, 2004). Nevertheless, previous research on interventions has not examined how teachers use curricular resources to intervene when students have difficulty with the main mathematical idea of the lesson.

Even though it is difficult to plan daily interventions since any issue can come up during instruction, there are foreseeable student struggles on the main mathematical idea of the lesson. Many curriculum programs provide anticipated difficulties students may have around the mathematical point of the lesson and suggestions for teacher actions in such occurrences. In implementing written lessons, teachers evaluate curricular resources as well as student thinking to determine appropriate teaching actions. Therefore, micro-interventions impose challenges, on both teacher and curriculum, of predicting student struggles and addressing issues productively toward learning goals. Emerging questions are: How do curriculum programs support teachers to prepare for dealing with students' difficulties in daily lessons? How do teachers use such resources in the curriculum to cope with the moments in which students need extra support? This study investigates the nature of micro-interventions around the mathematical point of the lesson and the relationship between the interventions provided in written lessons and those in enacted lessons.

METHODS

Data Sources

This study draws on data from a larger study on teachers' use of curriculum materials to design instruction in grades 3-5 in the US. For curriculum analysis, 15 lessons (five per grade) were randomly selected from each of five elementary mathematics curriculum programs, ranging from reform-oriented to commercially developed: (1) *Investigations in Number, Data, and Space* (INV), (2) *Everyday Mathematics* (EM), (3) *Math Trailblazers* (MTB), (4) *Math in Focus: Singapore Math* (MiF), and (5) Scott Foresman–Addison Wesley *Mathematics* (SFAW). Twenty-five teachers (five per program) were observed in two rounds of three consecutive lessons and interviewed after each round of observations. All the observed lessons were videotaped and transcribed; the interviews were also transcribed.

This study uses all the written lessons selected to see the patterns in interventions from each program. This study also uses enacted lessons and interviews from all five teachers implementing INV and one teacher per program for the other four programs who was representative of the teachers using the same program. Data from all INV teachers are used because INV is unique in providing interventions in terms of their frequency, extensiveness, and emphasis. For example, each INV lesson includes a section of "INTERVENTION" after the main student activity/task, providing anticipated student difficulty and suggested teaching actions. The other four programs include a section of intervention in varying degrees. Besides those in the designated area, all five programs occasionally include intervention suggestions along with anticipated student struggle in the lesson guidance. All the observed lessons and interviews of the nine selected teachers were used for analysis. The written lessons used by the nine teachers were also collected for analysis of interventions in the curriculum and for comparison of written and enacted lessons.

Data Analysis

First, I analyzed the nature of interventions in the written lessons per program: their frequency, format and location, emphasis (procedural or conceptual), relationship to the mathematical point of the lesson, and extensiveness of guidance. Then, I specifically focused on the written lessons that the nine teachers enacted in order to examine written interventions and anticipate what difficulties students might have and what teachers might do in the enacted lessons.

When analyzing the enacted lessons, first I identified trouble spots in each lesson where interventions are needed, by using the criteria Alibali et al. (2013) articulated: student-initiated questions, incorrect responses and statements, and lack of certainty. Then, I analyzed how teachers reacted in these core trouble spots in each lesson and compared and contrasted each teacher's interventions during instruction with those provided in the written lessons in order to find a pattern within each teacher. When there was no specific intervention provided in the written lesson, I examined how the teachers utilized resources provided in the instructional guidance (e.g., directions, representations, and mathematical explanations) of the written lessons while helping students with difficulty. In order to understand teacher intentions behind their specific intervention, I analyzed teacher interview responses to questions on specific teacher actions during the observed lessons. Finally, I compared and contrasted the patterns in the nine teachers' interventions along with the written lessons they enacted.

RESULTS

Overall, interventions in the written lessons were limited in terms of the specificity and comprehensiveness, and many of the micro-interventions in the enacted lessons were not productive, especially when important resources provided in the written lessons were not used. The results of the study are briefly presented in three parts: (1)

overall interventions in the written lessons in the five curriculum programs, (2) teacher interventions in relation to those provided in the written lessons, and (3) teacher interventions when there were no specific interventions provided in the written lessons.

Interventions in the Written Lessons

Interventions provided in the written lessons of the five programs vary greatly. Whereas EM seldom provides interventions, MiF and MTB occasionally do in designated sections called, respectively, "Common Errors" and "For Struggling Learners," and "Meeting Individual Needs." INV and SFAW include interventions along with "on-going assessment" on a regular basis. MiF and SFAW tend to have interventions on procedural errors. For example, MiF includes the following guidance in one of the written lessons examined: "Students may not always write their answers in simplest form. Remind students to check that the numerator and denominator in their answer have a common factor other than 1." INV provides the most extensive guidance for intervention, including specific actions often along with questions to ask and materials to use (see Figure 1). INV interventions address student difficulty with the mathematical point of the lesson, providing conceptual support for those who need assistance in the content of the lesson.

Although INV lessons usually provide useful interventions, sometimes it is not clear when to do such interventions, or the curriculum explains only what students may benefit from without indicating a specific struggle or any other specific instructional suggestion. For example, in a lesson on using two arrays to make a rectangle, the only intervention provided is: "Some students may benefit from working with you in a small group while others work in pairs. Students in the group take turns choosing a large array for the rest of the group to match with two small arrays." Also, some interventions in INV have limitations in addressing student struggles sufficiently because they simply suggest teachers use smaller numbers in the problems.

Interventions in the Enacted Lessons

All the enacted lessons exhibited student difficulty in relation to the mathematical point of the lesson at various moments. Students expressed their difficulty or confusion in varying degrees. In some classrooms, students' difficulty was related only to procedures because that was the focus of the lesson; in others, students expressed their confusion based on the lack of conceptual understanding. Surprisingly, the teachers who were analyzed rarely used interventions provided in the written lessons. They created their own interventions regarding the mathematical points of the lesson. In some cases, teacher actions apart from curricular guidance caused student difficulty. Although INV provides the most extensive and conceptually based interventions among the five programs analyzed, the teachers implementing INV did not utilize most of the interventions that could have been very effective in the trouble spots that they faced. The same trouble spots recurred since they were not handled properly. For example, one teacher emphasized key words in solving and creating multiplication and division story problems, and her students had tremendous difficulty creating their own word problems. The intervention suggestions provided in the written lessons are:

> Help students talk through the elements of a multiplication situation (two known factors and an unknown product and a division situation (product and one known factor). Write multiplication and division equations with small numbers and ask students to model the action of each with cubes. (TERC, 2008, p. 127)

This intervention guidance is further detailed with the specific script shown below, to use during intervention.

> Look at this equation, $3\times4=\_\_$ (or $12\div4=\_\_$). Can you show me with cubes what this problem would look like? Can you think of a situation to write about in which you might have 3 groups of 4 things (or 12 things divided into groups of 4 or 4 groups)? (TERC, 2008, p. 128)

As seen above, the written lesson predicted that students would have difficulty distinguishing multiplication and division situations and creating story problems on their own, and provided detailed guidance to support such students. The intervention highlights the meaning of multiplication and division with a pair of related equations (i.e., $3\times4=\_\_$ and $12\div4=\_\_$). The written lessons also include the following guidance, using the meaning of equal groups:

> Listen for student understanding of the difference between multiplication and division. For example, do the problems students make for the expression $18\div3$ begin with the quantity 18 and divide it into 3 equal groups or groups of 3? Do the problems for 6×3 involve 6 groups of 3 or 3 groups 6? (TERC, 2008, p. 126)

The written lessons consistently emphasized the equal groups meaning of the two operations in order to highlight their similarities and differences and guided teachers to do so. Not using any of the extensive specific interventions, however, the teacher repeatedly reminded students of key words they generated. In her interventions the teacher constantly stated, for example, "If it says 'in each,' it's gonna be a division problem." She also asked questions, such as, "Now remind me, what are our multiplication key words? If it's a multiplication story problem, it's gonna have what key words in it?" As a result, she lost an opportunity to highlight the characteristics of multiplication and division in relation to each other, and students continued to have difficulty creating their own multiplication and division story problems.

Teacher Actions When Specific Written Interventions Not Available

When there were no interventions provided in the written lessons or, if any, only procedural ones, teachers had difficulty providing appropriate interventions. Some teachers inaccurately assessed what students had difficulty with or what might have caused the difficulty. It seemed that some teachers did not to know how to help students overcome their constant difficulty understanding and using the main ideas of the lesson. In such cases, they usually tried to tell students facts and information students need to know or repeated the same explanation they had already provided. Even when they tried to assist students with conceptual meaning, they did not go beyond the surface level and stopped pursuing a further intervention.

Although at times no specific interventions were provided in the written lessons, some lessons included critical curricular resources, such as representations and mathematical explanations based on the meaning, which could be used effectively during interventions. I observed that teachers did not use such critical resources provided in the curriculum when tried to help students understand the mathematical ideas of the lesson. For example, the teacher who enacted lessons from MiF did not use a bar model representing addition and subtraction with fractions (see Figure 1). The written lessons introduced two methods for subtracting a fraction from a whole number or a mixed number:

Method 1: $3 - \frac{4}{9} = 2\frac{9}{9} - \frac{4}{9} = 2\frac{5}{9}$

Method 2: $3 - \frac{4}{9} = \frac{27}{9} - \frac{4}{9} = \frac{23}{9} = 2\frac{5}{9}$

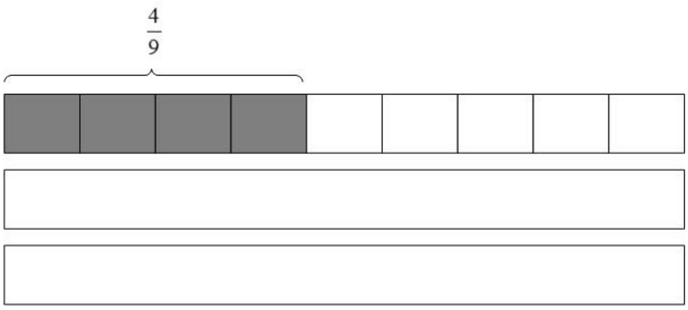

Figure 1. Bar Model Used in MiF to Represent 3 – 4/9

Although students renamed whole numbers as mixed fractions and improper fractions (e.g., $3 = 2\frac{9}{9} = 1\frac{18}{9} = \frac{27}{9}$) in previous lessons, they had a lot of difficulty making sense of the two methods introduced by the teacher and how the two are related. In MiF there were no specific interventions regarding this difficulty other than one sentence in the guidance for the lessons: "Note: Reading the number sentences aloud may help students understand why only the numerators of the fractions are subtracted" (Kheong, Sharpe, Soon, Ramakrishnan, Wah, & Choo, 2010, p. 253). This particular intervention emphasizes the meaning of fraction and fractional units, such as how many ninths are there as a result of subtraction. However, it does not help students understand why 3 needs to be renamed as 2 and 9/9, or 27/9, why both methods work, and how they are related.

As shown in Figure 3, the written lesson uses a bar model to represent 3 – 4/9 visually and conceptually—what it means to subtract 4/9 from 3 and what is left as a result of the operation. Without using the bar model, however, the teacher verbally explained renaming of 3 in different ways (e.g., 2 and 9/9, and 27/9) in order to subtract 4/9. Explaining renaming without the model kept the concept on an abstract level and students continued to have difficulty understanding similar solutions to other problems in the three observed lessons. Without the representation, her explanations did not help students see the rationale for the procedures, and many of the students chose just one of the two methods to solve other problems and were not able to relate the two methods presented in the written lessons. Even when students mentioned using the model ("I can draw a picture on the board"), the teacher said, "No, that's okay. If somebody needs a picture, we will add that. I don't want to confuse anybody." The teacher strongly believed that the model would confuse students rather than helping them see why the procedure works and explained the renaming repeatedly.

DISCUSSION

This study highlights the importance of intervention resources in the curriculum and teacher role of recognizing the mathematical point of the lesson and the affordances of curricular resources to use intervention resources productively and to create an appropriate one when not available in the curriculum. The latter is a critical component of teacher *pedagogical design capacity*, which Brown (2009) refers to as a teacher's ability to perceive affordances of the curriculum, make proper decisions, and follow through on plans. This study has implications for teacher education and curriculum design regarding teachers' instructional decisions, although further studies on micro-interventions are needed for theoretical and practical elaborations.

It seems that two kinds of teacher knowledge were particularly critical in the interventions in the enacted lessons: teachers' knowledge of student need (what students have difficulty with and where the difficulty comes from) and curricular knowledge (Ball, Thames, & Phelps, 2008; Choppin, 2011). The teachers recognized student difficulty, but many of them failed to accurately assess the origin of the difficulty and determine what could be done to resolve the problem. Choppin (2011) elaborated teacher knowledge of resources that facilitate student thinking, suggesting that teachers need to recognize the affordances of resources to help students learn the content. It seems that most of the teachers analyzed in this study failed to recognize the affordances of the resources included in the curriculum that they were using.

This study also revealed inconsistences and limitations of intervention resources available in the written lessons. Curriculum developers need to examine the way they provide intervention resources, because crafting appropriate, timely interventions is a real instructional challenge for teachers as they are to make abundant decisions during instruction. Further research can guide the direction for providing proper resources to teachers.

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PROBLEM-BASED LEARNING ASSOCIATED BY ACTION-PROCESS-OBJECT-SCHEMA (APOS) THEORY TO ENHANCE STUDENTS' HIGH ORDER MATHEMATICAL THINKING ABILITY

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ABSTRACT: The research has shown a model of learning activities that can be used to stimulate reflective abstraction in students. Reflective abstraction as a method of constructing knowledge in the Action-Process-Object-Schema theory, and is expected to occur when students are in learning activities, will be able to encourage students to make the process of formation of new mental objects, new processes and new schemes through the construction process in the form of generalization, interiorization , encapsulation, coordination and reversal. Problem-based learning that is presented through eight steps of learning has been able to enhance the mental action in students even though there is no doubt that it can not possibly know the whole picture of a person's mental activity. All steps in the problem-based learning approach can reflect on the problems of mental action in students. Problem-based learning is appropriate to be used to improve students' high order mathematical thinking ability because of it has been able to condition the reflective abstraction related mental actions, mental processes, mental objects and schemes in students. Computer assistance and scaffolding techniques can be further stimulus for students to take place in their mental action which corresponded to expectations.

Key words: problem-based learning, APOS theory, high order mathematical thinking

INTRODUCTION

Learning mathematics in the view of recent development of mathematics education must create processes and goals that lead to the achievement of competencies that make students able to make a conjecture, to communicate, to solve problems, reasoning logically and having positive attitude towards mathematics. This is because of learning mathematics is not only learning it as a fixed and unchanging collection of facts and skills, but it must be an emphasis on the importance of conjecturing, communicating, problem solving and logical reasoning (Conway & Sloane, 2005). High School Subjects' Mathematics Standards Content Document (Depdiknas, 2006: 388) reinforces this view of mathematics by stating that mathematics intended that learners have the ability to understand mathematical concepts, using reasoning the pattern and nature, solving problems, communicating ideas, and have respect for the usefulness of mathematics in life. This assertion is related to senior high schools students' ability of high order level mathematical thinking ability and respect for the usefulness of mathematics known as mathematical disposition after learning of mathematics in schools and termed as competency standards. Since it is considered as a standard, then the whole effort is worth the ability to be shared by all students after they completed their education at high school level.

Resnick (Mc Curry, 2005: 2) suggests the characteristics of high-order thinking as thinking and non-algorithmic complex that includes:

a. many solutions;
b. nuanced decide and interpret;
c. application of the employed several criteria;
d. lack of stipulations;
e. self-regulation of the process of thinking;
f. determination of meaning, the discovery of the lack of uniform structure, and business.

Mathematical problem solving is a part of high-order mathematical thinking ability. Resnick [2] suggests the characteristics of high-order thinking as thinking and non-algorithmic complex that includes:

a) multiple solutions;
b) nuanced judgment and interpretation;
c) application of the employed multiple criteria;
d) often involves uncertainty;
e) self-regulation of the thinking process;
f) involve imposing meaning.

Activities that classified to the mathematical problem solving according to Sumarmo [3] include:

a) Declare a situation, figure, diagram, or tangible objects into the language, symbols, ideas, or mathematical

models
b) Explain the idea, situation, and relations math orally or in writing.
c) Listening, discussing, and writing about mathematics.
d) To read with understanding a written mathematical representations.
e) Disclose back one paragraph description or math in own language.

Mathematical Communication ability is also a part of high-order mathematical thinking ability. This ability can be classified at the high-order mathematical thinking ability but could also be classified in the low-order mathematical thinking ability, depending on the complexity of communication involved. Mathematical Communication according to NCTM (2000) is an important part of mathematics and mathematics education and a way of sharing ideas and clarifying understanding. When students are challenged to think about mathematics and communicating it to others either orally or in writing, they learn to be a person who can explain and convince others. Given this mathematical communication, students will be able to listen to the explanations of others so that give them the opportunity to develop their understanding. Efforts to share ideas and clarify mutual understanding can occur in mathamateics classroom when the discussion is in progress both in the classical and in groups.

The students involved in the discussion according to Hatano and Inagaki (NCTM, 2000) will gain a better understanding of mathematics when trying to explain their different point of view to convince their group discussion. Activities that involve mathematical communication skills thereby helping students to develop a language that expresses mathematical ideas and an appreciation of the need for precision in the use of language. The students who have the opportunity, encouragement, and support for speaking, writing, reading and listening in mathematics classes will gain a double advantage in the form of communicating to learn mathematics and learning mathematics to obtain mathematical communication skills.

Communication skills of high school students in mathematics at NCTM (2000) must appear in the form of the ability to construct a logical sequence of thought, express themselves in a clear and reasonable, to hear others ideas, and think about the people who pay attention to writings or their words. Senior high school students must be capable of being a good critic on the opinion of others and himself. Thus, high school students should be able to build a variety of explanations, formulate various questions, and write a variety of arguments that can be logically correct and reasonable by the teachers, their colleagues or the mathematicians. All of that can be done if the students have the ability to use language and mathematical symbols and correct both when communicating it using descriptions, geometric diagrams, ordinary language or the algebraic symbols. Students also must be able to work just as well in the sense that it can work effectively with colleagues.

Learning mathematics in accordance with the present views about mathematics have to pay attention to students' learning processes through the construction of the knowledge that they are doing by their own based on their cognitive development. Piaget's ideas about learning by means of cognitive development have developed by von Glaserfeld [4] as a view of constructivism, a knowledge philosophy which emphasis knowledge that one acquire is a construction from him or herself and known as radical constructivism. This view of learning formulated its fundamental principles as follows:

1. Knowledge is not passively received either through the sense or by way of problem solving;
2. Knowledge is actively built up by the cognizing subject.
3. The function is adaptive, in the biological sense of the term, tending towards fit or viability;
4. Cognition serves the subject's organization of the experiential world, not the discovery of an objective ontological reality

Related to the constructivist view of learning mathematics, Meel (2003) states that construction of knowledge as a result of the understanding of mathematical concepts developed through the formation of mental objects and the association between it. Thus, when constructivism learning theory will be applied in mathematical learning, it will be needed to pay attention to the meaning of the process of formation of new knowledge and its main elements to support the learning process that is expected.

Theories about constructing new mathematical knowledge that is part of the constructivist view begins with what Piaget stated (Dubinsky, 2002) about the process of reflective abstraction which are part of the three types of abstraction processes as well as empirical abstraction and pseudo-empirical abstraction. Reflective abstraction as a method of knowledge construction is the core theory of APOS (Action - Process - Object - Schema) from Dubinsky. According to Dubinsky [6] five types of important Piaget's construction process explain how the new objects, new processes and new schemes can be constructed in an effort to develop an abstract mathematical concepts consist of: generalization, interiorization, encapsulation, coordination and reversal. A Person's response to a situation that allows the emergence of a mathematical concept through the construction of a mental process in his thoughts related to the concept is the meaning of interiorization.

The composition of two or more processes to construct a new process called coordination. Psychological description given by Ayres and Dubinsky (Dubinsky, 2002) pointed to the formation of the composition of two functions. The composition of function is a binary operation that has meaning to take action on the two objects to form a third object. Two functions are considered as two objects must be "disassembled" by a student to be reflected on the related processes and being interiorized. Construction stage which may be the most important and most difficult math for students called to convert a dynamic process into a static object and is referred to as encapsulation. When a student learns to apply an existing scheme on a wider set of phenomena, then we say that the scheme has been generalized. Meanwhile, when a process appears internally, allowing for students to think about in the opposite form, and can be interpreted as constructing a new process using the reverse process of the origin, then the ability to this kind of thinking is called a reversal.

In an effort to try to develop this idea of reflective abstraction, Dubinsky (2002) isolated what appears to be a significant feature of these ideas, reflect on their role in high-level mathematics, and reorganize or reconstruct to form a theory related to mathematical knowledge and its construction. Reflective Abstraction by Dubinsky will be the construction of mental objects and mental actions on these objects. In an attempt to elaborate his theory and relate to certain concepts in mathematics, Dubinsky then uses the idea of the schema. A schema is a collection of objects and processes that can be highly inter-related or less related. The tendency of students to involve a schema in an effort to understand, treat, organize, or interpret a problem situation has been estimated as a conceptual knowledge of mathematics itself. Thus a mathematical concept will have a unity of some vast scheme. There will be some schema for situations that include numbers, arithmetic, form the set, function, proposition, calculation, verification by mathematical induction, and so on through the whole of one's mathematical knowledge. These schemas should be completely intertwined in a large number of complex organizations.

Mathematics teachers do not only have to teach their students how to solve problems, but to learn mathematics through problem solving too. When many students develop procedural fluency, they often lack understanding of the concepts needed to solve new problems or make connections between mathematical ideas. This presents a challenge for teachers, and Problem-Based Learning (PBL) provides opportunities for teachers to face this challenge. PBL emerged as a teaching approach based on constructivism learning and the ideal student-centered learning. When using PBL, teachers help students to focus on solving problems with a real life context, encouraging them to consider the situation that posed by a problem when trying to find solutions.

Computer-assisted instruction with regard to teaching or learning presented by means of a computer device. Computer programs are interactive and can illustrate a concept through animation, sound and attractive demonstrations. The programs provide flexibility for students to develop through their own pace and work individually or in groups to solve problems. Computers can provide immediate feedback that allows students to know their correct answers. If the answer is incorrect the program shows students how to answer the question correctly. Computers offer a different type of activity and a change of pace through the guidance of a teacher or teaching groups.

MathXpert (Beeson, M., 2003) is a system that allows a person to do mathematics on a computer screen in much the same way as it is done with pencil and paper, but with some important differences:

(1) It is not possible to make a mistake.
(2) If you do not know what to do, MathXpert can help you.

These features of MathXpert should be compared to the two main difficulties that people experience in their attempts to learn mathematics: you have to be very careful in mathematics, because a slight error can throw you completely off track; and mathematics is cumulative, so you must master each part of the subject before moving on to the next part. The benefits of using mathxpert software are happens because this program can help show all steps; its computer algebra is true: it can serve as a teacher, it draws the graph correctly, and can easily make the graphs students need to see.

Computer-assisted problem-based learning (CAPBL) by using MathXpert software program can be expected to maximize the benefits of Problem Based Learning. The goals of mathematics learning which allow students to have an important role in the process of learning mathematics and mathematical abilities obtained in accordance with that goals, are expected to be more easily realized. Another important thing to note by the teacher is an attempt to make the appropriate teaching materials through the use of CAPBL.

METHODS

The study used a 3 × 2 and 3 × 3 factorial designs and each were varying in learning approaches and student settings (3 × 3 factorial design for students' prior mathematical ability (PMA) and 3 × 2 factorial design for school category or cluster). The two dichotomous variables in 3 × 3 factorial design generated six experimental groups: (1) CAPBL in high level of PMA; (2) CAPBL in medium level of PMA; (3) CAPBL in low level of PMA; (4) PBL in high level of PMA; (5) PBL in medium level of PMA; (6) PBL in low level of PMA; and generated three control groups: (1) conventional learning in high level of PMA; (2) conventional learning in medium level of PMA; and (3) conventional learning in low level of PMA. The two dichotomous variables in 3 × 2 factorial design generated four experimental groups: (1) CAPBL in high category school; (2) CAPBL in middle category school; (3) PBL in high category school; (4) PBL in middle category school; and generated two control groups: (1) conventional learning in high category school; and (2) conventional learning in middle category school.

The participants were 209 Year 11 students in six mathematics classes of two Indonesian senior high schools with two categories. Each school category consisted of 3 classes students. 3 classes in high category school consisted 1 class for CAPBL setting (31 students); 1 class for PBL setting (34 students); and 1 class for conventional setting (34 students). 3 classes in medium category school consisted 1 class for CAPBL setting (38 students); 1 class for PBL setting (36 students); and 1 class for conventional setting (36 students). The students had graduated from junior high schools that used a National Curriculum, and therefore, it can be assumed that all students had fairly similar mathematical experiences. The participant school used a competency-based curriculum (Depdiknas, 2006) that was part of the Indonesian National Curriculum for senior high schools. Mathematical problem solving ability developed through small group learning, such as the ability to demonstrate and interpret mathematical ideas in written or oral form, were one of the outcomes. At the time the research was carried out, students had been taught by the same mathematics teacher.

RESULTS AND FINDINGS

Most of all of the research results are the inferences of statistical test. Statistical result of mathematical problem solving is on the Table 1, Table 2., and Table 3. The Tables show that learning factor tends to give higher mathematical problem solving achievement and gain than school category and PMA. Learning factor has give higher mathematical problem solving achievement and gain than school category because of medium category school of CAPBL setting get similar post test score and gain (32.61 and 0.46) than high category school of PBL (32.00 and 0.45) and get higher than conventional setting (27.09 and 0.35). Learning factor has give higher mathematical problem solving achievement and gain than PMA level because of medium level of PMA from students that acquire CAPBL setting get similar post test score and gain (35.98 and 0.52) than high level of PMA from PBL (35.00 and 0.49) and get higher post test score and gain from conventional setting (27.28 and 0.36).

Table 1. CAPBL Students' Mathematical Problem Solving According To Learning Approach, School Categories And PMA

School Category	PMA	CAPBL					
		Pre Test		Post Test		<g>	n
		r	s	**r**	s	**r**	
High	High	8.17	1.94	47.17	4.07	0.71	6
	Medium	7.43	2.11	36.35	4.13	0.58	23
	Low	5.00	4.18	31.80	2.95	0.46	5
	Sub Total	**7.21**	**2.57**	**37.59**	**6.15**	**0.55**	**34**
Middle	High	7.67	3.06	34.0	8.1	0.4	3

				0	9	7	
	Medium	4.71	3.53	35.47	6.75	0.53	17
	Low	7.89	2.32	29.67	6.65	0.40	18
	Sub Total	**6.45**	**3.30**	**32.61**	**7.19**	**0.46**	**38**
Total	High	8.00	2.18	42.78	8.39	0.63	9
	Medium	6.28	3.08	35.98	5.34	0.52	40
	Low	7.26	2.97	30.13	6.05	0.41	23
	Total	**6.81**	**2.`98**	**34.96**	**7.13**	**0.50**	**72**

Maksimum Score = 68

<g> = Normalized gain = $\frac{Post\,test - pretest}{Maximum\ Score - pretets}$

CAPBL: Computer-Assisted Problem Based Learning Approach

Table 2. PBL Students' Mathematical Problem Solving According to Learning Approach, School Categories And PMA

School Category	PMA	PBL					
		Pre Test		Post Test		<g>	N
		r	s	**r**	s	**r**	
High	High	6.75	1.89	38.75	2.22	0.57	4
	Medium	7.47	2.37	32.94	5.46	0.46	17
	Low	6.50	3.06	27.70	4.92	0.38	10
	Sub Total	**7.06**	**2.53**	**32.00**	**6.03**	**0.45**	**31**
Middle	High	8.00	6.93	30.00	4.35	0.39	3
	Medium	8.06	3.42	32.38	6.57	0.44	16
	Low	6.71	2.89	22.53	3.59	0.24	17
	Sub Total	**7.42**	**3.47**	**27.53**	**6.99**	**0.36**	**36**
Total	High	7.2	4.2	35.	5.	0.	7

		9	7	00	54	49	
	Medium	7.74	2.89	32.67	5.94	0.45	3
	Low	6.63	2.87	24.17	9.97	0.31	2
	Total	**7.25**	**3.05**	**29.60**	**6.89**	**0.40**	**6**

Maksimum Score = 68

$$<g> = \text{Normalized gain} = \frac{Posttest - pretest}{Maximum\ Score - pretets}$$

PBL = Problem-Based Learning Approach

Table 3. Conventional Students' Mathematical Problem Solving According to Learning Approach, School Categories, □nd PMA

School Category	PMA	Conventional					
		Pre Test		Post Test		<g>	n
		r	s	**r**	s	**r**	
High	High	9.40	2.85	27.09	4.77	0.35	5
	Medium	8.00	2.24	28.63	6.10	0.37	1
	Low	5.00	2.54	22.50	4.33	0.30	1
	Sub Total	**7.32**	**2.85**	**27.09**	**6.13**	**0.35**	**3**
Middle	High	11.50	3.53	30.50	0.71	0.37	2
	Medium	7.85	3.08	19.65	5.73	0.21	2
	Low	6.13	2.8	19.75	3.61	0.24	8
	Sub Total	**7.67**	**3.18**	**20.28**	**5.70**	**0.23**	**3**
Total	High	10.00	2.99	27.28	6.01	0.36	7
	Medium	7.91	2.73	23.44	7.35	0.28	4
	Low	5.50	2.64	21.28	4.16	0.27	1
	Total	**7.50**	**3.01**	**23.59**	**6.80**	**0.29**	**7**

Maksimum Score = 68

$$<g> = \text{Normalized gain} = \frac{Posttest - pretest}{Maximum\ Score - pretets}$$

According to learning factor, the enhancement and the achievement of students' mathematical problem solving that acquire learning in CAPBL setting tend to get higher than the students that acquire PBL and conventional learning. So it is with PBL setting tends to get higher than the students that acquire conventional learning. According to school category, the enhancement and the achievement of students' mathematical problem solving whose acquire CAPBL from high category school tend to get higher than the students whose acquire CAPBL from medium school category. So it is with PBL setting and conventional setting. According to PMA, the enhancement and the achievement of students' mathematical problem solving whose acquire CAPBL from high level tend to get higher than the students whose acquire CAPBL from medium and low level of PMA. So it is with PBL setting and conventional setting.

Most of all of the research results are the inferences of statistical test. Statistical result of mathematical communication ability is on the Table 4, Table 5., and Table 6. The Tables show that learning factor tends to give higher mathematical communication achievement and gain than school category and PMA. Learning factor has give higher mathematical communication achievement and gain than school category because of medium category school of CAPBL setting get higher post test score and gain (44.47 and 0.51) than high category school of PBL (42.84 and 0.47) and conventional setting (36.62 and 0.36). Learning factor has give higher mathematical communication achievement and gain than PMA level because of medium level of PMA from students that acquire CAPBL setting get higher post test score and similar gain (47.53 and 0.56) than high level of PMA from PBL (42.57 and 0.57) and get higher post test score and gain from conventional setting (43.86 and 0.21).

Table 4. CAPBL Students' Mathematical Communication According To Learning Approach, School Categories, And PMA

School Category	PMA	CAPBL					
		Pre Test		Post Test		<g>	n
		r	s	**r**	s	**r**	
High	High	16.00	2.53	56.67	3.88	0.69	6
	Medium	13.39	3.54	48.87	4.54	0.57	23
	Low	12.20	4.32	40.00	3.54	0.44	5
	Sub Total	**13.68**	**3.60**	**48.94**	**6.36**	**0.57**	**34**
Middle	High	13.33	4.62	46.00	8.19	0.53	3
	Medium	12.18	5.95	45.71	7.88	0.53	17
	Low	12.78	3.61	43.06	6.07	0.49	18
	Sub Total	**12.55**	**4.75**	**44.47**	**7.02**	**0.51**	**38**
Total	High	15.11	3.33	53.11	7.39	0.64	9
	Medium	12.88	4.69	47.53	6.29	0.56	40
	Low	12.65	3.68	42.39	5.69	0.48	23
	Total	**13.08**	**4.26**	**46.58**	**7.04**	**0.54**	**72**

Maksimum Score = 75

<g> = Normalized gain = $\frac{Post\,test - pretest}{Maximum\ Score - pretets}$

CAPBL: Computer-Assisted Problem Based Learning Approach

Table 5. PBL Students' Mathematical Communication According to Learning Approach, School Categories, And PMA

School Category	PMA	PBL					
		Pre Test		Post Test		<g>	N
		r	s	**r**	s	**r**	
High	High	14.25	0.96	48.25	5.50	0.56	4
	Medium	15.00	4.53	42.82	6.14	0.47	17
	Low	13.90	3.84	40.70	4.64	0.43	10
	Sub Total	**14.55**	**3.97**	**42.84**	**5.92**	**0.47**	**31**
Middle	High	7.33	4.04	48.33	4.73	0.60	3
	Medium	12.94	4.14	43.50	5.13	0.49	16
	Low	14.24	3.80	34.18	4.90	0.32	17
	Sub Total	**13.08**	**4.29**	**39.50**	**7.16**	**0.42**	**36**
Total	High	11.29	4.42	42.57	12.83	0.57	7

	Medium	14.00	4.40	34.70	9.40	0.45	33
	Low	14.11	3.75	16.85	4.75	0.20	27
	Total	**13.76**	**4.17**	**41.04**	**6.78**	**0.44**	**67**

Maksimum Score = 75

$$\langle g \rangle = \text{Normalized gain} = \frac{Posttest - pretest}{Maximum\ Score - pretets}$$

PBL = Problem-Based Learning Approach

Table 6. Conventional Students' Mathematical Communication According to Learning Approach, School Categories, And PMA

School Category	PMA	Conventional					
		Pre Test		Post Test		<g>	n
		r	s	**r**	s	**r**	
High	High	15.60	2.97	47.80	10.11	0.54	5
	Medium	15.00	4.18	36.05	3.63	0.35	19
	Low	15.00	3.20	32.10	3.75	0.28	10
	Sub Total	**15.09**	**3.66**	**36.62**	**6.98**	**0.36**	**34**
Middle	High	21.50	0.707	34.00	1.41	0.23	2
	Medium	12.73	3.157	27.08	6.324	0.23	26
	Low	12.25	2.188	24.38	4.984	0.19	8
	Sub Total	**13.11**	3.52	**26.86**	6.16	**0.22**	**36**
Total	High	17.29	3.77	43.86	10.67	0.21	7
	Medium	13.69	3.75	30.87	6.94	0.11	45
	Low	13.78	3.06	28.67	5.77	0.09	18
	Total	**14.07**	**3.70**	**31.60**	**8.17**	**0.13**	**70**

Maksimum Score = 75

$$\langle g \rangle = \text{Normalized gain} = \frac{Posttest - pretest}{Maximum\ Score - pretets}$$

According to learning factor, the enhancement and the achievement of students' mathematical problem solving that acquire l

CONCLUSION

This study contrasted the influence of a learning approach in either problem-based learning (CAPBL and PBL) or conventional settings. Four experimental groups and two control groups were formed varying in learning approach (CAPBL, PBL or conventional) and student setting (School categories and students' PMA) during acquisition of multi-step calculus concepts (limit and differential). All students were then tested individually on problems that were very similar in nature to those provided during acquisition. Both mathematical problem solving and mathematical communication were assessed during these two tests.

The results based on mathematical problem solving ability test in both the experimental class of school categories have been able to show that students mathematical problem solving from high category school are higher than students in experiments middle school category. Meanwhile, students of the high PMA experimental class have been able to demonstrate higher mathematical problem solving than students from the medium and low PMA experimental class. Similarly, students of the medium PMA experimental class were able to demonstrate higher mathematical problem solving than students from low PMA experimental class. This indicates that problem-based learning with all supporting components for facilitating students can improve mathematical problem solving skills in accordance with the mathematical potential with respect to both categories of schools and PMA.

Based on the results of mathematical problem solving test (MPSA Test) students who received problem-based learning without and with computer assisted instruction shows improved mathematical problem solving significantly better than students who received conventional learning. This suggests that, in the process of problem-based learning both computer-aided and unaided computer with all supporting components have contributed to the improvement of students' mathematical problem solving.

Identify the adequacy of the data for problem solving is one of the indicators of the mathematical problem-solving abilities are enhanced in this study. Problem-based learning process that places more emphasis on the activities of students in constructing their own mathematical knowledge through problem solving activities provided by the teacher has been able to make the students accustomed to identifying the problem. Identification data through problem solving in groups to train the students to learn to challenge the adequacy of the data needed to solve the problem. Computer-assisted experimental class students have more opportunities to perform activities related to the ability of these indicators for the identification of the adequacy of the data have been trained in problem solving is better than the experimental class students without computer assistance. The information obtained by students through the existing facilities at MathXpert program makes students feel more independent and this is quite a positive influence in efforts to solve the problems they confront. Meanwhile, students in the control class have less opportunity to practice identifying the adequacy of the data needed to solve the problem because all of the proposed solutions are available or have been given by the teacher.

The results based on mathematical communication abitily test in both the experimental class of school categories have been able to show that students mathematical communication ability from high category school are higher than students in experiments middle school category. Meanwhile, students of the high PMA experimental class have been able to demonstrate higher mathematical communication ability than students from the medium and low PMA experimental class. Similarly, students of the medium PMA experimental class were able to demonstrate higher mathematical communication ability than students from low PMA experimental class. This indicates that problem-based learning with all supporting components for facilitating students can improve mathematical communication skills in accordance with the mathematical potential with respect to both categories of schools and PMA.

Based on the results of Mathematical Communication Ability Test (Mca Test) students who received problem-based learning without and with the aid of computer-assisted instruction shows improved mathematical communication significantly better than students who received conventional learning. This suggests that, in the process of problem-based learning both computer-aided and unaided computer with all supporting components have contributed to the improvement of students' mathematical communication ability.

The ability of students to express a situation, drawing, diagram, or tangible objects into the language, symbols, ideas, or mathematical models is the ability related to mathematical concepts relevant knowledge and true-owned to be used according to the needs in this ability. In terms of ability, the second class of experiments through learning activities that emphasize problem solving by the teacher, students have the flexibility to better understand the concept of the teacher. These activities can make students have higher ability to declare a situation into the language, symbols, ideas, or mathematical models. Especially for computer-assisted experimental class, students are better trained to be able to have the skills mentioned above. MathXpert Program used as a tool in learning the information obtained independently and students need to be able to declare a situation into the language, symbols, ideas or mathematical models. The students as well as to test the accuracy of the mathematical models they use to help MathXpert program tailored to the problems they face. Meanwhile, the control class students' ability to express a situation is not so well trained in conventional classroom learning because despite the discussion in the face of problems, but done in the classical style that students tend to immediately get an answer.

The ability of students to be able to listen, discuss, and write about mathematics can also be obtained during the learning process in the classroom experiment. The learning process conducted by the students through a discussion of each small group of students by challenging problems given on the student worksheet, make the students accustomed to doing things related to this capability. On a class of computer-aided experiments, the ability of students to be able to listen, discuss, and write about math as well as obtained through student worksheets are also available from the computer display MathXpert program that stimulates the curiosity of students. All of it is less found in the control class because the student has the opportunity to discuss at the time the teacher asked a question in the classical style. The problems submitted by teachers also tend to problems directly lead to the concept being taught.

Based on the above, it is concluded that the cause of the increase in mathematical communication ability of students in the experimental class better than students in the control class is differences used of learning approach in the experimental class and control class. Similarly, the advantage of computer-assisted problem-based learning compared to the problem without the help of computers in improving students' mathematical communication skills more on the wider opportunities provided MathXpert program to provide independence in doing the student worksheet. However, an increase in the better class of experimental than control class does not mean that students in the experimental class has mastered well all the components of mathematical communication skills.

The mean score of students’ posttest mathematical communication ability in the class computer-aided experimentation, namely 46.58 and the class of experiments without the aid of a computer is 41.04 out of the ideal score 75 show that this ability is less than optimal. Although the implementation of this is done with the time for half the semester, it seems that the time frame was too little compared to the custom of students over the years following the conventional learning since they were sitting on a bench elementary school through high school class. This leads to the difficulty of providing adjustments to the students. Adjustment is one of them is in their ability to demonstrate higher-order thinking, because the problem-based learning students' willingness to do the work that requires a high level of mathematical thinking skills are the main assets in constructing knowledge. This is consistent with the character-based constructivist learning which requires the construction of knowledge by students themselves.

Creating a mathematical model of a situation or daily life problem and solve it is also an indicator of the ability of solving mathematical problems which seek improved in this study. Serving teaching materials that emphasize the experimental class that each student in each group to discuss issues related to daily life problem as a mathematical problem can train students' ability to create mathematical models of the problems that confront. On a class of computer-assisted experiments, presentation of teaching materials that include a duty to utilize MathXpert program can help students to examine the accuracy and relevance of mathematical models they have acquired to the problems they are facing. Meanwhile, students in the control class have less opportunity to practice making mathematical models needed to solve the problem because all of them are presented by the teacher at the beginning of the concept being taught.

Selecting and implementing a strategy to solve mathematical problems and or outside of mathematics is one more indicator of the ability of solving mathematical problems that are the focus to be improved in this study. Serving experimental class teaching materials in the form of delivery problems containing linkages with other mathematical concepts and the relation to others can provide wider opportunities for students to understand mathematical concepts by making learning material connections in the context of other math concepts or other subjects. It is thus not surprising that the application of problem-based learning makes students accustomed to solve problems that arise in mathematics and other fields. Learning on the computer-assisted experiments class are able to present a variety of alternative problem-solving strategies for program MathXpert provide a menu that provides a complete selection of problem-solving strategies with explanations and rationale of each step is selected. Meanwhile, students in the class have less control the opportunity to perform the above activities such as learning characteristics can not facilitate the condition.

Explain or interpret the results as concerns the origin and verify the results or answers, is an indicator of other mathematical problem-solving skills that are the focus to be improved in this study. In this connection, the problem-based learning through problem solving by the teacher, students have ample opportunity to think, to express an assortment of solutions or approaches to problem resolution, filed opinions or ideas, ask questions, consider the completion of the other students, featuring ideas in solving the problem. In problem-based learning students are conditioned to prepare or add details of an idea to counter criticism of other students. This is what seems to make the students in the experimental class used to describe anything in detail, making connections, and enrich and develop an idea to solve the problem. Various habits lead students to explain and interpret the results as concerns the origin at the time of mathematical problem solving process. In the computer-assisted classroom experiment, students attempt to interpret the results and check the correctness of the result or response can be directed more accurately through the menu and look at the program MathXpert. Meanwhile, students in the class that have less control opportunities as experienced by the students in the experimental class to do the explanation and interpretation, because the characteristics of conventional learning does not lead to the ability of students to have a better ability to do the explanation and interpretation of results.

Applying mathematics is a significant indicator of the ability of solving mathematical problems which are also the focus to be improved in this study. In this connection, the problem-based learning through solving everyday problems set by the teacher, students are encouraged to be able to apply mathematical concepts that they have based their understanding of the issues being addressed. With such a process, the significance becomes an important thing to be a foundation for students to solve problems. Students in the class have less control the opportunity to apply mathematics in meaningful because of the problems given in the learning process tends to abstract and unrelated to everyday life.

Based on the result above, it is concluded that the cause of the increase in mathematical problem solving of students in the experimental class better than students in the control class is differences used of learning approach in the experimental class and control class. Similarly, the advantage of computer-assisted problem-based learning compared to the problem-based learning without the help of computers in improving students' mathematical problem solving skills more on the wider opportunities provided MathXpert program to provide independence in doing the student worksheet. However, an increase in the better class of experimental than control class does not mean that students in the experimental class has mastered well all the components of mathematical problem solving skills.

If related to the theory of Action-Process-Object-Schema (APOS), this research has generally demonstrated a model of learning activities that can be used effectively to stimulate reflective abstraction in students. Reflective abstraction as a method of constructing knowledge on APOS theory and are expected to occur when students are learning activities, students will be able to push the process of forming a new mental objects, new processes and new schemes through the construction process in the form of generalizations, interiorization, encapsulation, coordination and reversal.

Problem-based learning that is presented through an eight-step lesson has been able to push the mental action in students. The whole lesson on problem-based learning to reflect the occurrence of mental action in students although there is no doubt that they could not possibly know the whole picture of a person's mental activity. Presentation of the problem at any given learning materials and require the student to realize that he found the problem to be understood through the steps of defining the problem is the driving force for the occurrence of mental action in students.

At the moment students are trying to gather the facts, make up provisional estimates, and investigate, they are taking advantage of the scheme is a prerequisite that they have the APOS theory is the object that will be given to action. Perfecting the problems that have been defined in a problem-based learning can be considered as interiorisasi the object, in this case an existing scheme to be used as a new mental processes. This is reasonable because when students are involved in this step, then they're responding to the situation by trying to construct mental processes as a way of understanding the phenomena that have their perceptions.

Perfecting these problems can be seen as the construction of the student in the form of coordination and or reversal. Students are conducting mental constructs such as coordination compose two or more mental processes that have been generated by interiorisasi on previous activities. In the meantime, students can also be said to be doing mental constructs shaped reversal when perfecting this issue takes the form of constructing a new process using the inverse of the original.

When students do the step that concludes the alternatives solutions collaboratively, students might still doing construction coordination and mental form reversal when they are still trying to find a new mental process. But when the student has begun steps to convert a dynamic process resulting from interiorization, coordination and reversal, into a static object, forming a new concept scheme in their mind, then the student has committed a mental constructs shaped encapsulation.

The last step of the problem-based learning is a test solution to problems step. In this step the student can be said to still be in the process of mental construction in the form of encapsulation or may have been in the form of generalized mental construction. Testing solutions to problems will still shaped encapsulation when this step is used as an attempt to strengthen students' beliefs about the mental processes they have to be subjected construction resulting scheme. Testing solutions to problems step will be considered a mental construction of the student in the form of generalizations when students step is used to apply a set of objects and the mental processes by which has been owned and Dubinsky (2000) referred to as a schema.

Related computer-assisted learning theory applied in this study are very supportive as well. This is consistent with the role of the computer is capable of making abstract ideas can be implemented or appear to be something concrete in mind, most do not even appear in the form of impressions (Dubinsky, E. Tall, D., 2002). The ideas include mathematical concepts that will be constructed by a student tends to be more concrete for them so much easier to understand. Even according to Dubinsky & Tall [8], construction not only computers can only be used to show the processes represented by abstract ideas, but it also can be manipulated. Furthermore, when the various constructions appeared on the computer, it would be useful to reflect on its meaning in terms of how to make computers and any processes that may be involved. Thus, the computer was able to make abstract ideas more concrete, especially for students who are constructing them.

When students encounter in constructing mental processes in themselves as a result of overly complex problems they faced, there would be the possibility that the learning process will stop just on students or some construction can not be implemented as changing mental processes into a new object (encapsulation). The role of the teacher in this case the application of scaffolding techniques to students is very important in solving the learning problem. This is in line with what is delivered by Hmelo-Silver, Duncan, & Chin (2007), states that the use of scaffolding techniques to reduce cognitive load, providing expert guidance and help students gain disciplinary ways of thinking and activity.

The description has been presented, the problem-based learning computer aided very appropriate to be used as an alternative to appropriate learning in improving mathematical problem solving ability because of the approach has been able to condition the reflective abstraction related to mental actions, process- mental processes, mental objects and schemes in students. Computer assistance and scaffolding techniques can be further stimulus for students to be in her mental action occurs after the hopes.

RECOMMENDATIONS

The mean score of students’ posttest mathematical problem solving in the computer assisted problem-based learning class, namely 34,96 and the problem-based learning without computer assistance is 29.60 out of the ideal score 68; and the mean score of students’ posttest mathematical communication in the computer assisted problem-based learning class, namely 46.58 and the problem-based learning without computer assistance is 41.04 out of the ideal score 75 show that mathematical problem solving and mathematical communication abilities are less than optimal. Although the implementation of this is done with the time for half the semester, it seems that the time frame was too little compared to the custom of students over the years following the conventional learning since they were sitting on a bench elementary school through high school class. This leads to the difficulty of providing adjustments to the students. Adjustment is one of them is in their ability to demonstrate higher-order thinking, because the problem-based learning students' willingness to do the work that requires a high level of mathematical thinking skills are the main assets in constructing knowledge. This is consistent with the character-based constructivist learning which requires the construction of knowledge by students themselves.

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PREFERENCE LEARNING STYLE IN MATHEMATICS: STUDENTS PERCEPTION

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ABSTRACT: Teaching is an ability of complex recognition which is not inborn, but it is a process which can be learned and improved during time. This is the reason why we always try to improve and develop our ability in offering the best qualitative teaching methods to students in our universities.

The aim of this research is to analyze some different aspects of student's preferences in learning mathematics, especially to analyze the preferences concerning the teaching style used by the teacher in the classroom.
In this paper we show the results obtained from a survey realized during the fall semester of 2014 - 2015 with students of two different faculties of the SEE-University, students from the Faculty of Contemporary Sciences and Technologies and Faculty of Business Economics.

The results obtained by this survey show that the method favored by the students is the non-traditional one with preference of 60.5%. In order to analyze student's preferences over different teaching methods versus some other factors, we have used cross tabulation. The results obtained in this paper show that the preferences of the female students, students with the GPA now between 7 and 8, students with MATH score in last semester with 6 (Satisfactory) tend in preference towards non-traditional methods.

Taking into consideration the nature of the subject of mathematics, the obtained results suggest that the teacher should increase his engagement in the subject using different practices and methods in the classroom in order to enhance the interest of the students for the subject.

Key words: mathematics, learning preferences, traditional, nontraditional, cross tabulation

INTRODUCTION

The effort of increasing the quality of teaching is a continuous process. In this context, the teachers are aware of the need to revise the teaching materials and methods in the subjects of the natural sciences. They are aware that these changes should include a much stronger emphasize of the new methods for applying the natural sciences in other fields, as well as the need for enrichment of the teaching methods.

It is a known fact that mathematics plays a crucial role in the establishment of a strong intellectual character. It influences the private, civil, and social life of an individual. Nevertheless, both in the past and nowadays, a lot of students are unsatisfied with the level of their knowledge of the subject. It becomes a barrier for achievement of good results.

One of the basic things which can offer improvement in achieving better results is the creation of new opportunities for learning. Students learn better if we offer them new space of learning. This can be done by using new methods and techniques which will create a new space of concrete and real learning.

Another interesting fact that we want to emphasize is that the majority of teachers have the same style of presentation during lectures. They almost never use different models of teaching or different materials in order to connect the learning process with the field of interest of their students as well as their aims and requests.

Researchers have used different approaches in analyzing teaching methods used at Universities. They have noted very positive results in the case of working with students in small groups, in the case when students cooperate with each other and with their teachers, as well as in the case when students use internet for learning purposes.

In a study concerning the impact of different teaching methods for teaching mathematics done with students of business economics in the SEE-University, Iljazi and Alija (2010), have shown that the most acceptable method is working in small groups. The survey showed that when the above mentioned method was used, students increased their success, improved their class attendance, and interactivity between students increased. Another interesting impact of this method is that students worked more outside of the classroom. As a result of the studies realized by McCarthy and Anderson (2000) and Hinde and Kovac (2001), one can conclude that the best results during exams were achieved by students who used learning methods based on active cooperation between students, compared with students from the classes taught with the traditional methods of lecturing.

Goe's (2007) (2007) examination of teacher quality focuses on four categories of teacher quality indicators-teacher qualifications, teacher characteristics, teacher practices, and teacher effectiveness-which.

Johnson and Johnson (1986) defend the idea that the so called 'cooperative learning' has a positive effect, not just on the students performance, but it also affects positively the students motivation, socialization in the classroom, their confidence that they can learn, and their attitude toward the subject in general.Concerning the methods of learning via internet (known as online learning), Woo and Kimmick (2000) concluded that students who use this method are more stimulated to learn. This happened even in the cases when there were no big differences in learning methods.

In a study with the title "Traditional versus Non-Traditional Teaching", realized by Johsnon and Dasgupta (2005), one can find that the total percentage of students who prefer the non-traditional method versus the traditional one (lecturing), is significantly bigger.

Many of the current researchers find that educators need to claim greater instructional responsibility (Hansson, 2010) and devise means to become more effective in teaching mathematical constructs in order for students to truly develop conceptual mathematical knowledge (Desoete, Roeyers, & Buysse, 2001; Powell & Kalina, 2009). As societal expectations of students‟ mathematical knowledge evolve, so too should teaching strategies.

It is a known fact that the educational process is not static, but it is evolving through time. Especially nowadays, it is a process in evolution and it is changed depending on the way how the students learn, how they accept the information and in general, how they leave and work. It is the process in evaluation also because of the influence of new technologies. This requires changes in the teaching methods, the offering of information, the content of the course, the presentation of new ideas etc. These changes should be on the direction of refitting of the teaching and learning process in most eligible way and style for the students. This is necessary for the students in order to make them adaptable to the new trade markets in the future.

On the other hand, we must take care for the situations when students may become the victims of using the different teaching methods. In such cases, the teacher must take into the consideration the students' needs and perspectives; otherwise all the given effort from the teacher would be purposeless. This is the reason of doing this research, with which we want to have a clear image of the most preferable teaching method of our students. Also we want to have the information of the most preferable factors concerning the teaching style used from the teachers.

Students that enroll in the faculty of contemporary sciences and technologies (CST Faculty), and in the faculty of business economics (BE Faculty) at the SEE-University in Tetovo, come from different high schools, and consequently have different background knowledge in mathematics. By this research we wish to detect which teaching methods are preferred by our students. This information is very important for the teachers in order to improve their teaching methods and skills in future.

METHODS

In this study the population consists of students from CST faculty and BE faculty of the SEE-University. During the fall semester of the academic year 2014-2015 we surveyed 124 randomly chosen students from second year. The math class for these students was obligatory for that semester, but also they had another obligatory math course in the previous semester.

The questionnaire consisted of questions concerning some important data about the students, as well as questions concerning the teaching and learning methods used in the math class that the students took that semester. The purpose of the survey was to detect which teaching method is preferred the most by our students. Also we wanted to detect the method in which students prefer to receive information concerning materials, content of the syllabus, the method of assignment etc.

In order to get a clear illustration concerning the interpretation of the gathered data, making conclusions and decisions, we have used the Statistical Analysis Software SPSS.

At the beginning we analyzed some elements from the descriptive statistics concerning some characteristics of the students, and then we continued with an analysis concerning the most preferred teaching method depending on some of these characteristics.

Since the obtained results show that part of the students prefer the traditional method of teaching and the preferences of the other part tend toward the non-traditional methods, for analyzing the obtained data in this research we have used Cross Tabulations. This is done with the purpose to get clearer picture for this issue. By Cross tabulations we can detect the preferences of our students versus some other characteristics.

RESULTS AND DISCUSSION

From the processed data we can see that the gender distribution of the surveyed students is as follows: 61.29 % of them are male and 38.71 % female. The GPA distribution of the students is as follows: at the time of the survey 17.74% of the students had a GPA between 6 and 7, 28.23% of the surveyed students had a GPA between 7 and 8, 29.84% between 8 and 9, and 24.19% had a GPA greater than 9. Concerning the grades received in the math course which they took the previous semester the percentage distribution is as follows: 11.29% of the students failed the course (they received a grade 5), 25.81% of them received grade 6 (Satisfactory), 15.32% grade 7 (Good), 12.10% grade 8 (Very Good), 17.74% grade 9 (Excellent), and 17.74% grade 10 (Outstanding).

Concerning the class attendance for the math course they took the previous semester we have the following results: 62.10% of the students attended all lectures (they didn't miss any lecture), 37.10% of the students missed only a few hours, and 0.81% often missed lectures.

On the questionnaire there was a question whether the student generally seeks help from their instructor during lectures; 85.48% of the students have answered that they have asked for help. On the other hand 14.52% answered that they never asked for help.

Another interesting question on the questionnaire asked students to self-evaluate their skills in mathematics using grades from 1-10. The average for this question was 7.48.

The obtained results are represented in table 1.

Table 1: Description of Sample

Characteristic		Percent
Gender	Male	61.29
	Female	38.71
Average Student Math Skill Rating: Scale: 1 to 10 (# of students)		7.48
Success GPA until now: (# of students)	Between 6 and 7	17.74
	Between 7 and 8	28.23
	Between 8 and 9	29.84
	Above 9	24.19
MATH scores from the previous semester: (# of students)	5 (Failing)	11.29
	6 (Satisfactory)	25.81
	7 (Good)	15.32
	8 (Very Good)	12.10
	9 (Excellent)	17.74
	10 (Outstanding)	17.74
Student generally seeks help from the instructors in classes taken:	Yes	85.48
	No	14.52
Attendance of students during the previous	I have not missed any hour	62.10

semester: (# of students)	I was absent a few times	37.10
	I was often absent	0.81
Total		100.00

Concerning the most preferred teaching method, the answers of the students are distributed as follows: 60.48% of the students have answered that they prefer non-traditional methods. (The methods where students are divided into small groups, methods that encourage students to participate in discussions, the method of distance learning using IT technologies, learning based on using a special computer software etc.). On the other hand just 39.52% of the students have answered that they prefer the traditional method of learning.

In order to get a detailed picture concerning students preferences over teaching methods in math classes versus some other characteristics, we have used a Cross tabulation of these characteristics. The obtained results are represented in table 2.

Table 2: Students Preferring Traditional And Non-Traditional Approaches By Some Characteristic

		Traditional	**Nontraditional**	**Total**
Gender	Male	46.1%	53.9%	**100.0%**
	Female	29.2%	70.8%	**100.0%**
GPA at present: (# of students)	Between 6 and 7	36.4%	63.6%	**100.0%**
	Between 7 and 8	31.4%	68.6%	**100.0%**
	Between 8 and 9	48.6%	51.4%	**100.0%**
	Above 9	40.0%	60.0%	**100.0%**
MATH grade from the previous semester: (# of students)	5 (Failing)	35.7%	64.3%	**100.0%**
	6 (Satisfactory)	25.0%	75.0%	**100.0%**
	7 (Good0	47.4%	52.6%	**100.0%**
	8 (Very Good)	40.0%	60.0%	**100.0%**
	9 (Excellent)	59.1%	40.9%	**100.0%**
	10 (Outstanding)	36.4%	63.6%	**100.0%**
Attendance of students for the previous semester: (# of students)	I have not missed any hour	40.3%	59.7%	**100.0%**
	I was absent a few times	39.1%	60.9%	**100.0%**
	I was often absent	50.0%	50.0%	**100.0%**
Average Student Math Skills Rating: Scale: 1 to 10 (# of students)	2	50.0%	50.0%	**100.0%**
	4	16.7%	83.3%	**100.0%**
	5	25.0%	75.0%	**100.0%**
	6	26.1%	73.9%	**100.0%**
	7	42.9%	57.1%	**100.0%**
	8	44.8%	55.2%	**100.0%**
	9	51.9%	48.1%	**100.0%**
	10	33.3%	66.7%	**100.0%**
Student generally seeks help from the instructors in classes taken:	Yes	43.4%	56.6%	**100.0%**
	No	16.7%	83.3%	**100.0%**
Total		**39.5%**	**60.5%**	**100.0%**

From the table given above one can see that the non-traditional method of teaching is preferred more by students with the following characteristics: female students, students with a GPA between 7 and 8, students who have received a satisfactory grade (grade 6) for the class they took the previous semester, students who have evaluated their math skills with the grade 4, students who are not asking for help from the lecturer, students who were absent during the math lectures only few times during the previous semester.

Concerning the students opinions about the importance of solving homework, taking quizzes, having lectures in the computer labs and posting the lecture materials on LIBRI (Learning Management System, the online software offered in the SEE-University), the percentage of confirmative answers are 87.10% , 77.42%, 60.48%, and 98.39% respectively. Concerning students preferences over taking notes during class versus just listening to the lecture, the preference for the former is 75%. Regarding the way of taking notes, students prefer the most to take notes directly from the white board on which the teacher writes using a marker. The percentage of this preference was 76.61%.

Taking into the consideration the fact that nowadays using the internet has become an indispensable tool of learning, and due to the fact that SEE University offers very good conditions for IT communication and IT learning, we asked a question concerning this issue as well. The obtained answer was that 88.71% of surveyed students use internet every day. Among different activities that they are performing via internet, 91.25% of the students declared that they use internet for finding information and learning materials.

We want to emphasize an interesting fact, namely 79.03% of the students have the opinion that having a free discussion during class which is not connected with the course topic, as well as having fun or hearing a joke during a particular part of the lesson, has a positive effect on achieving the learning objectives. The obtained results are given in table 3.

Table 3: Students Opinion Concerning Some Characteristics Of Learning Mathematics

Characteristic		**Percent**
The opinion concerning the positive effect of doing homework	No	12.90
	Yes	87.10
The opinion concerning the positive effect of quizzes	No	22.58
	Yes	77.42
The opinion concerning the positive effect of having lessons in computer labs	No	39.52
	Yes	60.48
The opinion concerning the positive effect of delivering materials in LIBRI	No	1.61
	Yes	98.39
The opinion concerning the positive effect of discussion and hearing a joke during the lessons	No	20.97
	Yes	79.03
Using internet	Every day	88.71
	1 to 4 times during the week	8.06
	1 to 3 times during the month	0.81
	Rarely than once per month	1.61
The preferences of taking notes during class	Taking notes during lesson	75.00
	Having prepared notes at the beginning of the lesson.	10.48
	Having online prepared notes on internet	8.06
	It's not important	6.45
The preferences concerning the lecturing method used by the lecturer	Writing on the white board by marker	76.61
	Using slides prepared before the lesson	5.65
	Writing with pencil on a S-BORD	3.23
	A combination of above mentioned cases. Please specify!	6.45
	It's not important for me.	8.06
Total		**100.00**

In order to check these characteristics depending on students who prefer the traditional methods versus students who prefer the non-traditional methods, cross tabulation analysis gives detailed results shown in table 4.

Table 4: Students Preferring Traditional And Non-Traditional Approaches By Some Characteristic

		TEACHSTYLE		
		Traditional	Nontraditional	Total
The opinion concerning the positive effect of doing home work	No	31.25	68.75	100.00
	Yes	40.74	59.26	100.00

The opinion concerning the positive effect of quizzes	No	35.71	64.29	100.00
	Yes	40.63	59.38	100.00
The opinion concerning the positive effect of having lessons in computer labs	No	28.57	71.43	100.00
	Yes	46.67	53.33	100.00
The opinion concerning the positive effect of delivering materials in LIBRI	No	100.00	0.00	100.00
	Yes	38.52	61.48	100.00
The opinion concerning the positive effect of discussions and hearing a joke during class	No	30.77	69.23	100.00
	Yes	41.84	58.16	100.00
Using internet	Every day	37.27	62.73	100.00
	1 to 4 times during the week	50.00	50.00	100.00
	1 to 3 times during the month	100.00	0.00	100.00
	Rarely than once per month	100.00	0.00	100.00
The preferences of taking notes during class	Taking notes during the lessons	37.63	62.37	100.00
	Having prepared notes at the beginning of the lesson.	38.46	61.54	100.00
	Having notes on internet	50.00	50.00	100.00
	It's not important	50.00	50.00	100.00
The preferences concerning the lecturing method applied from the lecturer	Writing on the white board with marker	38.95	61.05	100.00
	Using prepared slides before the lesson	42.86	57.14	100.00
	Writing with pencil on the S-BORD	42.00	58.00	100.00
	A combination of above mentioned cases. Please specify!	25.00	75.00	100.00
	It's not important for me.	70.00	30.00	100.00
Total		**39.52**	**60.48**	**100.00**

From the table, one can see that the non-traditional method is preferred more by students who have declared that doing homework, having quizzes, having lessons in computer labs and hearing jokes during class has no positive effect for learning.

CONCLUSIONS AND RECOMMENDATIONS

Using the results of this research one can create a clearer and more detailed picture concerning students' perspectives on math courses. So, the information about the student's perspectives concerning the most preferred style of teaching has the aim to improve the learning process and the achievement of better results.

From the research one can see that a bigger percentage of students (60.48%) prefer the non-traditional method versus the traditional one. Another conclusion is that the female students, students with a GPA between 7 and 8, students with grade 6 (Satisfactory) for the math course they took the previous semester, students who have evaluated their math skills with the grade 4, students who do not seek help from the teacher, students who have missed class few times during the last semester prefer the non-traditional method compared with their counterparts who have different preferences.

On the other hand, one can see that students who have answered that solving homework, doing quizzes, having lectures in the computer labs and having free discussion or hearing jokes during class are not very useful for achieving the learning objectives, prefer non-traditional teaching versus the traditional method compared with their counterparts who have different preferences.

75% of students prefer taking notes during class compared with the traditional way of listening. The bigger percentage of them prefers the non-traditional method versus the traditional one. Even more, 76.61% of students prefer to attend lessons where teachers write notes on the white board compared with other forms. The bigger percentage of these students prefers more the non-traditional method.

However, from the obtained data one can see that there are a considerable percentage of students, whose preference tends toward the traditional method. This percentage is 39.52%. Therefore, taking into consideration the nature of the subject, the teacher should have bigger engagement in achieving the learning objectives using different practices and methods. This is very important in order to have a positive influence on the students and make mathematics more attractive for them.

The basic purpose of the lecturers (teachers), Universities and society in general, is the enhancement of students learning. We hope that the results from the study shown in this research will help in the direction of enhancement of the quality of education of new generations.

The enhancement of the quality of students learning is the final purpose. So, we hope that the results of this research are an important step into the right direction.

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GENERALIZING REPEATING PATTERNS: A STUDY WITH CHILDREN AGED FOUR

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ABSTRACT: This paper presents part of a study that aimed to understand how the emergence of algebraic thinking takes place in a group of four-year-old children, as well as its relationship to the exploration of children's literature. To further deepen and guide this study the following research questions were formulated: (1) How can children's literature help preschoolers identify patterns?; (2) What strategies and thinking processes do children use to create, analyze and generalize repeating and growing patterns?; (3) What strategies do children use to identify the unit of repeat of a pattern? and (4) What factors influence the identification of patterns? The paper focuses only on the strategies and thinking processes that children use to create, analyze and generalize repeating patterns. The present study was developed with a group of 14 preschoolers in a private school in Lisbon, and it was carried out with all children. In order to develop the research, a qualitative research methodology under the interpretive paradigm was chosen, emphasizing meanings and processes. The researcher took the dual role of teacher-researcher, conducting the study with her own group and in her own natural environment. Participant observation and document analysis (audio and video recordings, photos and children productions) were used as data collection methods. Data collection took place from October 2013 to April 2014. The results of the study indicate that children master the concept of repeating patterns, and they are able to identify the unit of repeat, create and analyze various repeating patterns, evolving from simpler to more complex forms.

Key words: children's literature; repeating patterns; algebraic thinking in four-year-old children.

INTRODUCTION

Mathematics is part of our life and we use it to solve different problems on a daily base. Children are no exception and they use it intuitively when they play and when they need to solve problems. Considering the children's ability to interpret stories and the association that literature makes with real life as well as our imaginary world, we think that the understanding of several basic mathematical concepts can be developed from certain children's books, recognizing the potential of children's literature in learning mathematics (Loureiro, 2006; Smole, Rocha, Cândido, & Stancanelli, 2007). When performing connections between children's literature and mathematics, children are encouraged to make use of mathematical ideas they already know and to extend mathematical concepts, bringing out new content.

The algebraic thinking, in particular, can be developed within the context of children's literature, considering both illustration and text. Several researchers reported the importance of early development of algebraic thinking (Garrick, Threlfall, & Orton, 1999; Threlfall, 1999) beginning by the study of patterns right from kindergarten (Threlfall, 1999; Borralho, Cabrita, Palhares, & Vale, 2007). Threlfall (1999) reinforces the idea that repeating patterns prepare children for future algebra learning and offer a vehicle for learning to interpret symbols. Working with repeating patterns in preschool encourages logical thinking development and helps to develop the generalization of rules about the patterns made.

This paper presents part of a study (Serra, 2014) that aimed to understand how the emergence of algebraic thinking takes place in a group of children aged 3,5 to 4,5 years, as well as its relationship with the exploration of children's literature. To further deepen and guide this study the following research questions were formulated: (1) How can children's literature help preschoolers identify patterns?; (2) What strategies and thinking processes do children use to create, analyze and generalize repeating and growing patterns?; (3) What strategies do children use to identify the unit of repeat of a pattern? and (4) What factors influence the identification of patterns? This paper focuses only on the repeating patterns of the 2nd and 3rd questions. The present study was developed with a group of 14 preschoolers in a private school in Lisbon and it was carried out with all the children**.**

THEORETICAL FRAMEWORK

Algebraic Thinking

The word algebra may be regarded by the common people as associated with formulas and equations, letters and symbols that are manipulated and worked only at high levels of education (Suh, 2007), leading teachers themselves into thinking that algebraic thinking should not be promoted soon. Moreover today, algebra is seen, more broadly, as a generalizing and human activity. According to Kaput (2008), there are two essential aspects of algebraic thinking: (a) the generalization and formalization of patterns, and (b) symbolic manipulation.

Blanton and Kaput (2011) define algebraic reasoning as a generalizing activity of mathematical ideas, defending its development in elementary levels, and they refer to this activity as *early algebra*. This is a kind of activity that prepares children for developing structures and mathematical generalization modes. As referred by Carraher, Schliemann, & Schwartz (2008), early algebra is not the same as algebra early. Early algebra is sought to develop algebraic thinking in a way that includes an understanding of mathematical structures represented by the language and the gestures, using concrete materials and representations, and in this sense, it does not mean beginning algebra´s study earlier than usual (Warren & Cooper, 2008). Children today need to learn a significantly different mathematics than the one their parents learned, using for this significant experiences that lead them to recognize and develop structures and mathematical relationships, using objects for mathematical reasoning (Blanton & Kaput, 2011). This will be the path for young children to become mathematically successful later on (Blanton & Kaput, 2011). Moreover current research has shown that young children can generalize mathematical ideas much earlier than previously supposed (Mulligan, 2013).

Patterning at the Preschool Level

Borralho et al. (2007) assert that the learning of patterns in preschool assist the development of logical thinking, being a way to explore other mathematical content and to create a foundation for the future learning of algebra. Papic, Mulligan and Mitchelmore (2011) consider repeating patterns, which have a cyclic structure that is being repeated, suitable for work in preschool. Thus, there are many children who would spontaneously create simple repeating patterns using different classroom materials, such as bead necklaces and other manipulatives, or representing them in the drawings and clothing decorations (Threlfall, 1999). So it is important to have materials available to children as diverse as shapes, stones, shells, bears or other objects. It is also fundamental to make children use sounds, with the body or with musical instruments, movements, and iconic and symbolic representations (colored dots, letters, numbers) to help them to generate and generalize repeating patterns (Palhares & Mamede, 2002; Threlfall, 1999). As referred by Vale et al. (2011), it is important to encourage children to see patterns using different materials, modes (colors, shapes, gestures, words) or symbols (letters or numbers) in order to identify that the structure of a pattern does not depend on the material used. Palhares and Mamede (2002) propose the exploitation of different representations of the same pattern, so that children can generalize and identify patterns in other contexts.

Palhares and Mamede (2002) report that different pattern types can be exploited in preschool and, based on the articulation of their differences and similarities, clustered as follows: (a) with an alternative component, which may be unique (the AB type); (b) with an arithmetic progression component (the ABAABAAABAAAAB type); (c) with a symmetric component (the ABABBABA type); and (d) by adding a second dimension (ABABAB
BABABA
ABABAB).

In curricular terms, patterns assume a higher standard as a unifying theme or as a supporter for meaningful learning (Borralho et al., 2007; Vale et al., 2011). According to NCTM (2000/2007), the patterns are the foundation of algebraic thinking and working with patterns invites students to identify relationships and to make generalizations. This document also proposes the inclusion of exploratory activities that make use of diverse materials, encouraging the ability to continue patterns and cope with different properties of algebraic relations.

Mathematics has been an important subject area within the Portuguese curricula for preschool education. The Portuguese Curriculum Guidelines for Pre-School Education (PCGPE) (DEB, 1997), in the mathematics domain, propose the use of repeating patterns, giving as an example the days of the week, or growing patterns, namely the sequence of natural numbers. These activities aim to develop the logical reasoning in tasks in which children discern the underlying rule of a given pattern or create their own patterns. Also, in musical domain, PCGPE refers to the construction and the discovery of musical or rhythmic patterns (DEB, 1997). In the area of language, we can find patterns in rhymes or stories that have linguistic rhythms, which can be transformed into mathematical sequences.

Research on Repeating Patterns in Early Years Classrooms

According to Threlfall (1999), several empirical studies undertaken with preschoolers suggest two independent strands to development in repeating patterns: their complexity and the way children see them. Concerning the first strand, the author states that the AB pattern (the simplest alternating elements type) is more common among younger children than the ones with more complex elements or with more than one attribute (color and size and shape, for instance, instead of just color). In the second strand, the author emphasizes the importance of children's awareness that a pattern is a whole being related to a unit of repeat. The identification of the unit of repeat can occur in two ways: by a chant that emphasizes the unit of repeat by the rhythm used (eg: red blue blue, red blue blue) or by an explicit reference to the unit of repeat (eg: one red and two blues). Threlfall (1999) stresses the higher level of awareness present in this last way of describing the pattern. The level of awareness of the unit of repeat has implications for generalization (Vale et al., 2011) and mathematical understanding (Threlfall, 1999).

Rustigian (cited by Threlfall, 1999) observed how 3- to 5- year old children explore repeating patterns and concluded that finding a physical movement (enactive mode) when dealing with a pattern representation was easier than finding a pictorial representation (iconic mode), and that shape attribute was easier than color attribute. This author further identified a progression in children's procedures when asked to extend a given pattern. The responses were ordered by a hierarchy of response: (a) *random selection* of new elements, without reference to prior elements; (b) *repeating the last element* (perseverance); (c) *use of the previous elements but in any order*; (d) *a symmetrical approach* however the given sequence is inversely reproduced; and (e) *a deliberate continuation of the pattern*, looking at the start in order to check the elements to be put (Threlfall, 1999). In research undertaken by Palhares (cited by Palhares & Mamede, 2002) with 4- to 6- year old children, when working with the AB repeating patterns within the color attribute, the children were able to continue the given model and identify that the same pattern existed in objects around the room but found it difficult to make other types of patterns using the same material. Recently, Papic et al. (2011) conducted a study with 53 preschool children aged 3 years 9 months to 5 years old, implementing a 6-month intervention in only one group, focused on repeating patterns. They concluded that children intervened showed great understanding of the unit of repeat and the structure of a pattern. These authors identified five strategies that children use when they work with repeating patterns, increasing the order of sophistication: (a) *random arrangement* (the elements are placed randomly without any care about their place and orientation); (b) *direct comparison* (when copying a pattern, children make a one to one correspondence, matching item by item); (c) *alternation* (children focus on independent successive items independently of the unit of repeat; for example, green, then blue, then green; and not on the unit of repeat, e.g., green-blue); (d) *basic unit of repeat* (children identify the unit of repeat, regardless of the number, type and complexity of elements and attributes, and use it to extend the pattern); and (e) *advanced unit of repeat* (as the children develop their sense of the unit of repeat, they can transfer the same pattern in different modes or materials, reconstructing it in more creative ways).

The study undertaken by Garrick et al. (1999) points to the ease of children to identify patterns of their own creation contrasting with the difficulties in the recognition of patterns created by others. According to Vale et al. (2011), most preschoolers when creating repeating patterns, create n(A) m(B) y(C) patterns where n, m and y, may range from 0 to 3. In repeating patterns with the color attribute, these authors observed some children who invent additional spaces or in the last space overlap the colors needed to complete the unit of repeat. Relatively to the two-dimensional patterns, they refer that children tend to not respect the regularity in column.

The generalization occurs when children can determine that the pattern has a unit of repeat that is repeated cyclically, and using different materials or forms, they are able to recognize the structure pattern (Papic et al., 2011). Indeed, it is the awareness of the structure pattern that allows them to generalize. Mulligan (2013) reports studies with 4- to 8- year old students that show that the awareness of mathematical pattern and structure is a critical aspect, and simultaneously a fundamental one, to their mathematical development. According to the author, it is important to implement a pedagogical approach to promote the pattern awareness since this awareness is correlated with mathematical understanding. With appropriate designed and implemented learning experiences, young children are able to develop forms of reasoning involving the process of generalizing (Papic et al., 2011).

METHODOLOGY

A qualitative research methodology under the interpretive paradigm was chosen, emphasizing meanings and processes (Bogdan & Biklen, 1994). The researcher, second author of this paper, took on the dual role of teacher-researcher, conducting the study with her own group and in her own natural environment. The participant children were 14 preschoolers aged 3 years 6 months to 4 years 6 months, at the beginning of data collection, in a private school in Lisbon. The group was active, curious and interested in mathematics, which is one of the most sought after areas in the class. To make the data collection permission was sought from both the School Director and the parents of the participant group children. Taking into account some ethical issues (Bogdan & Biklen, 1994), fictitious names are being used. We present the ages of the children referred in this paper in table 1:

Table 1. Children Names and Ages

Fictitious names	Ages (years; months)
António	4;4
Dinis	3;11
David	4
Frederico	3;10
Fernando	4;6
Guilherme	4;2
Joaquim	4;2
Jacinto	4;5
Luísa	4;3
Mário	4;6
Matilde	4;3
Tatiana	3;6

Participant observation and document analysis (audio and video recordings, images and documents produced by the children) were used as data collection methods. All the children's drawings representations (when produced) and their recorded explanations supplemented the video recordings as well as field notes and photographs. The group was accustomed to the teacher making digital recordings and taking photos of classroom activities.

Data collection took place from October 2013 to April 2014 and were proposed eleven tasks based on two children's literature books and lasted about 30 minutes each. In this paper we will address only some tasks that are presented in table 2. Their numeration corresponds to the order they were implemented.

Table 2. Books, Tasks, and Descriptors

Book	Tasks	Descriptors
The very hungry caterpillar Eric Carl	1^{st} task *Coloring the caterpillar*	Create repeating patterns coloring on paper the caterpillar's body with a limit of 20 rings.
	2^{nd} task *Reading the caterpillars patterns*	Read orally the created repeating pattern.
	3^{rd} task *Reading the caterpillar pattern by gestures*	Use gestures to represent the created pattern.
	4^{th} task *Creating patterns using gestures*	Create repeating patterns using gestures. Color in an orange sequence the gesture pattern from memory.
The house of Fly Fosca Eva Mejuto	6^{th} task *Decorating Fly Fosca's House*	Copy and continue AB, ABC, ABB, AABB and ABBB patterns using a single attribute (shape). Read orally the repeating patterns. Identify the unit of repeat. Identify the pattern type.
	7^{th} task *Decorating Fly Fosca's House with candies*	Copy and continue AB, ABB, ABC and ABCD patterns using two attributes (color and shape). Read orally the repeating patterns. Identify the unit of repeat. Identify the pattern type.

The analytical categories related to this paper were the following: the creation, reading, copying and extending repeating patterns, the identification of the unit of repeat and the generalization process.

RESULTS

Creating Patterns

In the first task, *Coloring the caterpillar*, children were asked to color on paper a caterpillar's body with a limit of 20 rings, choosing the colors they wanted in order to create a pattern. Children started coloring right to left, from head to tail. The way of coloring was spontaneous and not suggested by the teacher. Some children claimed they could color the caterpillar with the same colors that they used to make necklaces -- a task performed on another day.

> Fernando - I already know my pattern. I will do the same as I did.
> David- I'm going too do it too.
> Guilherme – I'll do, yellow orange, yellow orange, yellow orange ...
> (...)
> Fernando - One red and two blues.

Several children referred to what colors they were going to use before starting to color, identifying at the same time the number of pens that they were going to need. During this task, the teacher questioned children trying to mobilize their informal ideas about patterns but also to see if they could identify what was being repeated and similarities and differences between the patterns that were being created.

> Guilherme – I'll do, orange, yellow.
> Teacher - You'll need how many pens?
> Guilherme - Two.
> (...)
> Teacher - And Joaquim? How many colors will you use? (*Joaquim shows 3 fingers*). Three colors? Good!
> (...)
> Mário - Me! I'm doing with two colors, red and blue. It is red, blue blue, red blue blue. (*Reading his pattern as far as he had already colored*).

The colored caterpillars were of three different patterns (figure 1):

Figure 1. AB, ABC and ABB Patterns

So the strategy that some children used was previously thinking about the colors they were going to use, simplifying the creation of a pattern. Two of the children, Joaquim and Guilherme, put the necessary pens to color the caterpillar near the drawings, removing them from the box, already showing some sense of the unit of repeat. The way Fernando verbalized the pattern created earlier in beaded necklaces and now replicated in the task of coloring the caterpillar -- "One red and two blue" -- indicates a higher level of understanding of the unit of repeat, as he referred to it explicitly (Threlfall, 1999). Children were able to relate the various types of pattern with two colors (AB or ABB) or with 3 colors (ABC).

Children, who did not put their pens outside of the box, used the strategy of looking back to the beginning of the caterpillar to check the correct order of the colors. Dinis (figure 2) used a symmetrical approach. He started by using the sequence of colors of purple, red and blue and at the 10th ring, he reversed the sequence of colors, placing purple, blue and red. Probably Dinis looked at what he had already colored, from left to right, reversing the sequence and did not look at the beginning of the caterpillar, from the head to its end.

Figure 2. Dinis's Caterpillar

António tried to create a pattern using all the pens in the box, but he was not able to make a repetition (figure 3). António used the strategy of arranging a wide variety of colors, without repeating any color (the first nine rings of the caterpillar), and from the repetition of gray appears to have arranged them randomly. He was the only child that failed to make a sequence with repeated motifs.

Figure 3. António's Caterpillar

The other children claimed that it was not a pattern, but could not explain why not; the most used argument was that "it has many colors and you can not make a pattern with lots of colors". The caterpillar colored by António was looked at as a counterexample of pattern. The children identified the initial difficulties of António and tried not to make the same mistake.

The given caterpillar had 20 spaces to color. In the AB patterns, children ended them using the last element of the unit of repeat, since 20 is a multiple of 2. In the ABC or ABB patterns, it did not occur, but the majority of children did not experience any difficulty completing the caterpillar with the last color that followed in sequence, making no reference that it had to end using the last element of the unit of repeat, unlike the children observed by Vale et al. (2011). Nevertheless, Mário ended his caterpillar with a entire unit of repeat, coloring just one blue ring, after the red one in the 16th position (figure 4).

Figure 4. Mário's Caterpillar

Reading Patterns

During the first moment of the *Coloring the caterpillar* task, three children started a dialogue about the similarities of their patterns, all ABB patterns, and with the same sequence of colors in the unit of repeat- red, blue, blue. The way two of them read their pattern led to a discussion where they concluded that what they had done was the same pattern, although they read it differently:

> Mário - Me! I'm doing with two colors, red and blue. It is red, blue blue, red blue blue...
> Fernando - Mine is the same as my pattern (...) because look, red, two blues, red, two blues.
> David - Mine is red blue blue, red blue blue.

> Teacher - David says, red blue blue, Fernando says red two blues, red two blues. Are your patterns the same?
> Fernando- No.
> David- Yes.
> Mário - Yes, because it's red, blue blue, red, blue blue.
> Teacher - So let's see. You were saying one red two blues, one red two blues, David was saying red blue blue. Is it the same?
> Fernando – It is. Because look, I have a red and two blues and David has a red and two blues.
> Teacher- Ah! He also has two blues. I thought it was not the same because he was saying, red blue blue, but it is! You're right. It's another way of saying it. Is yours equal to them or not, Mário?
> Mário – It is.
> Teacher - Equal to whom? To the one David did or to the one Fernando did?
> Mário - (*pause before answering*) Equal to both of them.

When children were asked to read each other their created patterns, it was identified children's use of a rhythmic chant that emphasizes the unit of repeat by the intonation they used. Also some gestures or hand movements were used, allowing the children to identify the correct sequence of colors and even some mistakes made. In the case of Dinis's caterpillar (figure 2), Mário made the following remark:

> Mário – Ah….you've done it differently! (*making hands gestures*). It's purple, red blue purple, red, blue …and in the end it's….after purple it´s blue, it looks different (*using a rhythmic chant when he speaks*)
> Teacher – Is it different? How do you think it's different?
> Mário – Because it has purple with red next to the blue, then the blue changed next to the purple, then the red changed next to the blue (*he explains using his fingers hopping three*)
> Teacher – Can you come here and explain to the teacher what you are saying?
> Mário – Because Dinis placed purple here then here he broke it up and placed purple, blue and red.

Frederico suggested a way for Dinis not make any more mistakes and wrote it on a sheet:

> Frederico - Oh I know! We do some squares for to not make a mistake.
> Mário - I know. We can make a pattern so that Dinis doesn't make a mistake , we put the sheet in front of him and he will know.
> Frederico - I'll take the pens that he used. Red, purple, blue.

Figure 5. Control Pattern Registers Made by Frederico (A) and by David (B)

Frederico also took from the box a green pen and used it to draw a closed line within he made colored "squares", according to the unit of repeat used by Dinis: purple, red and blue (A, figure 5). David suggested another way and drew a green "circle" surrounded by other circular lines of identical colors of Dinis's caterpillar:

> David - A large green circle ... blue, brown ...
> António - Purple, it's purple, the caterpillar begins here!
> David - I can do around, the first is a turn, now the other ...
> Luisa - There are many turns!
> António - First was it green?
> David – Because… it was ... it was a circle that was holding the colors, then Dinis came here to see what the first color was. It was this, then this, then this.

Frederico's drawing shows that he identified the unit of repeat independently on the number of items (Papic et al., 2011). It was the first time that an iconic record of the unit of repeat appeared. This drawing was as a way for children to have greater control over the pattern correction during the process of creation.

Children also identified the correct sequence of colors.

> Teacher - Were you never wrong? (*Tatiana shakes her head*) How do you know that you were ever wrong?
> David - Because she says brown and blue, brown and blue, brown and blue (*using a rhythmic chant*).

In this case, David realizes that no error occurred by the tone that Tatiana read her caterpillar, emphasizing the unit of repeat. The children were able to analyze their own patterns as well the patterns created by their friends.

Transferring Iconic Patterns to Gesture Patterns

In the 3rd task, *Reading the caterpillar pattern by gestures*, each child was asked to reproduce his own caterpillar pattern with gestures, touching any part of the body, and teaching it to the group, who also reproduced it using the same gestures. All the children reproduced with gestures the patterns previously made in caterpillars, identifying easily the equivalence between gestures and colors. While touching the various parts of the body, these were verbalized:

> Duarte - Head feet feet, head feet feet, head feet feet.
> Teacher - What is the color of the head? (...)
> David - Red.
> Teacher - And when do you touch your feet, what is the color that you're saying?
> David - Blue.
> Teacher - And why did you touch your feet twice?
> David - Because there are two blues.

The teacher reinforced the idea of repetition and that it was only necessary to make a "unit" of gestures to teach the pattern to friends, and not the complete represented pattern. The teacher also stressed that if they continued to make gestures, they could go on indefinitely.

> Teacher - If the teacher does not say stop, you could stay here repeating, repeating ... (...) The night would come and we would be here repeating the pattern.
> (...)
> Teacher - So if you want to teach your pattern to children you just have to teach ...
> David - Head feet feet!
> Teacher - And from there they will repeat. Is that it?
> David - It is.

Children that followed just mentioned, with gestures and orally, their unit of repeat and the group repeated it to reproduce the pattern.

> Teacher - Again ... you just figured it out! Jacinto said nose, feet, and everyone began to repeat. So now... Tatiana, what gestures do you need to repeat to do your caterpillar?
> Tatiana - Mouth eyebrow (*just saying the unit of repeat*).

In this task, children used an advanced unit of repeat strategy, since they transferred the same pattern in different modes, reconstructing it in more creative ways (Papic et al., 2011). There is also evidence of awareness of the unit of repeat when they were able to teach to their friends just the unit and use it to continue the pattern.

Transferring Gesture Patterns to Iconic Patterns

All children, in large group, created without difficulty, gesture patterns, verbalizing the body parts they touched. They used the process described above. They taught the group just the unit of repeat that was used by everyone to continue the pattern. They did it one at a time, knowing that everyone should memorize their own created pattern to reproduce it pictorially later on. The first to create a pattern had a more difficult task than the last one as the time distance to the realization of this reproduction was higher.

After the creation of gesture patterns, each one went to their desk to color the sequence of oranges using colors to reproduce the same pattern. They adopted the orientation from left to right to color the oranges. The patterns evolved to a more complex form, being documented, in the sequences of oranges, different complex patterns: AB (4), ABC (4), ABB (1) ABCDE (2) ABBCD (1), ABCC (1).

They could associate a gesture to a color. Almost all remembered the gesture pattern created and eight children matched exactly the gesture pattern to the oranges pattern, showing the use of an advanced unit of repeat strategy (Papic et al., 2011). Five of the children colored patterns in the sequence of oranges, but without corresponding accurately to the gesture pattern invented before. Mário stated "eyes nose mouth nose feet shoulder" (ABCBDE) but he colored a figurative ABBCD pattern, both complex. Fernando was able to match his gesture pattern "head feet arm hand belly" to the figurative pattern ABCDE (figure 6).

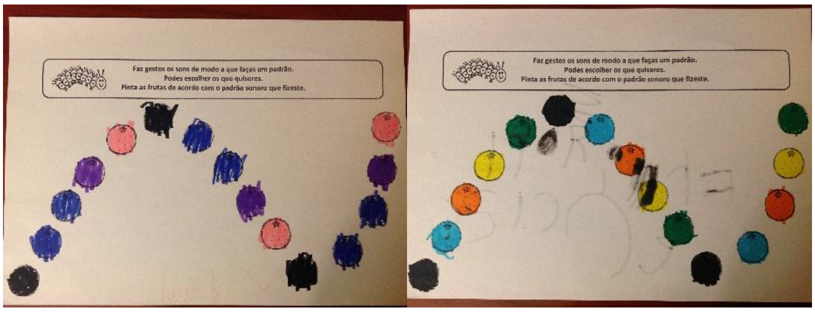

Figure 6. The Patterns of Mário and Fernando Respectively

António created a gesture pattern "eyes mouth ears feet", mentioning that he will require four colors. However when he colored he did an ABCDE pattern (figure 7), having used five colors. Although he did not fully achieve matching the gesture pattern to the pictorial one, there is a great evolution since the first task, in which he was not able to create a repeating pattern. In this task, António maintained his preference of using a large number of colors manifested in the first task of coloring the caterpillar, and he already managed to color a pattern without any mistakes.

Figure 7. António's Orange Pattern

After the initial choice of pens, eight children chose to position the pens outside the box showing to identify the unit of repeat, as they selected and put together all colors necessary for making the unit of repeat, focusing exclusively on the color sequence. Children who did not take their pens outside of the box, again used the strategy of looking at the beginning of the pattern to check the correct order to place the colors.

Coding Patterns

The teacher began to encourage children to identify the structure of a pattern, first through the use of numbers ("If your pattern were numbers, how would you read it?", and Matilde answered to an ABC pattern, "1 ... 2 ... .3, 1 2 3, 1 2 3"). After this codification, the teacher fostered the use of letters in order to not confuse with the number of times an item could be repeated in the unit of repeat of a given pattern representation, as might be the case of the use of numbers.

The use of letters to recognize the structure of the patterns allows children to realize that their patterns are similar regardless of the colors used, as we can see in the following excerpt:

> Teacher - But they are different colors ... Why are they equal?
> Fernando - Because they are ABABAB.
> David- ABABABAB.
> Teacher - Ah, because they are all AB, although not of the same color.

The need to assign a name to the unit of repeat arose spontaneously in a situation where the children were asked to make necklaces with color beads and yarn. The children were asked to identify and draw the findings on a big wall paper (figure 8).

Figure 8. Registration and Collage of Patterns and Codes

Dinis represented the sequence of colors and identified the unit of repeat, representing it in a designated box, describing it by *code*, because his older brother played computer games that had codes. Dinis explained: "It's so we don't deceive ourselves. We look at the *code"*. From this moment on, all the children referred to the unit of repeat as the *code*.

Copying and Continuing Patterns

In the task *Decorating Fly Fosca's House*, the children were asked to decorate the house for the party that Fosca Fly would give, using patterns. Children were to copy and continue repeating patterns presented in strips with patterns of various types: AB, ABC, ABB, AABB and ABBB. Each strip contained two units of repeat. Each child had a set of cards with different shapes but with the same color (yellow, red, green, orange or blue) to make the pattern represented in the strip. The strips varied in shape or position attributes.

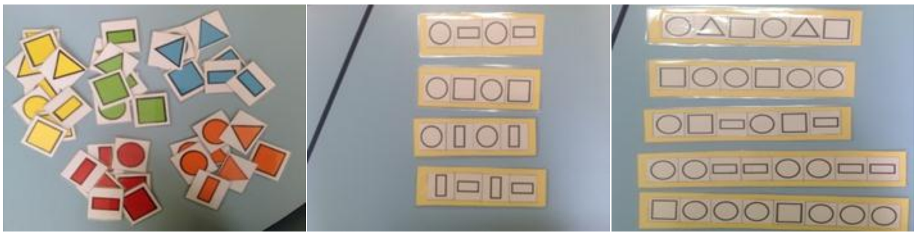

Figure 8. Material Used to Perform the Task

For the AB patterns, most children had no difficulty in copying and continuing the patterns shown and did so reproducing the pattern that was presented to them, using linearly the colored cards intended for each one. However a child, Dinis, used a two-dimensional disposition (figure 9). Dinis seems to ignore the formation law of a two-dimensional pattern, not respecting the regularity in column, since attended the alternation only on row (Vale et al., 2011). Thus, Dinis copied the strip composed of two units of repeat and repeated it twice by duplicating the unit of repeat below.

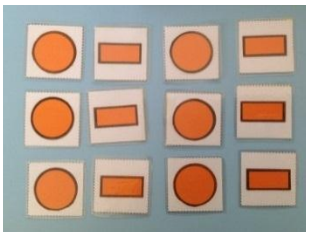

Figure 9. Dinis's Two-dimensional Disposition

The patterns continued by the children had three to six units of repeat. Most children ended their pattern, using the last element of the unit of repeat. But some children did not seem to assign this special importance, as was the case of Fernando (figure 10) who ended his AB pattern using the first item of the unit of repeat.

Figure 10. Fernando's Pattern

The code facilitated structure patterns awareness by the children:

Teacher - What is your pattern *code* António?
António – Circle rectangle.
(...)
Teacher - What is your code? That name that Dinis invented? (*Luísa shows with her hands the unit of repeat and separate it from the rest of the pattern)*
Luísa - ABABAB.
(...)
Teacher - What is the bit that is repeated which is always equal?
Tatiana - (*with two fingers points to the unit of repeat*) One two three (*counting the unit of repeat repetitions*).

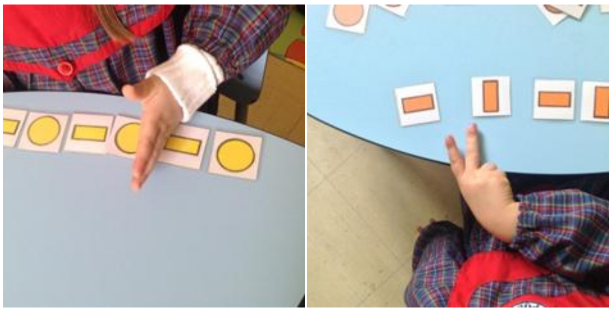

Figure 11. Luísa Identifying the Unit of Repeat and Tatiana Identifying and Counting the Units of Repeat Respectively

While António just verbalized the unit of repeat ("Circle rectangle "), Luísa read all the elements that she had built, representing them by the letters AB. Luísa used hand movements to help her separate the unit of repeat revealing an awareness of it. Like Tatiana, a large number of children could count the number of times that the unit of repeat repeats.

For the other type of patterns, the majority of children was able to copy and continue the patterns shown. Some children made them separating the respective unit of repeat. While António put the unit of repeat on the left, Guilherme and Joaquim put it over the pattern (figure 12).

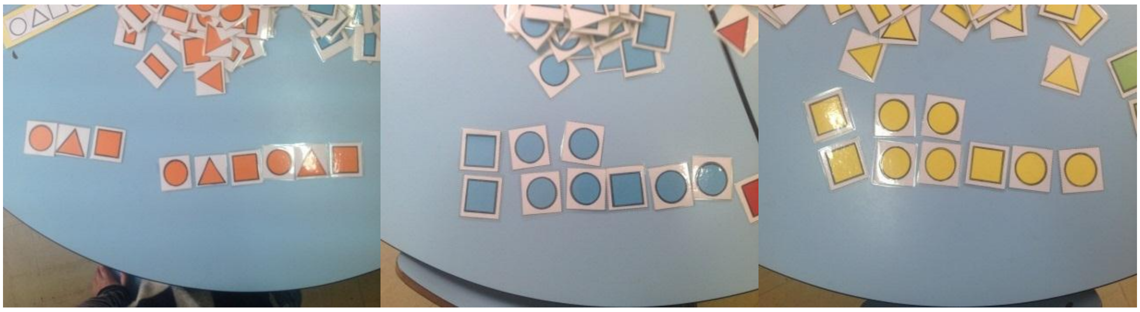

Figure 12. Isolating the Unit of Repeat in the Patterns Made by António, Guilherme and Joaquim

With these types of patterns, the teacher tried to understand if they could identify how often the different elements were repeated in a specific pattern, bearing in mind the unit of repeat. Concerning the circle triangle, square pattern, see the following excerpt which illustrates their thinking:

Teacher - And how many squares?
Matilde - (*counting*) One, two, three.
Teacher - And how many triangles?
Matilde - (*counting*) One, two, three.
David - One, two, three.
Teacher - And if you repeat your code 10 times, how many circles would you put? (*pause*) Don't you know? (*Matilde shakes her head*)
Fernando - Can I?
David - Can I?
Teacher - And you how often did you repeat the code?
David - (*with fingers*) One ... two ... three ... (*he gets a square because his pattern ended with a triangle*)
Teacher - So how many circles did you place in your pattern?
David - (*counting*)) One, two, three. Three.
Teacher - And how many triangles?
David - Three.
Teacher - And how many squares?
David - Three.
Teacher - And if you did the code five times how many circles would you place?
David - Five (*showing fingers*)
Fernando - I repeated six.
Teacher - (*to Matilde*) If you did your code six times how many circles would you place?
Matilde - Six.
Teacher - And if you repeat your code four times how many circles would you place?
David - Ahm ...... four!
Teacher - Four. Why?
Mário - So it is easier to make the numbers (*shows his pattern which has three units of repeat*).
Teacher - But why? Do you see something funny between the number of times we repeat the code and the number of shapes that we have?
David - I think it's funny because so we repeat, so the things… three we repeat and three the things. So many things.

These children seem to realize the relationship between repetitions number of the unit of repeat, its elements and the number of times that they are repeated. The children's response illustrated their thinking evolution. For example, David started by counting and after he answered a hypothetical question without difficulty, referring to the same number of times the code repeats explaining this relationship: "so we repeat, so the things… three we repeat and three the things".

In the seventh task, the children were asked to decorate a cake with sweets for Fly Fosca's party based on the book's illustrations. The cards represented the sweets. The children performed this task in small groups, having been formed into two groups. As in the previous task, the same type of material was used. A set of cards was given to each group: blue and red, for one group, and green and yellow to the other. The two groups had the same shapes available: squares, circles, triangles and rectangles. The children were asked to make patterns with the unit of repeat represented in each strip (figure 13).

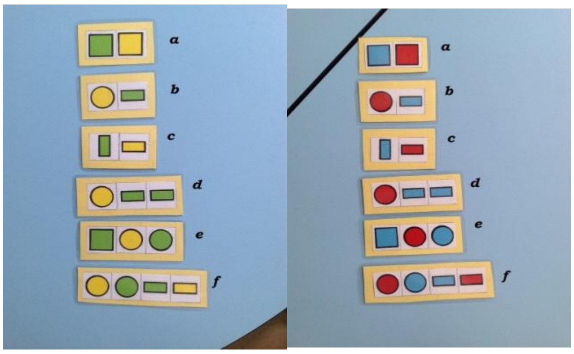

Figure 13. Strips with Units of Repeat Presented to Children

Most children had no difficulty in performing the task. Some of them used the strategy of isolating the unit of repeat to make the pattern again(figure 14). They copied the unit of repeat, the code, and then built the pattern easily.

Figure 14. - Isolating the Unit of Repeat Represented in the Strip to Make the Pattern

The given *a* pattern, which had two different colored squares (green, yellow) but maintained the shape attribute, most children read it referring to the alternation of colors. Matilde, Tatiana and David were the only children who read it referring to the name of the shape and not using any inflection to read it:

> Matilde - (*long pause before starting*) Square square square square square square square square square... (*looks at me).*

Considering Matilde, the absence of a rhythmic chant seems to be due to the fact that she has focused only on the geometrical shape which does not vary throughout the pattern. When building the pattern, the children appear to have no difficulty copying and continuing it. But when these three children began reading, they assumed the pattern had identical elements, once the children only refer to as square. However some children disagreed and the following excerpt illustrates their comments:

> David - Square square square square square square (*reading the pattern made*)
> Teacher - Can anyone tell me what kind of pattern is this?
> David - AB ... AAAAAA.
> Fernando - ABAB.
> Teacher - Fernando says it is ABAB and David says it's AAAAAA. Which is it?
> David - AB only if it’s like this. (*picks up a yellow square of its pattern and take from the pile ahead a green rectangle, putting the two together in the air*)
> Mário - AAAAA? This is not true!
> Teacher -Mário, explain to me how you were seeing it.
> Mário –It isn’t the same!
> Teacher - Isn’t it the same? So what’s different?
> Mário - Because we are using different colors, yellow ...they are the same shape ... but ... even if this has the same shape, but it’s not the same ... the same colors.

Fernando said that the pattern was AB type, and Mário explained that even though the cards had the same shape, square, the colors were different and one could not assign the same letter, since the pattern elements were different. The following excerpt illustrates the reading of the unit of repeat of *f* pattern made by David when he was looking at the strip, before its construction:

David – Yellow circle green circle green rectangle yellow rectangle.

Matilde and David were the only children that made a reading considering the two attributes, color and shape. Both children appear to have evolved in their pattern awareness, since in the previous *a* pattern, they made a reading using a single attribute, not taking into account the color. The evolution of complexity of the patterns did not appear to have influenced this reading, once the pattern *a* was AB type and the pattern *f* was ABCD.

CONCLUSION

The tasks presented here began with the creation of patterns and not with copy and continue models provided by adults. According to Threlfall (1999), it is essential the children create their own patterns formerly than to copy pre-established models. The study results reinforce this idea, since the children seem to grasp easily and significantly the notion of pattern and evolve their level of awareness of the structure of the patterns, through the implementation of this approach.

After the exploitation of the tasks, the whole group achieved the pattern concept and was able to create repeating patterns. The children's evolution in the level of complexity of patterns created was shown. They first started with patterns having units of repeat with a number of elements up to 3 (Vale et al., 2011), increasing that number to a higher number of elements, up to 5. Once, Dinis used a symmetrical approach when creating a pattern. The spontaneous way as Dinis collocated a pattern, intend to be linear, assuming a two-dimensional disposition, converges with results of Vale et al. (2011), since he did not respect the formation law in column. Nevertheless, unlike the results of Vale et al. (2011), most children did not need end the patterns with a entire unit of repeat.

The children were also able to identify errors in their pattern's construction when reading it out loud, in part due to the use of a rhythmic chant (Threlfall, 1999). Unlike the results reported by Garrick et al. (1999), the children were able to recognize the patterns of their own creation as well the patterns created by other children. Some strategies they used in the beginning seem to evidence the emergence of the awareness of the unit of repeat, such as the strategy of isolating the necessary pens to color the pattern or the strategies of helping the friends not to make mistakes in the pattern. Also important was the request of the teacher to explain the gesture patterns to friends, making only the gestures corresponding to the unit of repeat. The physical movements not only facilitate the representation of the pattern but also the perception of the unit of repeat (Threlfall, 1999). In the beginning of patterning work, there were different levels of awareness of the structure pattern: some children emphasized the unit of repeat by a rhythmic chant while others showed a higher level of awareness referring explicitly to the unit of repeat (Mulligan, 2013; Threlfall, 1999). For copying and continuing patterns more complexes, with units of repeat with 3 or more elements, some children used the strategy of isolating the unit of repeat to facilitate making the pattern.

The evolution in the level of complexity of the patterns created and recognized was due to the development of children in relation to the structure pattern awareness, seeing the pattern as a whole being related to the unit of repeat named by them as the 'code'. The "code" quickly helped understand the structure of a pattern. The use of letters to encode patterns allowed the children to recognize different structures of repeating patterns. They were not dependent on the material used in the sense they could transfer the same pattern to different modes or materials, corresponding to the strategy of advanced unit of repeat (Papic et al., 2011; Vale et al., 2011), the most sophisticated strategy.

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7TH GRADE STUDENTS'PROBLEM SOLVING SUCCESS RATES ON PROPORTIONAL REASONING PROBLEMS

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ABSTRACT: This research was conducted to investigate 7th grade students' problem solving success rates on proportional reasoning problems and whether these success rates change with different problem types. 331 randomly selected students of grade seven participated in this study. A problem test which contains three different types of missing value (direct proportional, inverse proportional and additive/non-proportional) word problems was designed as a data collecting tool for the research. Descriptive data analysis methods were used in this study. Analysis has shown that 7th grade students solved different problem types with different success rates. The findings of the study also indicate that problem types affect students' problem solving performances.

Key words: problem solving success rate, proportional reasoning, problem types

INTRODUCTION

Proportional Reasoning

Students' first experiences with mathematics are based on natural numbers in their school life. The first years of primary school includes addition and subtraction that is based on the first-order relationships between countable objects. In the middle school years, students introduce with rational numbers as well as natural numbers. During these years, students must make several major transitions in their mathematical thinking. A central change in thinking is required in a shift from natural number to rational numbers and from additive concepts to multiplicative concepts (McIntosh, 2013, p. 6). This is an important and difficult conceptual leap for students; mathematical experiences in elementary school focus primarily on countable objects and first-order relationships. In proportional situations students must replace additive reasoning and notions of change in absolute sense with multiplicative reasoning and notions of change in a relative sense (Baxter & Junker, 2001). This second-order relationship is difficult for students because it requires more complicated mental structures than simple multiplication and division. Piaget considered the development of proportional reasoning to be a turning point in the development of higher order reasoning (Aleman, 2007, p. 22). In this sense, the proportional reasoning ability merits whatever time and effort that must be expended to assure its careful development (NCTM, 2000; Ben-Chaim, Fey, Fitzgerald, Benedetto, Miller, 1988; Lesh, Post, Behr, 1988; Lamon, 1993; Baykul, 2009).

Smith (2002) described the importance and complexity of proportionality in this way: "No area of elementary school mathematics is as mathematically rich, cognitively complicated, and difficult to teach as proportionality (Johnson, 2010, p. 3). Many important concepts at the foundation level of elementary mathematics are often linked to proportional reasoning (NCTM, 2000, p. 212). Proportional reasoning is both capstone of elementary arithmetic and the cornerstone of all that is to follow. It therefore occupies a pivotal position in school mathematics programs (Lesh et al., 1988). Using proportional reasoning, students consolidate their knowledge of elementary school mathematics and build a foundation for high school mathematics. Students who fail to develop proportional reasoning are likely to encounter obstacles in understanding higher-level mathematics (Langrall & Swafford, 2000).

Problem types

Cramer & Post (1993) categorized proportional tasks as missing-value problems, numerical comparison problems and qualitative prediction and comparison problems. In missing-value problems three pieces of numerical information are given and one piece is unknown. In numerical comparison problems, two complete rates are given. A numerical answer is not required, however the rates are to be compared. Qualitative prediction and comparison problems require comparisons not dependent on specific numerical values. Van Dooren, De Bock, Hessels, Janssens, Verschaffel, (2005) categorized non-proportional tasks (i.e., problems for which a proportional solution was manifestly incorrect but for which another method could be applied to find the correct answer) as additive problems, constant problems and linear problems. In linear problems, the linear function underlying the problem situation is of the form f(x) = ax + b with b ≠ 0. Additive problems have a constant difference between the two variables, so a correct approach is to add this difference to a third value. Constant problems have no relationship at all between the two variables. The value of the second variable does not change, so the correct answer is mentioned in the word problem.

According to Lesh et al., (1988) proportional reasoning encompasses not only reasoning about the holistic relationship between two rational expressions but wider and more complex spectra of cognitive abilities which includes distinguishing proportional and non-proportional situations. Studies on proportional reasoning has shown that additive strategy is the most frequently used error strategy while students solve proportional problems (Tourniaire, 1986;Karplus, Pulos, Stage, 1983; Bart, Post, Behr, Lesh, 1994; Singh, 2000; Misailidou & Williams, 2003; Duatepe, Akkuş, Kayhan, 2005). Similarly, students give proportional responses to non-proportional problems (Duatepe et al., 2005;Van Dooren, De Bock, Vleugels, Verschaffel, 2010; Van Dooren, De Bock, Verschaffel, 2010; De Bock, Van Dooren, Janssens, Verschaffel, 2002; De Bock, De Bolle, Van Dooren, Janssens, Verschaffel, 2003). This shows that students have difficulty in distinguishing proportional and non-proportional problem statements.

The middle school mathematics curricula also include inverse proportional relations but in related literature this relations has not studied deeply so far. Thus it could be beneficial to study whether students can distinguish this kind of relations with other relations.

Statement of the problem

This research was conducted to investigate 7th grade students' problem solving success rates and whether these success rates change with different problem types. Depending on this aim, the research problem was determined as "What are the success rates of 7th grade students in solving missing value problems with different types?"

METHOD

Research design

Since survey studies collect data from a group of people in order to describe some aspects or characteristics (such as abilities, opinions, attitudes, beliefs or knowledge) of the population of which that group is a part (Fraenkel & Wallen, 2005), this research was carried out by using survey method.

Sample

A total of 331 (162 boys and 169 girls) randomly selected students of grade seven from five different public middle schools in 2014-2015 education year participated in this study.

Instrument

A problem test which contains three different types of missing value (direct proportional, inverse proportional and additive/non-proportional) word problems was designed as a data collecting tool for the research. Problem test consisted of 24 open ended items and these items were developed in parallel with the objectives of renewed elementary mathematics curriculum (MEB, 2013).

Data analysis

Descriptive data analysis methods were used in this study. Pupils' responses to the problems in the solution task were scored in order to determine their problem solving success rates on different problem types. To check the internal consistency of the instrument, Kuder Richardson-20 coefficient was calculated and was found to be 0,823.

RESULTS AND FINDINGS

Table 1 shows the mean scores on different types of problems. Analysis of the mean scores showed that students showed the best performance on solving direct proportional problems while the worst performance on solving non-proportional problems.

Table 1.Mean Scores on Different Types Problems

Problem Types	Direct Proportional	Inverse Proportional	Non-Proportional (Additive)	Total
Means	6,20	4,84	2,57	13,61

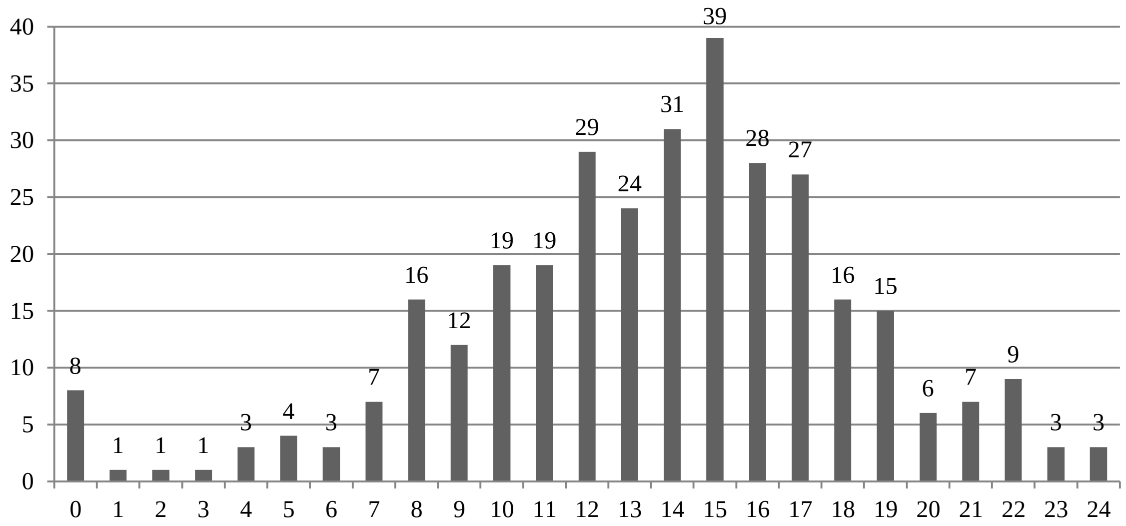

Figure 1. Frequency Histogram of The Total Scores

Figure 1 shows the distribution of the scores. The frequency histogram shows that the distribution of the scores is normal. Most of the students' scores concentrate between 8 and 19 points.

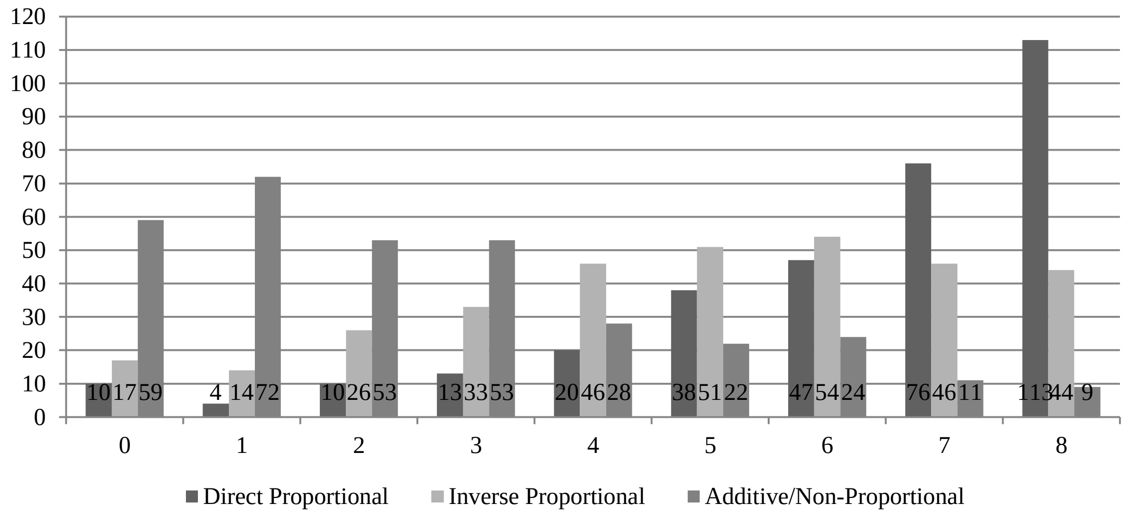

Figure 2. Frequency Histogram of The Scores on Different Types of Problems

Figure 2 shows the distribution of the scores on different types of problems. Students showed the best performance on direct proportional problems and worst performance on non-proportional (additive) problems.

Analysis taken from the data collecting tool has shown that 7th grade students solved different problem types with different success rates. The findings of the study also indicate that problem types affect students' problem solving performances. In detail, additive/non-proportional problems were solved with the lowest success rate, while direct proportional problems with the highest success rate. The tendency to overuse proportional responses in inverse proportional and additive/non-proportional situations was observed. Study showed that students have difficulty on distinguishing direct proportional, inverse proportional and non-proportional (additive) problem statements.

CONCLUSION AND RECOMMANDATIONS

The findings of the study revealed that problem affect students' success rate while solving missing value problems. Study also showed that students have difficulty on distinguishing direct proportional, inverse proportional and non-proportional (additive) problem statements. Students should encourage to realize the mathematical structures underlying the problems so that they can be more successful to distinguish direct proportional, inverse proportional and non-proportional (additive) problems and develop better conceptual understandings. In this sense, students should simultaneously be faced to both proportional (direct and inverse) and non-proportional (additive) problems in order to comprehend the mathematical structures underlying the problems. For further studies, it can be suggested to make clinical interviews with pupils in order to explore deeper understanding on how and why students make different success rates on different types of missing value problems.

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THE EFFECTS OF STUDENTS ATTENDANCE IN THE SUCCESS OF UNDERGRADUATE MATHEMATICAL COURSES-THE CASE OF THE SEE-UNIVERSITY

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ABSTRACT: This study investigates the influence of student's attendance in mathematics lectures and their final examination success. There are two basic objectives in this study: a) to identify the most common reasons of student's attendance/absence in mathematics lectures; and b) to identify the effect of the student's attendance in mathematical courses on their general results.

The population of the study consists of the second year students of two different faculties of the SEE-University, students from the faculty of Business Economics and the faculty of Contemporary Sciences and Technologies. A survey is realized during the academic year 2014/15.

This paper provides results of a survey completed at the beginning of the summer semester and results of the final success in Mathematics.

The results of this survey show that besides the most common reasons of their absence during the lectures/practical hours, as are their family engagements and other part time engagements, there are also some other reasons which are influenced of other different factors. The survey shows that the nature of these other reasons can be classified in different groups such are: the timetable of the lecture/practical hour is not suitable for them; the boring courses; the subject is difficult and they cannot understand, so, there is no reason to take part in it; and also as e reason is mentioned that they simply dislike the subject.

Using the method of logistic regression, we have indicated that student's attendance has a statistically significant impact on their final success in Mathematical courses.

These findings suggest that enhancement of student participation, is a crucial aspect of administration which improves their performance. At the same time, the lecturer should also create a good learning environment, to motivate students and enlarge their interest to the course.

Key words: mathematics lectures, attendance, absence, success, binary logistic regression.

INTRODUCTION

Taking into the consideration the society development, especially the development of the communication recourses as the consequence of the increasing of the electronically services, the students attendance is in the center of interest in a lot of Universities in the world. The development of the new contemporary technologies creates different possibilities of teaching in the way which is not depending of the attendance in the classes. Nevertheless, especially for the subject of mathematics there is a general opinion that the attendance is a very important factor in achieving the objectives of the teaching process. Therefore by this research we want to investigate the influence of this factor in our University. Teaching where the student is in the center of the process is a very important part of the teaching and learning process of cooperation.

It is a very known fact that mathematical and quantitative abilities of the person are very important and crucial factor in achieving a good results in each subject during the studies. But also, good mathematical background helps very much for the future. The chances for the employment, productivity in the life, and other important things in the future life are bigger if one has a good mathematical background.

Because of the reasons mentioned above, there is showing a big attention for the process of learning the subject of mathematics as well as the students performance in this subject. This attention is showing from the side of teachers, parents and all the society in general. So, it is of big interest to identify the main factors which influence in students achieving on the subject of mathematics. Identifying these factors, one can find the ways how to help students in improvement and progress in their academic life.

All of us who work with the students have a big concern and we always try to find the answer to the question "why students are missing during the lectures?". This concern is the topic of research studied from a lot of researchers. In the different researches done in this field, there are found a different reasons and also there are given a different explanations why students are missing in the classes. These studies have shown that there are some valuable reasons, and among others they happen as the consequence of everyday's life circumstances.

The literature suggests a lot of possible reasons for the missing of the students during the lectures and practical hours. Some of them are: They are employment, which means another engagement outside the studies, the health reasons, the additional sport activities, not appropriate schedule, the teaching methods used by the teacher, the teacher himself, the subject and its importance, the lack of motivation etc.

Some studies have confirmed that the students attendance is depended from the health factors. If they are fit and feel healthy then it results in better academic achieving (Donka Mirtcheva 2009).

There are also another factors with a considerable influence to the students attendance during the classes. One of the important factors why students do not attend the classes are related with the services given by the University. In this context Joanne (2007) has shown that the attendance is depending from the University services given to the students and she has discovered the so called "A phenomenon of student apathy or poor pedagogy".

In general the studies done in this field suggests that a very important think in order to improve the attendance is increasing and improvement of the pedagogical abilities of the lecturer. Massingham and Herrington (2006) are suggesting the teachers in general that they should be more careful in completing the students requirements. They have shown that the nowadays students are requesting more the lecturing where the student will be on the center of this process.

Lockwood et al. (2006) have analyzed the correlation between the obligatory presence during the classes with the final grades of the students in the subject where the attendance is obligatory. So the question of analysis is does the obligatory attendance improve the students grade? In their research they have found that there exists a very positive and strong statistical correlation between the attendance and the exam results achieved in the case of the students of agricultural sciences.

Purcell (2007) has studied the relation between the attendance during the classes with the students performance achieved on the end of the year. The study has done with the students of the second and third year of the engineering department at the University College Dublin. He has reporting that the average degree of the attendance in this case is 68%. On the other hand, Kirby and McElory (2003) on the research done with the sample of the first year students of the Economic department, have concluded that the average norm of attendance was 47%.

Maloney and Lally (1998) have found that there exists a very positive and significant statistical correlation between the attendance during the lectures and the students performance on the final exam. This research is done with the students of the third year of the Economic department of the Galway College University.

Cohen and Johnson (2006) have found a very positive dependence between the attendance and the academic performance. The study was done on the sample of 347 students of the Economic school.

In some recent studies, Spaho & Godolja (2014), Alija (2013) is used the so called binary logistic regression. By this study they try to find the dependence of the regular attendance to the final results achieved in the exams. The study done with the students of Economic department has shown that the regular attendance during the lectures have a significant statistical influence to the final success both on the subject of mathematics and some other subjects.

In general there are a variety of different factors which influence to the attendance in classes and the factors which have a very important role in achieving the academic success. They can be classified as the social-demographical factors such are the age, the gender, the revenues etc; then the psychological factors such are the motivation, the stress, the studying strategy etc; and also there are some other factors such are the schedule of the lectures, the ability of the lecturer, understanding the language of the lecturer, etc.

The purpose of this study is to analyze the influence and the effects of the student attendance on the final success on the subject of mathematics. The study is done with the second year students of the Department of Economic Faculty, and the Faculty of Contemporary Sciences of the SEE-University in Tetovo.

METHODS

As we mentioned above, the population of the study is consisted of the second year students of the Department of Economic Faculty, and the Faculty of Contemporary Sciences of the SEE-University in Tetovo.

The study is realized in two parts: The first part is depend on the survey realized with the 168 students of these two departments. The survey was build mainly on the questions of finding the reasons of their absence during the classes (both the lecture and the practical hours) on the subject of mathematics.

The second part of the study is focused mainly on the application of the logistical regression in order to find the relations between the students attendance during the classes and their performance and achieved success on the subject of mathematics.

We have gathered the data of 168 students concerning their attendance during the classes and their final success achieved in the subject of mathematics. The data were gathered on the end of the semester after ending with the course.

In order to evaluate the effects of the student attendance on their final success on the subject of mathematics, we have used the binary logistical regression. For this purpose in order to compute the results we have used the MedCalc software.

LOGISTIC REGRESSION WITH BINARY RESPONSE

Let Y be a binary response variable, which is coded as 0 or 1, referred to as fail or pass, respectively. Then the logistic regression model is given as follows:

$$\pi(x) = \frac{e^{\beta_0 + \beta_1 x}}{1 + e^{\beta_0 + \beta_1 x}} \ ,$$

$\pi(x)$ Represents the conditional mean of Y given *x*, i.e. $E(Y \setminus x)$. The value of response variable given *x* can be expressed as $y = \pi(x) + \varepsilon$, ε is the error term. If y =1, then $\varepsilon = 1 - \pi(x)$ with probability $\pi(x)$ and if y = 0, $\varepsilon = -\pi(x)$ with probability $1 - \pi(x)$. Therefore, ε follows a binomial distribution with mean 0 and variance $\pi(x)\left[1 - \pi(x)\right]$. A transformation of $\pi(x)$ which is called logit function is required:

$$g(x) = \ln\left[\frac{\pi(x)}{1 - \pi(x)}\right] = \beta_0 + \beta_1 x$$

The unknown parameters are estimated by the method of maximum likelihood estimation with given likelihood function for $\beta = (\beta_0, \beta_1)$ given as $L(\beta) = \prod_{i=1}^{n} \pi(x_i)^{y_i} \left[1 - \pi(x_i)\right]^{1-y_i}$.

FITTING LOGISTIC MODEL WITH BINARY EXPLANATORY VARIABLES

Let us consider the interpretation of the coefficients for logistic regression model with the case where explanatory variables are at the nominal level of measurement. Assume that X is coded either 0 or 1. Then the difference between logit function when x=1 and x=0 is given as $g(1) - g(0) = \beta_1$. To interpret this result, a measure of association called odds ratio (OR) is required:

$$OR = \frac{\pi(1) / \left[1 - \pi(1)\right]}{\pi(0) / \left[1 - \pi(0)\right]} = e^{\beta_{11}}$$

Odds ratio provides an approximation how much more likely or unlikely it is for the response variable to occur among those with x = 1 than among those with x = 0. For details, one can see Hosmer and Lemeshow (2000).

RESULTS AND DISCUSSIONS

Concerning the first part of the study, we have got that 72.35% of the students were missed less than 30% of classes, and on the other hand, just 27,65% of the studetns were missed more than 30% of the classes. This is shown on **figure 1**.

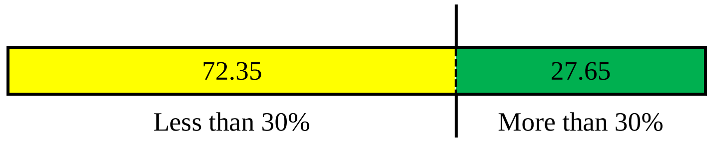

Figure 1. Proportion Of Lectures And Practical Sessins Attend

The reasons for not attending the lectures and the practical hours were of different nature and we have classified them with (1=not usual reason - 3=the most frequent reason). The obtained results show that as the most frequent reasons of not attending the classes are: not appropriate schedule of classes, the social and other free activities of the students, the difficult course where they don't see a reason why to attend if they do not understand the discussed topics, etc. At the table 1 is given a classification of the most common reasons for missing lectures and practical sessions.

Table 1. Thinking Backs Over Your Time At University So Far What Are The Most Common Reasons For Missing Lectures And Practical Sessions

(3 being the most common reason and 1 being the least common reason)	**Percentage Frequencies**		
	1	2	3
Engagement in the work out studies	55.23	21.82	22.95
There was only one lecture in a day	49.09	34.42	16.49
There were too many consecutive sessions in the day	47.25	32.00	20.75
The lectures/tutorials were too early or too late in the day	28.26	34.55	37.19
I had problems with transport	52.18	25.45	22.37
The weather conditions were too bad	58.64	26.24	15.12
I was ill	64.36	21.82	13.82
I had appointments with doctors or dentists	68.36	20.00	11.64
I had family commitments	45.45	30.73	23.82
I was on holiday	66.45	21.22	12.33
I was tired	42.36	31.28	26.36
I was engaged in other social or recreational activities	49.23	15.23	35.54
I was suffering from the effects of alcohol	75.23	15.25	9.52
I had already studied the material elsewhere(transfer)	70.91	16.36	12.73
The material covered was too difficult	43.64	32.73	23.63
The subject matter was boring	35.00	32.23	32.77
Lack of motivation	48.89	32.73	18.38
I was not interested in the subject matter	52.73	29.09	18.18
I do not like the lecturer	53.28	27.27	19.45
I was completing other work or assessments	49.09	23.64	27.27

For the second part of the study, we have gathered the data on the end of the semester (after we have finished by lecturing). as we have mentioned previously the data were taken for the course of mathematics. On the **figure 2** we present the general success achieved on the subject of mathematics.

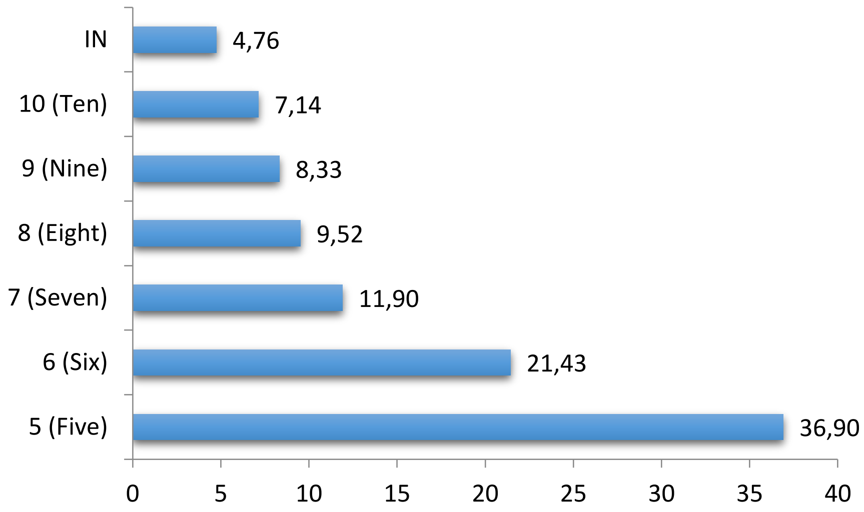

Figure 2. Scores In Mathematics

The main purpose of the study was to analyze the effect of the student attendance during the lectures and the practical sessions on the final results (success) in the subject of mathematics.

For this purpose, in order to apply the logistic regression, as the main variables of our study are taken the student attendance as the dependent variable and the final success of the student as the independent variable. The first variable is defined as the *dummy independent variable* and it is coded by 0 if the student has missed more than 30% of the classes, and by 1 if he has missed less than 30% of the classes. The second variable is defined as the *dummy dependent variable* and it is coded by 0 if the student doesn't pass the exam, and by 1 if the student has passed the exam.

setting the dialogue table of the program MedCalc for finding the logistical regression, the data for the final success of the students in the subject of mathematics are given in the table2.

Table 2. Estimation Results For Logistic Regression

Dependent Y	**Grade**

Method	Enter

Sample size	168
Cases with Y=0	70 (41.67%)
Cases with Y=1	98 (58.33%)

Overall Model Fit

Null model -2 Log Likelihood	228.209
Full model -2 Log Likelihood	204.360
Chi-square	23.849
DF	1
Significance level	P < 0.0001

Coefficients and Standard Errors

Variable	Coefficient	Std. Error	P
Attendance	1.59768	0.33895	<0.0001
Constant	-2.1630		

Odds Ratios and 95% Confidence Intervals

Variable	Odds ratio	95% CI
Attendance	4.9415	2.5430 to 9.6025

Classification table (cut-off value p=0.5)

Actual group	Predicted group		Percent correct
	0	1	
Y = 0	44	26	62.86 %
Y = 1	25	73	74.49 %
Percent of cases correctly classified			69.64 %

ROC curve analysis

Area under the ROC curve (AUC)	0.687
Standard Error	0.0424
95% Confidence interval	0.611 to 0.756

Using the obtained results from the table 2, one can get the logit model given below:

$$\log it\left(p\right)=\ln\frac{p}{1-p}=-2{,}163+1{,}59768\,X_{At}$$

The ratio of the chances (odds ratios) for this variable is $X_{At}=4.94>1$. This means that the student who has missed less than 30% of the lectures and practical sessions, has 5 times more chances to get a passing grade (to pass the exam) in the mathematic subject compared with the students who have missed more than 30% of the classes.

The percentage of the predicted cases in our study is 69,64%. This means that 69,64% of the predicted cases fulfill this prediction.

CONCLUSIONS

The subject of mathematics is very important for the students of our University. It is a very useful tool which helps in achieving the objectives in other subjects. The better results in mathematics implies the better success during the studies and their carrier in the future. Therefore it is very important to identify some of the basic factors which influence to the student performance in this subject. Identifying this factors, we can help students in improving of their abilities and progress in the subject of mathematics.

The obtained results have shown that the students attendance in lectures and practical sessions is depended of some factors, where the most frequent are: the reason because of the not appropriate schedule, the other social activities of the students, the difficult and unclear course, etc.

The results obtained from the binary logistical regression have shown that the student attendance in lectures and practical sessions is statistically very important independent variable. The students who have missed less than 30% of the classes, have approximately 5 times better chances to pass the exam of mathematics, versus the students who have missed more than 30% of classes.

Taking into the consideration the results obtained from this research, we give the following suggestion: There should be given a considerable importance to the students attendance during the classes. In order to improve this, it is of big importance participation of each side in this direction, starting from the administration of the University, the family and the lecturer. In order to motivate the students for their active participation on the classes, the lecturers should use different methods and strategies. The active participation will increase their interest for the subject and this will imply in achieving the better results and will improve the students performance in general.

Also, the lecturer should create a good environment for teaching. By this he can motivate the students and increase their interest for the subject. As we have confirmed by this research, as well as the other researches done in this field, there exists a very significant correlation between the attendance and the student performance.

It is a very big challenge for the teachers in general, to identify the factors which can increase the attendance and which can affect in the improvement of students achieving in general.

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PRESCHOOLERS LEARN PROPORTIONALITY AND INTEGRATION THROUGH ICON-COUNTING AND NEXT-TO ADDITION

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ABSTRACT: Preschool allows rethinking mathematics outside the tradition of ordinary school. Seeing schooling as adapting the child to the outside world containing many examples of Many, we can ask: How will mathematics look like if built as a natural science about physical fact Many? To deal with Many we count and add. The school counts in tens, but preschool allows counting in icons also. Once counted, totals can be added. To add on-top the units are made the same through recounting, also called proportionality. Adding next-to means adding areas, also called integration. So icon-counting and next-to addition offers golden learning opportunities in preschool that is lost in ordinary school allowing only ten-counting to take place.

Key words: count, add, proportionality, integration, preschool

MATH IN PRESCHOOL – A GREAT IDEA

Mathematics is considered one of the school's most important subjects. So it seems a good idea to introduce mathematics in preschool - provided we can agree upon what we mean by mathematics.

As to its etymology Wikipedia writes that the word mathematics comes from the Greek máthēma, which, in the ancient Greek language, means "that which is learnt". Later Wikipedia writes:

> In Latin, and in English until around 1700, the term mathematics more commonly meant "astrology" (or sometimes "astronomy") rather than "mathematics"; the meaning gradually changed to its present one from about 1500 to 1800. (http://en.wikipedia.org/wiki/Mathematics)

This meaning resonates with Freudenthal writing:

> Among Pythagoras' adepts there was a group that called themselves mathematicians, since they cultivated the four "mathemata", that is geometry, arithmetic, musical theory and astronomy. (Freudenthal 1973: 7)

Thus originally mathematics was a common word for knowledge present as separate disciplines as astronomy, music, geometry and arithmetic.

This again resonates with the educational system in the North American republics offering courses, not in mathematics, but in its separate disciplines algebra, geometry, etc.

In contrast to this, in Europe with its autocratic past the separate disciplines called Rechnung, Arithmetik und Geomtrie in German were integrated to mathematics from grade one with the arrival of the 'new math' wanting to revive the rigor of Greek geometry by defining mathematics as a collection of well-proven statements about well-defined concepts all being examples of the mother concept set.

Kline sees two golden periods, the Renaissance and the Enlightenment that both created and applied mathematics by disregarding Greek geometry:

> Classical Greek geometry had not only imposed restrictions on the domain of mathematics but had impressed a level of rigor for acceptable mathematics that hampered creativity. Progress in mathematics almost demands a complete disregard of logical scruples; and, fortunately, the mathematicians now dared to place their confidence in intuitions and physical insights. (Kline 1972: 399)

Furthermore, Gödel has proven that the concept of being well-proven is but a dream. And Russell's set-paradox questions the set-based definitions of modern mathematics by showing that talking about sets of sets will lead to self-reference and contradiction as in the classical liar-paradox 'this sentence is false' being false if true and true if false: If M = □A | A□A)□ then M□M □ M□M.

With no general agreement as to what mathematics is and with the negative effects of imposing rigor, preschool mathematics should disintegrate into its main ingredients, algebra meaning reuniting numbers in Arabic, and geometry meaning measuring earth in Greek; and both should be grounded in their common root, the physical fact Many. To see how, we turn to skeptical research.

POSTMODERN CONTINGENCY RESEARCH

Ancient Greece saw a controversy between two different forms of knowledge represented by the sophists and the philosophers. The sophists warned that in a republic people must be enlightened about choice and nature to prevent being patronized by choices presented as nature. In contrast to this philosophers saw everything physical as examples of meta-physical forms only visible to the philosophers educated at Plato's academy, who then should be allowed to patronize.

Enlightenment later had its own century that created two republics, an American and a French. Today the sophist warning against hidden patronization is kept alive in the French republic in the postmodern skeptical thinking of Derrida, Lyotard, Foucault and Bourdieu warning against patronizing categories, discourses, institutions and education presenting their choices as nature (Tarp 2004).

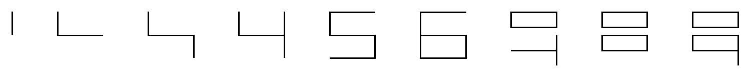
Thus postmodern skeptical research discovers contingency, i.e. hidden alternatives to choices presented as nature. To make categories, discourses and institutions non patronizing they are grounded in nature using Grounded Theory (Glaser et al 1967), the method of natural research developed in the other Enlightenment republic, the American; and resonating with Piaget's principles of natural learning (Piaget 1970) and with the Enlightenment principles for research: observe, abstract and test predictions.

With only little agreement as to what mathematics is we ask: How will mathematics look like if built as a natural science about the physical fact Many, and how can this affect early childhood education?

BUILDING A NATURAL SCIENCE ABOUT MANY

To deal with the physical fact Many, first we iconize, then we count by bundling. With 'first order counting' we rearrange sticks in icons. Thus five ones becomes one five-icon 5 with five sticks if written in a less sloppy way. In this way we create icons for numbers until ten since we do not need an icon for the bundle-number as show when counting in e.g. fives: one, two, three, four, bundle, one bundle and one, one bundle and two etc..

I II III IIII IIIII IIIIII IIIIIII IIIIIIII IIIIIIIII



1 2 3 4 5 6 7 8 9

Figure 1. Icons Contain As Many Sticks As They Represent

With 'second order counting' we bundle a total in icon-bundles. Here a total T of 7 1s can be bundled in 3s as T = 2 3s and 1. The unbundled can be placed in a right single-cup, and in a left bundle-cup we place first the bundles to be traded, first with a thick stick representing a bundle glued together, then with a normal stick representing the bundle. The cup-contents is described by icons, first using 'cup-writing' 2)1), then using 'decimal-writing' with a decimal point to separate the bundles from the unbundled, and including the unit 3s, T = 2.1 3s. Alternatively, we can also use plastic letters as B, C or D for the bundles.

IIIIIII → III III I → III III) I) → ▌▌) I) → II) I) → 2)1) → 2.1 3s or BBI → 2BI

Using squares or LEGO blocks or an abacus, we can stack the 3-bundles on-top of each other with an additional stack of unbundled 1s next-to, thus showing the total as a double stack described by a decimal number.

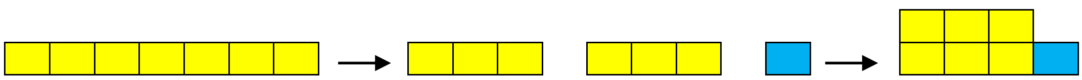


Figure 2: Seven 1s First Becomes 2 3s & 1, Then 2x3 + 1 Or 2.1 3s

We live in space and in time. To include both when counting, we can introduce two different ways of counting: counting in space, geometry-counting, and counting in time, algebra-counting. Counting in space, we count blocks and report the result on a ten-by-ten abacus in geometry-mode, or with squares. Counting in time, we count sticks and report the result on a ten-by-ten abacus in algebra-mode, or with strokes.

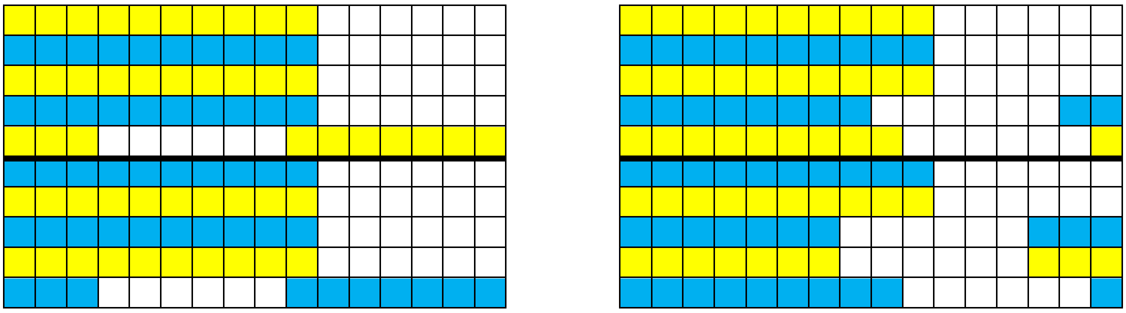


Figure 3: Counting 7 1s As 2.1 3s On An Abacus With Geometry Mode Below And Algebra Mode Above

To predict the counting result we can use a calculator. Building a stack of 2 3s is iconized as 2x3 showing a jack used 2 times to lift the 3s. As to the two icons for taking away, division shows the broom wiping away several times, and subtraction shows the trace left when taking away just once. Thus by entering '7/3' we ask the calculator 'from 7 we can take away 3s how many times?' The answer is '2.some'. To find the leftovers we take away the 2 3s by asking '7 – 2x3'. From the answer '1' we conclude that T = 7 = 2.1 3s. Showing '7 – 2x3 = 1', a display indirectly predicts that 7 can be recounted as 2 3s and 1.

7 / 3	2.some
7 – 2 x 3	1

Figure 4: A Calculator Predicts That 7 1s Can Be Recounted As 2.1 3s

Re-counting In The Same Unit And In A Different Unit

Once counted, totals can be re-counted in the same unit, or in a different unit. Recounting in the same unit, changing a bundle to singles allows recounting a total of 4 2s as 3.2 2s, 2.4 2s. Likewise 4.2s can be recounted as 5 2s less or short of 2; or as 6 2s less 4 thus leading to negative numbers:

Letters	Sticks	Calculator		T =
B B B B	Ⱨ Ⱨ Ⱨ Ⱨ			4.0 2s
B B B I I	Ⱨ Ⱨ Ⱨ I I	4x2 – 3x2	2	3.2 2s
B B I I I I	Ⱨ Ⱨ I I I I	4x2 – 2x2	4	2.4 2s
B I I I I I I	Ⱨ I I I I I I	4x2 – 1x2	6	1.6 2s
I I I I I I I I	I I I I I I I I	4x2 – 0x2	8	0.8 2s
B B B B B	Ⱨ Ⱨ Ⱨ Ⱨ Ⱨ	4x2 – 5x2	-2	5.2 2s
B B B B B B	Ⱨ Ⱨ Ⱨ Ⱨ Ⱨ Ⱨ	4x2 – 6x2	-4	6.4 2s

Figure 5: Recounting 4 2s In The Same Unit

To recount in a different unit means changing unit, called proportionality or linearity also. Asking '3 4s is how many 5s?' we can use sticks or letters to see that 3 4s becomes 2.2 5s.

IIII IIII IIII → IIIII IIIII I I → 2) 2) 5s → 2.2 5s, or with C = BI, BBB → BBIIII → CCII

Using geometry-counting on an abacus, reserving the bottom line for the single 1s, a stack of 3 4s is moved from left to right on an abacus. The top bundle is changed to 1s in the single line and twice a stick is removed to enlarge the two 4-bundles to 5-bundles. This shows that '3 4s can be recounted as 2.2 5s.'

Using algebra-counting, 3 beads are moved to the right on the bundle-line. Then one 4-bundle is changed to 4 1s on the single-line. Moving 2 beads to the left on the single-line allows enlarging the 4s to 5s thus showing that 3 4s = 2.2 5s

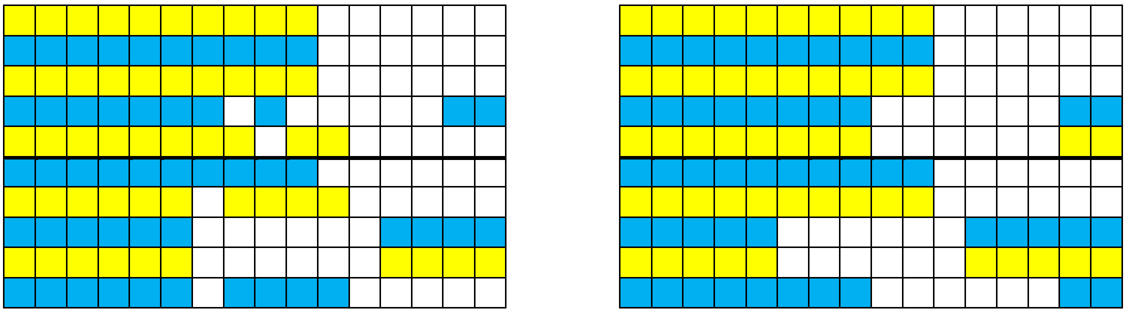


Figure 6: Re-counting 3 4s As 2.2 5s On An Abacus With Geometry And Algebra Mode

Using a calculator to predict the result we enter ‘3x4/5’ to ask ‘from 3 4s we take away 5s how many times?’ The calculator gives the answer ‘2.some’. To find the leftovers we take away the 2 5s and ask ‘3x4 – 2x5’. Receiving the answer ‘2’ we conclude that T = 3 4s = 2.2 5s.

3 x 4 / 5	2.some
3 x 4 – 2 x 5	2

Figure 7: A Calculator Predicts That 3 4s Can Be Recounted As 2.2 5s

Adding On-top And Next-to

Once counted, totals can be added on-top or next-to. Asking ‘3 5s and 2 3s total how many 5s?’ we see that to be added on-top, the units must be the same, so the 2 3s must be recounted in 5s giving 1.1 s that added to the 3 5s gives a grand total of 4.1 5s.

IIIII IIIII IIIII III III → IIIII IIIII IIIII IIIII I → 4) 1) 5s → 4.1 5s, or 3B + 2C = 3B III III = 4BI

On an abacus in geometry mode a stack of 3 5s is moved to the right and a stack of 2 3s is moved to the middle. Now, the 2 3s is changed to 6 1s on the bottom line allowing one additional 5s to be moved to the top of the stack of 5s to show the grand total is 4.1 5s. Using algebra mode, the 3 5s become 3 beads on the bundle line and the 2 3s become 2 beads on the line above. Again the 2 3s is changed to 6 1s on the bottom line allowing one additional bead to be added to the bundle-line to give the result 4.1 5s

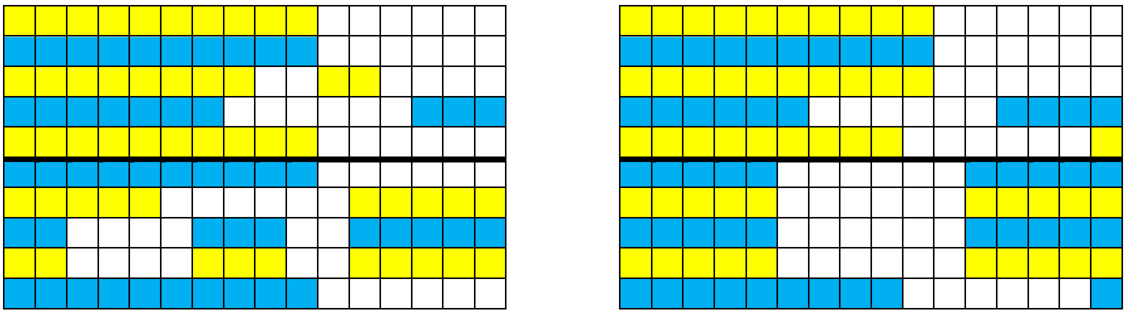


Figure 8: On-top Addition Of 3 5s And 2 3s As 5s On An Abacus With Geometry And Algebra Mode

Using a calculator to predict the result we include the two totals in a bracket before counting in 5s: Asking ‘(3x5 + 2x3)/5’ gives the answer 4.some. Taking away 4 5s leaves 1. So the answer is 4.1 5s.

(3 x 5 + 2 x 3)/ 5	4.some
(3 x 5 + 2 x 3) – 4 x 5	1

Figure 9: A Calculator Predicts That On-Top Addition Of 3 5s And 2 3s Gives 4.1 5s

To add next-to means adding areas called integration also. Asking ‘3 5s and 2 3s total how many 8s?’ we can use sticks or letters to see that the answer is 2.5 8s.

IIIII IIIII IIIII III III → IIIII III IIIII III IIIII → 2) 5) 8s → 2.5 8s, or 3B + 2C = 2BC + B

On an abacus in geometry mode a stack of 3 5s is moved to the right and a stack of 2 3s is moved to the middle. Now a 5-bundle is moved to the single line allowing the two stacks to be integrated as 8s, showing that the grand total is 2.5 8s. Likewise when using algebra mode.

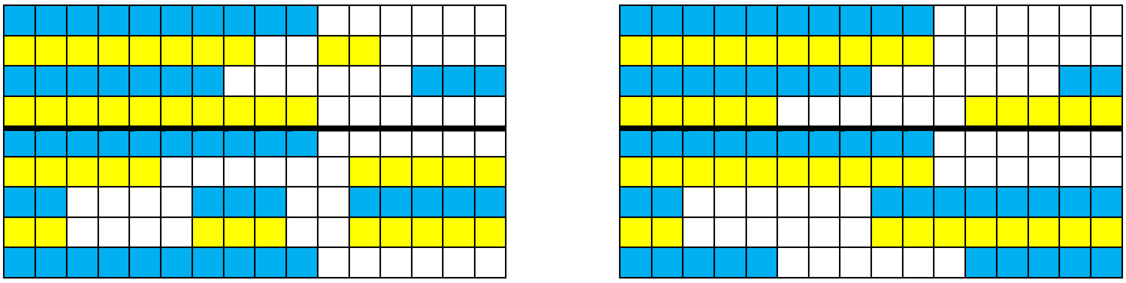


Figure 10: Next-to Addition Of 3 5s And 2 3s As 8s On An Abacus With Geometry And Algebra Mode

Using a calculator to predict the result we include the two totals in a bracket before counting in 8s: Asking '(3x5 + 2x3)/8' gives the answer 2.some. Taking away the 2 8s leaves 5. So the answer is 2.5 8s.

(3 x 5 + 2 x 3)/ 8	2.some
(4 x 5 + 2 x 3) – 2 x 8	5

Figure 11: A Calculator Predicts That Next-To Addition Of 3 5s And 2 3s Gives 2.5 8s

Reversing Adding On-top And Next-to

To reverse addition is called backward calculation or solving equations also. Asking '3 5s and how many 3s total 4.1 5s?' we can use sticks or letters to see that the answer is 2 3s:

IIIII IIIII IIIII III III ← IIIII IIIII IIIII IIIII I ← 4) 1) 5s ← 4.1 5s, or 4BI = 3B IIIII I = 3B + 2C

On an abacus in geometry mode a stack of 4 5s and 1 is moved to the right and a stack of 3 5s is moved back to the left. Now the remaining is recounted in 3s as 2 3s. Using algebra mode, after moving 3 bundle-beads to the left, the last is changed to 1s, allowing the 1s to be recounted as 2 3s.

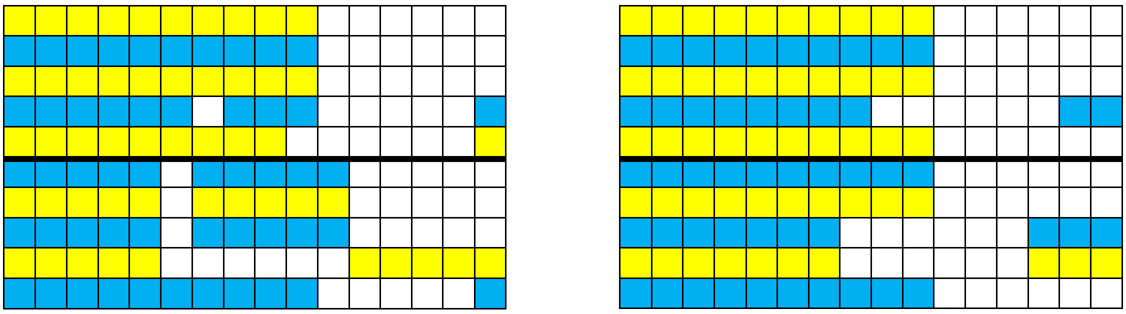


Figure 12: Reversed On-top Addition Of 3 5s And Some 3s to 4.1 5s On An Abacus

Using a calculator to predict the result we include the two totals in a bracket before counting in 3s: Asking '(4x5 +1 – 2x3)/3' gives the answer 2. Taking away the 2 3s leaves 0. So the answer is 2.0 3s or 2 3s.

(4 x 5 + 1 – 3 x 5)/ 3	2
(4 x 5 + 1 – 3 x 5) – 2 x 3	0

Figure 13: A Calculator Predicts That 2 3s Is What Must Be Added To 3 5s To Give 4.1 5s

To reverse next-to addition is called reversed integration or differentiation also. Asking '3 5s and how many 3s total 2.5 8s?' we can use sticks or letters to see that the answer is 2 3s:

IIIII IIIII IIIII III III ← IIIII III IIIII III IIIII ← 2) 5) 8s ← 2.5 8s, or = 2BC + B = BCBC B = 3B + 2C

On an abacus in geometry mode a stack of 2 8s and 5 is moved to the right and a stack of 3 5s is moved back to the left. Now the remaining is recounted in 3s as 2 3s. Using algebra mode, each 8-bundle can be changed to a 5-bundle and 3 1s. So moving 3 5s to left leaves 2 3s.

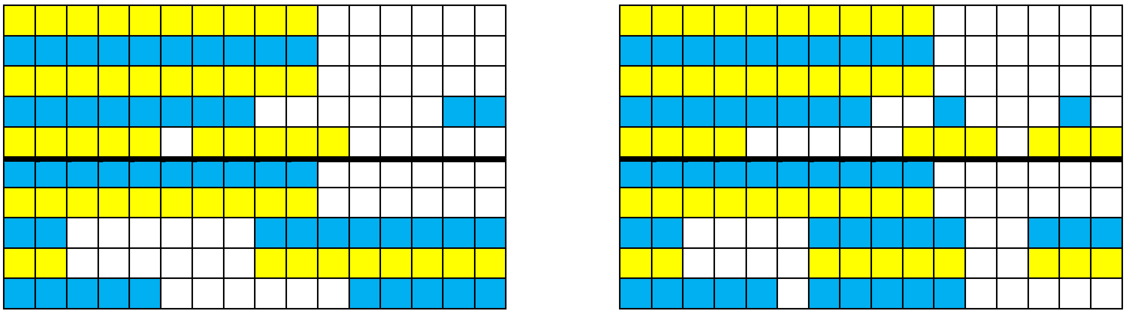


Figure 14: Reversed Next-to Addition Of 3 5s And Some 3s To 2 8s On An Abacus

Using a calculator to predict the result we include the two totals in a bracket before counting in 3s: Thus asking '(4x5 +1 – 2x3)/3' gives the answer 2. Taking away the 2 3s leaves 0. So the answer is 2.0 3s or 2 3s.

(2 x 8 + 5 – 3 x 5)/ 3	2
(2 x 8 + 5 – 3 x 5) – 2 x 3	0

Figure 15: A Calculator Predicts That 2 3s Is What Must Be Added To 3 5s To Give 2.5 8s

We notice that adding the two stacks 2 3s and 4 5s next-to each other means performing multiplication before adding; and that reversing integration means performing subtraction before division, as in the gradient formula y' = dy/t = (y2 – y1)/t.

Overloads And Extra Cups

With overloads also bundles can be bundled and placed in a new cup to the left. Thus in 6.2 3s, the 6 3-bundles can be re-bundled into two 3-bundles of 3-bundles, i.e. as 2))2 or 2)0)2), leading to the decimal number 20.2 3s:

III III) II) → II)) II), or 6)2) = 2))2) = 2)0)2, or 6.2 3s = 20.2 3s.

Adding an extra cup to the right shows that multiplying with the bundle-size just moves the decimal point:

T = 2.1 3s = 2)1) → 2)1)) = 21.0 3s

Traditional Counting

Traditional mathematics counts in tens only, which can be called 'third order counting'. Written in its full form, 354 = 3*10^2 + 5*10 + 4*1 becomes a sum of areas placed next-to each other, thus showing the four ways to unite numbers: Power unites bundles of bundles into a new bundle-size, multiplication unites like bundles into stacks, integration unites stacks with different bundle-size, and addition unites singles. Reversing uniting is predicted by the inverse operations called root, division, differentiation and subtraction. Thus it makes good sense that algebra means to reunite in Arabic.

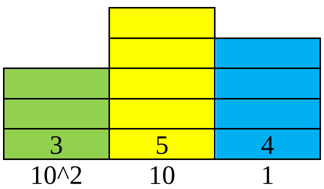


Figure 16: The Number 354 = 3*10^2 + 5*10 + 4*1 Shown As Three Integrated Stacks

The Two Counting Formulas

We have seen that to count a total of 7 in 3s, first we take away as many 3-byndles as possible, symbolized as 7/3, to be arranged as a stack of 2 3-bunles, symbolized as 2x3, that then is taken away to look for leftovers, symbolized as 7 – 2x3. Thus the counting process involves division, multiplication and subtraction, but no addition.

Counting a total T in 3s gives the counting result that T can be counted in T/3 3s. Thus we can set up a recounting formula T = (T/b) x b saying that a total T can be counted as (T/b) bs. This formula is also called a proportionality formula showing that proportionality is just another word for shifting units.

To look for leftovers, the stack is taken away and placed next-to what is left of the original total T. Again we can set up a restacking formula T = (T – b) + b saying that a total can be split into a stack and leftovers.

COMPARING MANYMATICS AND MATHEMATICS

Using postmodern contingency research we have discovered a natural science about the physical fact Many that can be called 'ManyMatics' and that allows us to deal with Many by counting and adding: First we count in icons, then in icon-bundles allowing a total to be written in a natural way as a decimal number with a unit where the decimal point separates the bundles from the unbundled. To add on-top and next-to we change the unit by recounting, predicted by a recount- and a restack-formula. Written out fully as stacked bundles, numbers show the four ways to unite: on-top and next-to addition, multiplication, and power. And to reverse addition we need inverse operations (Zybartas et al 2005), (YouTube), (Tarp 2014).

Counting Many by cup-writing and as stacked bundles contains the core of the mathematical sub-disciplines algebra and geometry. However there are fundamental differences between ManyMatics and Mathematics.

In the first an icon contains as many sticks or strokes as it represents, in the second an icon is just a symbol. In the first a natural number is a decimal number with a unit using the decimal point to separate bundles and unbundled; in the second a natural number hides the unit and misplaces the decimal point one place to the right.

The first presents operations as icons with the natural order division, multiplication, subtraction and two kinds of addition, on-top and next-to; the second presents operations as symbols; the order is the opposite; and next-to addition is neglected. The first uses a calculator for number prediction. The second neglects it. The first allows counting in icons, the second only allows counting in tens.

With ten as THE bundle-size, recounting becomes irrelevant and impossible to predict by a calculator since asking '3 8s = ? tens' leads to T = (3x8/ten) tens that cannot be entered. Now the answer is given by multiplication, 3x8 = 24 = 2 tens + 4 1s, thus transforming multiplication into division. Likewise adding next-to is neglected and adding on-top becomes THE way to add.

Furthermore the tradition changes mathematics into 'metamatism', a combination of 'meta-matics' and 'mathema-tism' where metamatics turns mathematics upside down by presenting concepts as examples of abstractions instead of as abstractions from examples, thus insisting that numbers are examples of sets in one-to-one correspondence; and where mathematism allows addition without units, thus presenting '1+2=3' as a natural fact in spite of its many counterexamples as 1 week + 2 days = 9 days, 1 m + 2 cm = 102 cm etc.

Thus the goal of a preschool curriculum should be the golden learning opportunities coming from icon-counting and next-to addition since they both disappear when traditional metamatism suppresses ManyMatics from day one in school. So ManyMatics is an example of postmodern 'paralogy' described by Lyotard to be a dissension to the ruling consensus (Lyotard 1984, 61).

THE TRADITIONAL PRESCHOOL MATHEMATICS

At the twelfth International Congress on Mathematical Education, ICME 12, the topic study group on Mathematics education at preschool level contains two interesting contributions from Sweden (http://www.icme12.org/sub/tsg/ tsg_last_ view.asp?tsg_param=1). The second discusses the content knowledge needed for preschool teachers to guide mathematical learning; and the first discusses the difficulties trying to categorize children behavior according to the revised preschool curriculum in Sweden from 2011, inspired by five categories claimed by Bishop to constitute mathematics (Bishop 1988).

The five categories are counting, i.e. the use of a systematic way to compare and order discrete phenomena; locating, i.e. exploring one's spatial environment and conceptualizing and symbolizing that environment, with models, diagrams, drawings, words or other means; measuring, i.e. quantifying qualities for the purposes of comparison and ordering; designing, i.e. creating a shape or design for an object or for any part of one's spatial environment; and playing, i.e. devising, and engaging in, games and pastimes, with more or less formalised rules that all players must abide by.

Bishop's five activities reminds of Niss' eight competencies: thinking mathematically; posing and solving mathematical problem; modelling mathematically ; reasoning mathematically; representing mathematical entities; handling mathematical symbols and formalisms; communicating in, with, and about mathematics; and making use of aids and tools (Niss 2003). Both define mathematics with action words. Bishop uses general words whereas Niss is caught in self-reference by including the term mathematics in its own definition.

However, both exceed in numbers vastly the two activities of ManyMatics, counting and adding, so skeptical thinking could ask: Since the numbers of activities alone makes it almost impossible for teachers and children to learn, is there a hidden patronizing agenda in these longs lists since just two activities or competences are needed to deal with the physical fact Many? And is it mathematics or metamatism these lists define?

To illustrate the issue we now look at the web-based training of in-service teachers at the MATHeCADEMY.net using 'pyramid-education'.

MICRO-CURRICULA AT THE MATHECADEMY.NET

The MATHeCADEMY.net sees mathematics as ManyMatics, the natural science about the physical fact Many. It teaches teachers to teach this natural science about Many to learners by allowing both teachers and learners to learn mathematics through investigations guided by educational questions and answers.

Seeing counting and adding as the two basic competences needed to deal with Many, it uses a CATS method, Count & Add in Time & Space, in a Count & Add laboratory where addition predicts counting-results, thus making mathematics a language for number-prediction. The website contains 2x4 study units with CATS1 for primary school and CATS2 for secondary school.

In pyramid-education 8 in-service teachers are organized in 2 teams of 4 teachers, choosing 3 pairs and 2 instructors by turn. The Academy coach helps the instructors instructing the rest of their team. Each pair works together to solve count & add problems and routine problems; and to carry out an educational task to be reported in an essay rich on observations of examples of cognition, both re-cognition and new cognition, i.e. both assimilation and accommodation. The coach helps the instructors to correct the count & add problems. In each pair each teacher corrects the other teacher's routine-assignment. Each pair is the opponent on the essay of another pair. Having finished the course, each in-service teacher will 'pay' by coaching a new group of 8 in-service teachers.

FIVE PLUS TWO LEARNING STEPS

The in-service teachers learn in the same way as their students by carrying out five learning steps: to do, to name, to write, to reflect and to communicate. For a teacher two additional steps are added: to design and to carry out a learning experiment, while looking for examples of cognition, both existing recognition and new cognition. To give an example, wanting children to learn that 5 is an icon with five sticks, the steps could be:

Do: take 5 sticks and arrange them next to each other, then as the icon 5.

Say: a total of five sticks is rearranged as the number icon 5, written as T=5.

Reflect. That five sticks is called five is old cognition. It is new cognition that five sticks can be rearranged as a 5-icon and that this contains the number of sticks it represents.

Communicate. Write a postcard: 'Dear Paul. Today I was asked to take out five sticks and rearrange them as a 5-icon. All of a sudden I realized the difference between the icon 5 and the word five, the first representing what it describes and the second representing just a sound. Best wishes'.

Design an experiment: I will help Michael, who has problems understanding 2digit numbers. Once he tries to build a number symbol for ten, eleven and twelve, he will realize how smart it is to stop inventing new symbols and instead begin to double-count bundles and unbundled. So I design an experiment asking the children to build the first twelve number-icons by rearranging sticks.

Carry out the experiment: It is my impression that constructing the number icon for ten was what broke the ice for Michael. It seems as if it enabled Michael to separate number-names from number-icons, since it made him later ask 'Why don't we say one-ten-seven instead of seventeen? It would make things much easier.' This resonates with what Piaget writes:

> Intellectual adaptation is thus a process of achieving a state of balance between the assimilation of experience into the deductive structures and the accommodation of those structures to the data of experience (Piaget 1970: 153-154).

DESIGNING A MICRO-CURRICULUM SO MICHAEL LEARNS TO COUNT

This 5-lesson micro-curriculum uses activities with concrete material to obtain its learning goals. In lesson 1 Michael learns to use sticks to build the number icons up to twelve, and to use strokes to draw them, thus realizing there are as many sticks and strokes in the icon as the number it represents, if written less sloppy.

In lesson 2 Michael learns to count a given total in 1s and in 4s; and to count up a given total containing a specified numbers of 1s or of 4s.

Lesson 3 repeats lesson 2, now counting in 3s.

Lesson 4 combines lesson 2 and 3, now counting in 1s, 3s and 4s.

In lesson 5 Michael learns to recount in 4s a total already counted in 3s, both manually and by using a calculator; and vice versa.

As concrete materials anything goes in lesson 1. The other lessons will use fingers, sticks, pegs on a pegboard, beads on an abacus, and LEGO blocks.

Another 5-lesson micro-curriculum could make Michael learn to add on-top and next-to to be able to answer questions like 2 3s + 4 5s = ? 3s = ?5s = ?8s. This will not be discussed further here.

Lesson 1: Building And Drawing Number Icons

On the floor the children place six hula hoop rings next to each other as six different lands: empty-land, 1-land, 2-land, 3-land, 4-land and 5-land shown by the corresponding number of chopsticks on a piece of paper outside the ring.

Each child is asked to find a thing to place in 1-land, and to explain why. Then they are asked to turn their thing so it has the same direction as the chopstick. Finally the group walks around the room and points out examples of 'one thing' always including the unit, e.g. 1 chair, 1 ball, etc.

In the same way each child is asked to find a thing to place in 2-land. The instructor shows how the two chopsticks can be rearranged to form one 2-icon. The children are asked to pick up two sticks and do the same; and to draw many examples of the 2-icon on a paper discussing with the instructor why the 2-icon on the wall is slightly different from the ones they draw. Now the children are asked to rearrange their 2s in 2-land so they have the same form as the 2-icon. And again the group walks around the room and points out examples of 'two things' that is also called 'one pair of things'.

This is now repeated with 3-land where three things are called one triplet. Before going on to 4-land the instructor asks the children to do the same with empty-land. Since the empty-icon cannot be made by chopsticks the instructor ask for proposals for an empty-icon hoping that one or more will suggest the form of the ring, i.e. a circle. And again the group walks around the room to try to locate examples of 'no things' or zero things.

Now the activity is repeated with 4-land. Here the instructor asks the children to suggest an icon for four made by four sticks. When summing up the teacher explains that the adults have rejected the square since it reminds too much of a zero, so the top stick is turned and placed below the square to the right. Here the children are asked to rearrange their 4s in 4-land so they have the same form as a square, and as the 4-icon. And again the group walks around the room and points out examples of ‘four things’ that is also called ‘a double pair’.

Now the activity is repeated with 5-land. Here the instructor asks the children to suggest an icon for five made by 5 sticks. When summing up the teacher explains that the adults have decided to place the five stick in an s-form. When walking around the room to point out examples a discussion is initiated if ‘five things’ is the same as a pair plus a triplet, and as a double pair plus one.

This activity can carry on designing icons for the numbers from six to twelve realizing that the existing icons can be recycled if bundling in tens.

Observing And Reflecting On Lesson 1

Having designed a micro-curriculum, the in-service teacher now carries it out in a classroom looking for examples of recognition and new cognition.

One teacher noticed the confusion created by asking the children to bring things to empty-land. It disappeared when one child was asked what he had just put into the ring and answered no elephant. Now all of the children were eager to put no cars, no planes etc. into the ring. Later the teacher witnessed children discussing why the 3-icon was not a triangle, and later used the word four-angle for the square. Also this teacher noticed that some children began to use their fingers instead of the chopsticks.

Under the walk around the room a fierce discussion about cheating broke out when a child suggested that clapping his hand three times was also an example of three things. It is not, another child responded. It is. No its not! Why not? Because you cannot bring it to 3-land! Let’s ask the teacher!

After telling about space and time, children produced other examples as three knocks, three steps, three rounds around a table, and three notes. Other children began to look at examples of threes at their own body soon finding three fingers, three parts on a finger, and three hands twice when three children stood side by side and the middle one lent out his two hands to his neighbors.

CONCLUSION

To find how mathematics would look like if built as a natural science about the physical fact Many, and how this could affect early childhood education, postmodern contingency research has uncovered ManyMatics as a hidden alternative to the ruling tradition in mathematics. Dealing with Many means bundling and counting in icons, and recounting when adding on-top or next-to thus introducing proportionality and calculus. Likewise reversing on-top or next-to addition leads to solving equations and differentiation. Furthermore, the fact that totals must be counted before being added means that the operations division, multiplication, subtraction must be introduced before addition. However, these golden learning opportunities are lost when entering grade one, where the monopoly of ten-counting and the opposite order of operations prevents both from happening. Furthermore grounded ManyMatics is replaced with metamatism true inside a classroom but not outside when introducing one-to-one corresponding sets and when teaching that 1+2 IS 3.

RECOMMENDATIONS

Besides commenting on internal research papers meant for themselves only, researchers should also produce papers telling governments that to enlighten and to prepare the learners for the outside world, the educational system must stop presenting its choices as nature. Instead it should be forced to accept the historic fact that long, long ago the antique collective name mathematics was split up into independent disciplines.

So instead of teaching mathematics, schools should teach the two competences needed to deal with the physical fact Many, to count and to add. Consequently, the golden learning opportunities in preschool mathematics should enter ordinary school that should be forced to accept icon-counting and next-to addition instead of suppressing it. Calculators should be included to allow predicting counting results. Likewise, an abacus should be reintroduced to primary school and used both in geometry and algebra mode. This means a need for a full scale re-education of pre-service and in-service teachers. The MATHeCADEMY.net using PRAMIDeDUCATION is designed to meet exactly this need in an effective, user-friendly and inexpensive way.

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TECHNOLOGY EDUCATION IN FINLAND – CRAFT, CREATIVITY, TEXTBOOKS OR TECHNOLOGY

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ABSTRACT: Changes in the economy, nature, production and society together with increasing scientific and technological knowledge make demands of transforming school teaching in the field of technology education. This article analyses current trends in Finnish technology education. The aim of the article is briefly to explore the integration between science - technology - and traditional craft education in Finland. Finnish technology education can be characterized as the design approach that has evolved from the craft oriented tradition. Additionally, it involves many elements of computer controlling and electronic principles. Thanks to Finnish industry and their interest groups there are some signs of strengthening in technology education. But still much of the learning is based on traditional craft education focused on production skills. Approaches that are now dominant in craft education do not prepare students to meet the challenges of modern technology and working life.

Key words: technology education, craft education, science education, creative problem solving

INTRODUCTION

During last twenty years there has been an active discussion about the role of technology education in Finnish compulsory education. Several development projects have been started aimed to develop the curriculum and technology education (Järvinen, Lindh & Sääskilahti, 2000; Lavonen, Autio & Meisalo, 2004; Parikka & Rasinen, 2009). Moreover, many public and private institutions claim that there is a growing need for employees, who are able to think critically and also to solve a range of technological problems (Grabinger, 1996). On the other hand, several researchers maintain that various cognitive, metacognitive and problem solving skills needed in the working life are seldom obtained at school (Resnick, 1986). The national discussion, the results obtained from the various development projects in the field of technology education and the international discussion about the role of technology education should have had an effect on the formulation of the goals and contents of technology education in the national curriculum framework for compulsory school.

In the beginning of 2000s, a discussion took place between the authorities and the spokesmen of the craft industry. Although, technology education was introduced for the first time in the framework curriculum, a separate technology education subject was not, however, been established. Nevertheless, technology was introduced as part of a specific cross-curricular theme, entitled 'The Human Being and Technology'. As a result of that, technology education should be taught in all subjects as an integrated subject. Officially, Finnish technology education was named handicraft which is in practice divided into two sections: technical - and textile craft. Hence, the main importance in the curriculum is still in the developing students' handicraft skills, within the context of the complete process of handiwork. In addition, the development of students' personalities and the growth of self-esteem were also emphasised.

However, the 2004 curriculum emphasized the meaning of technology from the point of view of everyday life, society, industry and environment, as well as human dependency on technology. The students should be familiar with new technology, including ICT (information & communication technology), how it is developed and what kind of influence it has. Students' technological skills should be developed through using and working with different tools and devices. Studying technology helps students to discuss and think about ethical, moral and value issues related to technology. There is a high compatibility with the goals mentioned in our new curriculum and the nature of literacy in technology described in the publication: International Technology Education Association (2007) Standards for Technological Literacy: Content for the Study of Technology.

TECHNOLOGY EDUCATION IN PRACTICE

Although, we have moved long ago from an agricultural society to a post-industrial society, out–of–date technological processes, such as the making of wood and metal artefacts, are more common than processes, such as working with plastic, service and repair of technical equipment and construction of electronic equipment. Computers are not used in technology education to a large extent, but usage is expected to increase in the near future. Moreover, in many schools, the students reproduce artefacts on their own, according to given models without any creativity. Students only occasionally plan and generate alternatives in small groups. Learning is focused on production skills, with the aim of teaching students how to replicate demonstrated skills. Approaches that are now dominant in technology are based on old fashioned craft education and they do not prepare students to meet the challenges of modern technology and working life. Craft education is a very practical school subject with small integration of science and technology aspects in the teaching and learning. Its purpose is thought to be simply for practicing manual dexterity without reflective discussions. Often such thinking is based on views that require students to merely copy and reproduce similar products, such as wooden boxes and other wooden artefacts commonly used in households.

On the other hand, it is important to notice that students are highly motivated to work with their hands (Autio, 1997, Autio, 2013). It is not surprising that both boys and girls are attracted to technology education because they enjoy working with their hands and like the independence and chance for creativity provided by these classes (Silverman & Pritchard, 1996). Students who typically enrol in technology education are attracted to the types of projects they will be engaged in (Weber & Custer, 2005). It seems that several other school subjects have more motivational problems than technology education. Craft lessons are unlike subjects such as physics or mathematics considered more practical than theoretic.

The current orientation in Finnish craft - and technology education is described in Figure 1. It shows the main directions: traditional craft education - modern technology education and product orientation – process orientation, which includes typical sections in craft and technology education: reproductive handwork, creative handwork, textbook technology and innovative technology.

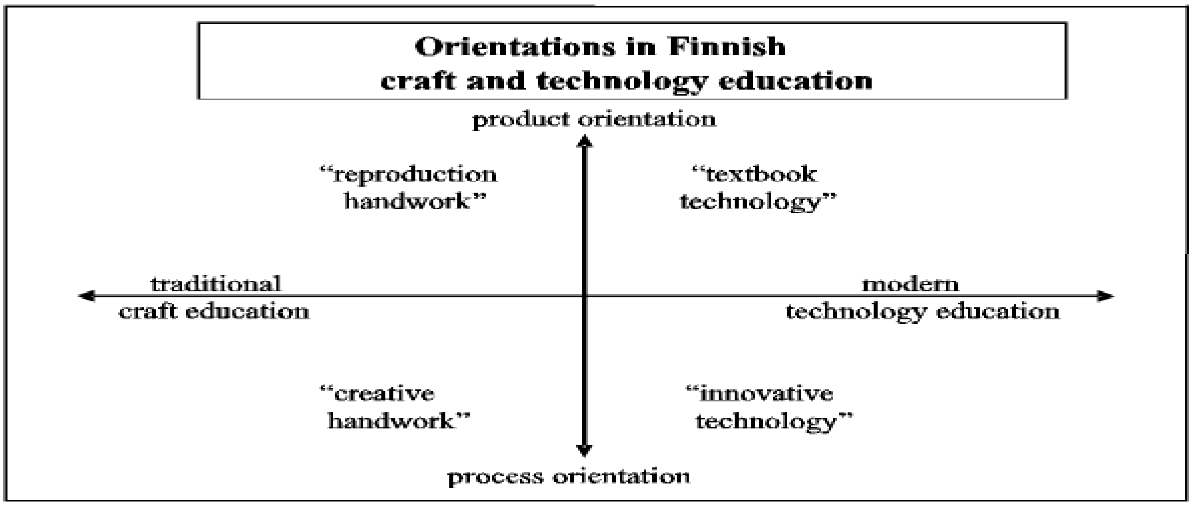

Figure 1. Current orientation in Finnish craft and technology education

In traditional craft education, children reproduce artefacts according to given models. It is adequate for teaching the basic skills, like learning to use a saw or soldering station. However, there must be time for learning creative problem solving and, from the design perspective, this is already happening in "creative handwork". In technology education, there is still the same problem as "textbook technology" overshadows practical innovations and creative problem solving. Therefore, we have developed "innovative technology" education programs for teacher education where learning in small groups is based on the creative process rather than just a product (Autio & Lavonen, 2005; Lavonen, Autio & Meisalo, 2004).

TRADITIONAL CRAFT AND CREATIVITY

The general aim of Finnish Craft and Technology education is to increase students' self-esteem by developing their skills through enjoyable craft activities; it also aims to increase students' understanding of the various manufacturing processes and the use of different materials in craft. Furthermore, the subject aims to encourage students to make their own decisions in designing, allowing them to assess their ideas and products. Students' practical work is product orientated and based on experimentation, in accordance with the development of their personality. The role of the teacher is to guide students' work in a systematic manner. They must encourage pupils' independence, the growth of their creative skills through problem-based learning and the development of technical literacy. Finnish handicraft traditions are also of importance throughout the whole curriculum (Framework Curriculum Guidelines, 2004).

However, the main problem with the traditional craft education approaches is linking the learning of knowledge to the learning of for example different designing skills. In reproductive handwork students reproduce artefacts according to given models and the teaching of design is based on simple sketching or direct shaping from the material. Instead, systematic creative problem-solving and planning models are seldom used. In the two dimensional model, planning is divided into three phases: initial planning, sketching and detailed planning. Each phase includes analysis, synthesis and assessment (Lawson, 1983). In more advanced, spiral process designers seem to backtrack at certain times and repeat a series of activities again and again, trying to resolve new problems with each repetition (Zeisel, 1995).

Moreover, knowledge and understanding of design should not emphasis only art related self-expression with artefact constructions. Designing should refer to technological design as well and the turning of making into thinking (Mitcham & Holbrook, 2006). According to Norman (1993), it is not guaranteed that if students' have expertise in artistic design they can automatically operate in technological design, for example in electronic circuits and mechanical movements. Competence in different Craft areas requires the development of different knowledge, skills and understanding. Therefore design and associated techniques are essentially independent (Lawson, 1983). That is clearly seen in traditional craft education, even if students' work with systematic planning models and uses their creativity, esthetical design usually overshadows technological issues.

It is not the main problem that in lower grades (1.-4.) most of the learning is focused on production skills, with the aim of teaching students how to replicate demonstrated skills and to achieve more knowledge of materials. We should be more concerned of whole-class teaching methodologies, with the teacher as expert and the student as the passive recipient of knowledge. Approaches that are now dominant in traditional craft education do not prepare students to meet the challenges of modern technology and working life. In spite of some progress, the legacy of behaviorist, teacher centered teaching methodologies; repeatedly appear as the dominant orthodoxy in technology education (Dakers, 2005). An important function of technology education should be the opportunity to transcend from routine activities and low-level thinking.

In creative handwork different ways to emphasize creative problem solving in small groups have been suggested (e.g., Grabinger, 1996; Dooley, 1997; Hill, 1999). A common feature of these approaches is to place students in the midst of a realistic, ill-defined, complex and meaningful problem, with no obvious or correct solution. Students work in teams, collaborate and act as professionals, confronting problems as they occur - with no absolute boundaries. Although they get insufficient information, the students must settle on the best possible solution by a given date. This type of multi-staged process is characteristic of effective and creative problem solving. The process is non-linear and follows no particular rules, because rational approaches miss the entire point of creative problem solving (Fisher, 1990).

TEXTBOOKS OR REAL TECHNOLOGY EDUCATION

A common problem in science and technology education in grades 5–9 is that many teachers teach the typical presentation-recitation way (chalk and talk), while students can also do, for example, routine practical work or solve simple textbook problems. This is a good example of "textbook technology". However, those activities do not encourage students to construct scientific concepts or meanings; neither does it help them to see phenomena and objects in the environment (Arons, 1997). In addition, many schools have poor laboratories and equipment for practical work. Therefore, these schools face considerable problems in carrying out practical student work, concretising science education and linking it to the environment. About five out of six schools have the proper ICT equipment for teaching Science. Moreover, it is a considerable problem that ICT is inadequately used by physics teachers.

The goals set for technology education have already been realised in the new science textbooks. More applications of science, for example, are described and there are even new chapters introducing technological themes, like the basics of electronics and the life cycle of products. It is obvious that teachers will, in future, based on the new textbooks, teach more technology in science

In grades 1–6, technological themes are also taught as part of Environmental and Natural Studies. This forms an entity containing aims and content from science and technology, environmental studies and civics. The different areas of Environmental and Natural Studies are: matter and energy; organisms and their environments; the globe and its areas; man and the environment. Besides technology education, in grades 7–9, there are three Science subjects, Biology, Physics and Chemistry, which contain technology education. The common aims of these subjects are to give a picture of man's living environment, and the interaction between man and the environment. Moreover, they help to realise the significance of individual and collective responsibility based on knowledge of the natural sciences and technology.

In Technology Education learning is based on practical work rather than in theoretical issues. Production emphasizes students' ability to expand the technological understanding and the ability to create new innovations by using different tools, machines and materials. According to Blomdahl and Rogala (2008) students will not just discover, create or develop useful technical products in technology education but will instead gain insight and knowledge about the origin and function of technology and its importance to people, nature and society. In practice, technology education can be used as a vehicle for teaching scientific knowledge in craft education as well as adding practical craft knowledge in science education (Ginns, Norton & McRobbie, 2005). From this point of view, contents (knowledge and concepts) and process (skills for construction and design) are equally important. In addition, one aim is to understand the need to manage in everyday life with mundane technologies in the continuously changing world (Michael, 2007; Stables, 2009).

DISCUSSION

Technology education as part of education in Finland has a long and rich history dating back to the 1800s when Uno Cygnaeus defined "sloyd" (handicraft). Since the first days of craft education over 150 years ago, students have made things using a variety of craft tools. In the beginning, work was based on copying and imitation, and was mainly geared toward the development of lower-level thinking skills. However, it might be assumed that technology education will be realised in the near future, because new goals and content for technology education have been set in the National Framework Curriculum of 2004. On the other hand, several goals set for the technology education were already presented in the general part of the National Framework Curriculum of 1994 and also in the goals of Science and Handicraft. At present, both Science and Handicraft education are quite far from the goals set for technology education. In school Physics and Chemistry, theoretical constructs easily overshadow practical applications of various physical phenomena, and connections between these two remain superficial. Likewise, in Technology, practical applications may overshadow the very basic physical phenomena and laws that lie behind the operation of any machine used. Furthermore, for example, if concepts and processes, like electric circuits and energy production, are met during Science or Handicraft lessons, they are seldom discussed in broad contexts such as environmental, ecological, and social perspectives.

Moreover, the nature of tasks and working processes in Handicraft give quite a narrow view of technological knowledge and processes: working with wood and metal is predominant. Furthermore, there is no consensus about how those new goals could be realised among teachers as well as among researchers or teacher educators. Others think that technology education should be design-process based with the emphasis on wood and metal work and others feel it should be a more theoretical "classroom-type" school subject.

In technology education, we should be more concerned about what children should learn rather than what kind of artefacts they make, because learning does not only take place upon completion of the product but also occurs through creative problem solving and reflection in every phase of the technological process. It is important that children understand that technology does not develop by itself, but is directed by human needs and wants. Technological development, control and mastery stop if technology is not taught from generation to generation. Every generation needs to understand how artefacts are made and what artistic and scientific knowledge is needed in technological production and utilisation.

In particular, it is argued that creative problem solving is an integral part of technology education, in contrast to an instruction-following method of technology education, reproducing artefacts, and teacher-dominated work (Sellwood, 1991; De Luca, 1993; Williams and Williams, 1997). Wu, Custer and Dyrenfurth (1996) have suggested even more forcefully that creative problem solving should be a core content area and method of teaching technology. These approaches particularly seem to fit technology-oriented modules in teacher education.

Right now there is an obvious need for young technology teachers to act as agents for change. Moreover, it is obvious as well that more research and development effort should be directed towards introducing creative problem-solving approaches in technology education (e.g., Lee, 1996; Gilbert & Boulter, 2000). Instruction and teaching models experienced during teacher education often serve as learning models for students.

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A SURVEY OF STUDENTS PARTICIPATING IN A COMPUTER-ASSISTED EDUCATION PROGRAMME

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ABSTRACT: This paper mainly examines anthropometric data, data regarding the habits, experiences and attitudes of the students about their tablet/laptop/desktop computer use, in addition to self-reported musculoskeletal discomfort levels and frequencies of students participating in a tablet-assisted interactive education programme. A two-part questionnaire was used to collect data. Results revealed that students are experiencing musculoskeletal discomforts highly at the neck, lower back and upper back regions.. The survey results are of critical importance because making reasonable recommendations to the new generations for healthy use of desktop/laptop/tablet computers is only possible if we can understand the relationships and risk factors involved in and eliminate the risks to prevent musculoskeletal discomfort.

Key words: tablet, laptop, desktop, musculoskeletal discomfort.

INTRODUCTION

Getting acquainted to technologies such as laptop or tablet computers at very early ages can be good with the perspective of training employees with skills to meet on-going demand of technologically skilled workforce of today's world. Besides, such modern portable technologies are playing an ever-increasing role in the lives of children with the widespread availability and usefulness of the the Internet. However, given the fact that musculoskeletal development of children and adolescents is still on going, potential musculoskeletal problems resulting from usage of such technologies must not be disregarded.

There are some studies in the literature reporting that there exists prevalence of musculoskeletal discomfort in children and/or adolescents using portable technologies like laptops and tablets [Straker et al. (1997), Harris and Straker (2000), Greig et al. (2005), Sommerich et al. (2007), Straker *et al. (*2008)]. However, to the best of our knowledge none of the existing studies focusing on laptop or tablet computer use of children (and/or adolescents) involved children (and/or adolescents) from all grades of middle school and high school (6th, 7th, 8th, 9th, 10th, 11th and 12th graders). This paper tries to fill this gap by studying experienced musculoskeletal discomfort by the students of a combined middle and high school in northern Cyprus (6th, 7th, 8th, 9th, 10th, 11th and 12th grades), which is running a computer-assisted interactive education programme.

186 students participated in a two-part questionnaire for obtaining general information on children's habits related to desktop/laptop/tablet computer use, relationship between demographics of the subjects and the frequency of musculoskeletal discomfort they experience, relationship between their daily use of such technologies and musculoskeletal discomfort they experience in their upper limb body parts, as well as study the correlation between musculoskeletal discomfort and their laptop, desktop, and tablet use.

METHODS

Data Collection

In order to achieve genralizability, students from different state and private high schools were aimed as potential participants. Thus, students with varying demographic structure and soci-cultural background were guaranteed to participate in this research.

At the time of the study, certain state and private schools have adapotedcomputer-assisted interactive education in some particular lectures in northern Cyprus. A total of 200 questionnaires were distributed to all classes in the schools. At the end, a total of 186 students consented to participate in the survey of the study. Thus, a total of 186 questionnaire forms were completed and collected back. In other words, we had a response rate of 93% from those whose parents gave written consent to participate in the study.

Study Design and the Questionnaire

The study design involved a cross-sectional survey of children using computer for educational purposes and data was collected during in January-April 2015.

The questionnaire was composed of two parts; first part of the utilized questionnaire tool is derived from the Dutch Musculoskeletal Questionnaire (DMQ), which was originally developed by Hildebrandt et al. (2001). The standard DMQ have been modified and shortened in order to fit the needs of the study. This section of the questionnaire part sought information on background variables (like age, height, weight, gender), on reasons, location, duration and history of desktop/laptop/tablet computer use of the participants, and on emotional background of the participants while using a desktop/laptop/tablet computer, and on lifestyle of the participants (sports activities, smartphone usage etc.).

A way for determining prevalence of musculoskeletal complaints is through the use of symptom surveys (Hedge et al. 1999). The second part is composed of SS-CMDQ, which is an adaptation of CMDQ (a symptom survey). SS-CMDQ, which includes a body map diagram to track the locations of musculoskeletal discomfort, was administered to study the correlation between musculoskeletal discomfort and tablet computer use. It should be noted that most of the students uses their tablets with desk stands in accordance with the school's policies.

The resulting two-stage questionnaire tries to obtain a representation of the relationships between the desktop/laptop/tablet use and musculoskeletal symptoms among students using tablet computers in classrooms. In general, the questionnaire included a combination of measures for evaluating musculoskeletal outcomes related to children's desktop/laptop/tablet exposure for educational purposes.

Development of the Questionnaire Questions

First four questions of the first part of the questionnaire, which are asking age, gender, height and weight of the participants, aim to collect demographic data in order to be able to describe the study population. This descriptive demographic data helps to identify range of ages, weight, height etc. of our sample population. These questions is also useful in comparing demographics related changes in reported musculoskeletal symptoms. The fifth question of the first part inquired about the type of computer preferred by the students (desktop/laptop/tablet computer). This is to determine whether there is a difference in the frequency and level of musculoskeletal discomfort experienced between the students who are exposed to one of these technologies and the students who are exposed to all or more than one of these technologies. Or to find an answer to the question "does any of the three types of computer used increase the frequency of level of discomfort experienced?" Question 6, which asks about the activities that the subjects are using the computers (all three types) for and the corresponding durations of use, is designed to check whether engaging in a specific activity and/or using the mentioned types of computers for that specific activity for long periods of time results in an increased amount of reported discomfort or pain? Question 6 helps us to determine the average duration of computing time for students in different grades on a typical school day. The questions related to the setting (home, school etc.) of computer (three computer types - desktop, laptop and tablet computers) use or duration of span of computer use are asked to determine whether the mostly preferred setting or duration of span of computer use related to the amount and/or area of pain. Questions from 9 to 11 check whether the experienced feelings of subjects regarding desktop/laptop/tablet computers correlates with the frequency of discomfort experienced in any body region. Question 12 is designed to ascertain if students engaging in certain artistic or physical activities report less discomfort compared to other students. Question 13 is to identify whether the students experienced accidents or had injuries in the past one year. The students with "Yes" answers to this question shall be removed from investigations regarding reported pain to avoid involving the effects of an accident in evaluation of computer use related pain. The last question of the first part of the questionnaire checks if the durations of smart phone use correlates with the frequency of amount of musculoskeletal discomfort.

Second part of the questionnaire (SS-CMDQ) is a one-page addition to the first part, which addresses the frequency (in the past week) and level of musculoskeletal discomfort and pain as well as the effect of experienced musculoskeletal discomfort to the performance of academic activities. In order to help self-administration of the questionnaire by reporting musculoskeletal complaints with respect to the corresponding body regions, this part of the questionnaire involves a body map to assist with identification of body regions and quantification of discomfort.

The SS-CMDQ asks sixty questions about the frequency of musculoskeletal discomfort/pain in 20 body parts referring to the previous week. The frequency of discomfort is assessed on a scale from 0 (none) to 4 (several times a day) and level of discomfort from is assessed on a scale ranging from 1 (slightly uncomfortable) to 3 (very uncomfortable).

Survey Administration

The two-part questionnaire was administered in approximately 20-25 minutes in all classrooms. The participants were provided with both Turkish and English version of the two-stage questionnaire. The first part, which has been developed in this study using the DMQ, was translated into Turkish. Both Turkish and English versions of the SS-CMDQ part have already been developed by Erdinç and Ekşioğlu [CUergo (1999)].

The SS-CMDQ part of the survey process is also analysed for determining the possible postural problems of the participants. Discriminant Analysis was applied to determine whether a set of variables is effective in predicting category membership, and to identify statistically significant factor(s) which contribute(s) formation of the musculoskeletal discomfort due to laptop, dekstop, and tablet use.

RESULTS AND FINDINGS

Descriptive Statistics

The results of the questionnaire revealed that 47.3% of the respondents were male students, and 52.7% were female students. Table 1 illustrates the demographic structure of the students.

Table 1. Student Demographics (*n*=186)

Variables	Range	Mean	Std. Dev.
Age	11-20	14.64	2.505
Height	1.37-1.87 m	1.63	0.116
Weight	30-96 kg	56.31 kg	14.995

Majority of the students (a total of 70.1%) stated that they were using either a combination of tablet, laptop, and desktop computers, or all of them in their daily life. Only 29.8% of the students provided that they were using only one of tablet, laptop, and desktop computer (table 2)

Table 2. Tablet / Laptop / Desktop Use Habits (*n*=186, hops= 2)

Only tablet	4,3%	8
Only laptop	17,9%	33
Only desktop	7,6%	14
Desktop & laptop	14,1%	26
Laptop & tablet	18,5%	34
Desktop & tablet	12,5%	23
All	25,0%	46

Figure 1 shows “communication” is not a preferred reason of use laptop, desktop, and tablet computers among students. Majorities of those who use any of laptop, desktop, and tablet for communication purpose, use these computers for less than 1 hour.

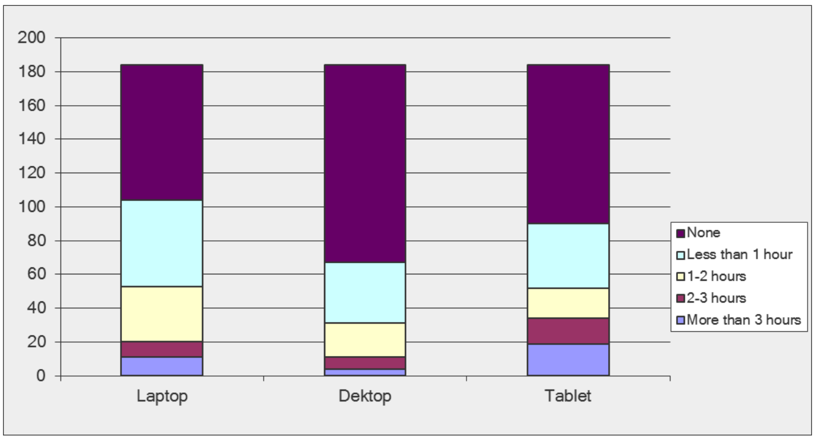

Figure 1. Use Of Laptop, Desktop, And Tablet For Communication Purpose (*n*=186, hops= 2)

Unexpectedly, a very high majority of the students provided that they were not using any of laptop, desktop, and tablet computers for playing games. When they play games, students prefer laptop, tablet, and desktop computers respectively (figure 2).

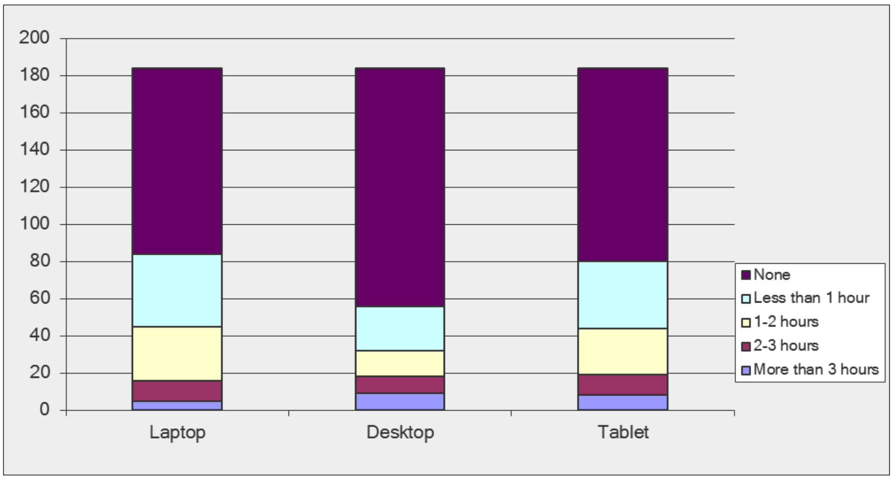

Figure 2. Use Of Laptop, Desktop, And Tablet For Playing Games (*n*=186, hops= 2)

Expect laptop users, majority of the students stated that they do not use desktop and tablet to watch films. However, more than half of the participants provided that they used laptop to watch films (figure 3).

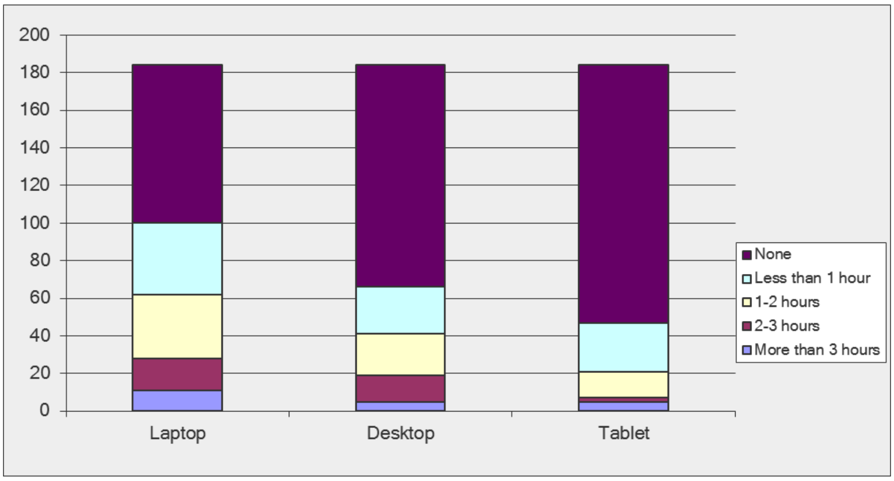

Figure 3. Use Of Laptop, Desktop, And Tablet To Watch Films (*n*=186, hops= 2)

A very high majority of the students provided that they do not use any of laptop, desktop, or tablet computers for studying outside the school. Tablets, particularly, were observed to be least preferred computers for studying purposes outside the school. On the other hand, when they study, students provided that they prefer laptop computer (figure 4).

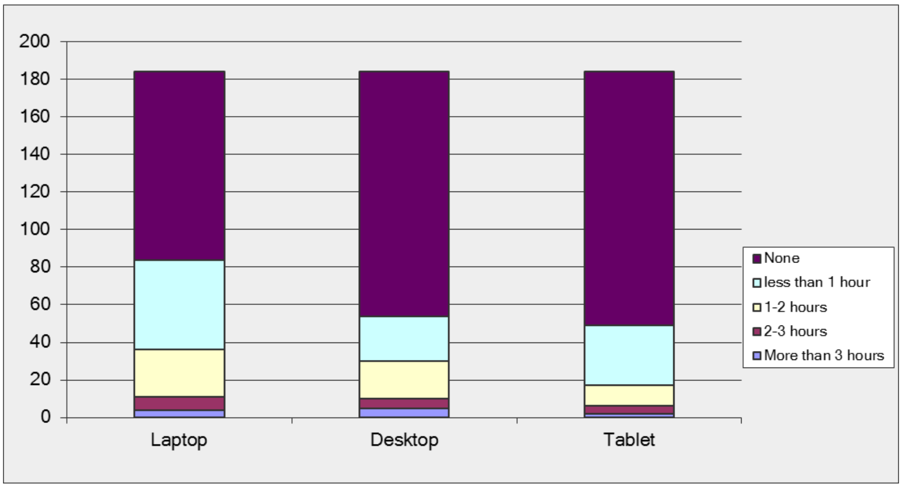

Figure 4. Use Of Laptop, Desktop, And Tablet To Study Outside The school (*n*=186, hops= 2)

Tablets were observed to be the least used computer at schools, whereas almost one third of the students stated that they use laptops during the lecture (figure 5).

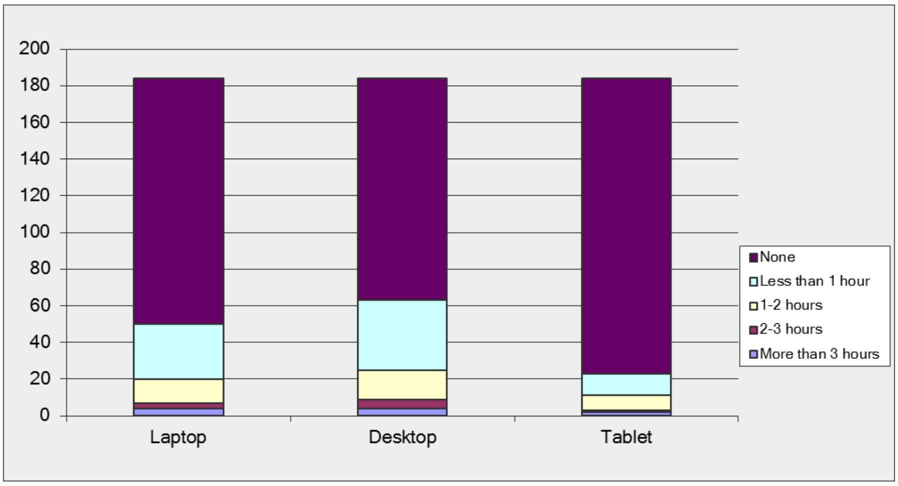

Figure 5. Use Of Laptop, Desktop, And Tablet During Lectures At School (*n*=186, hops= 2)

Laptops were stated to be the most preferred computer for internet surfing by the students, whereas desktops were not popular among students for the same purpose. However, tablets were observed to challenge the laptops for internet surfing. During tablet use, the number of internet surfers for less than 1 hour and 1-2 hours were also observed to be very close (figure 6).

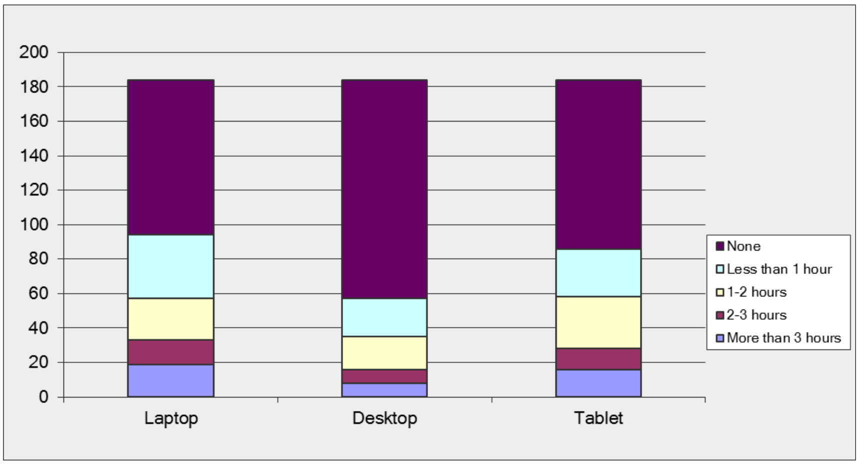

Figure 6. Use Of Laptop, Desktop, And Tablet For Internet Surfing (*n*=186, hops= 2)

Figure 7 illustrates that the majority of the students do not use any of laptop, desktop, and tablet for reading newspaper, book, magazines, etc… Those who use laptop, desktop, and tablet for reading were observed to spend less than 1 hour per day.

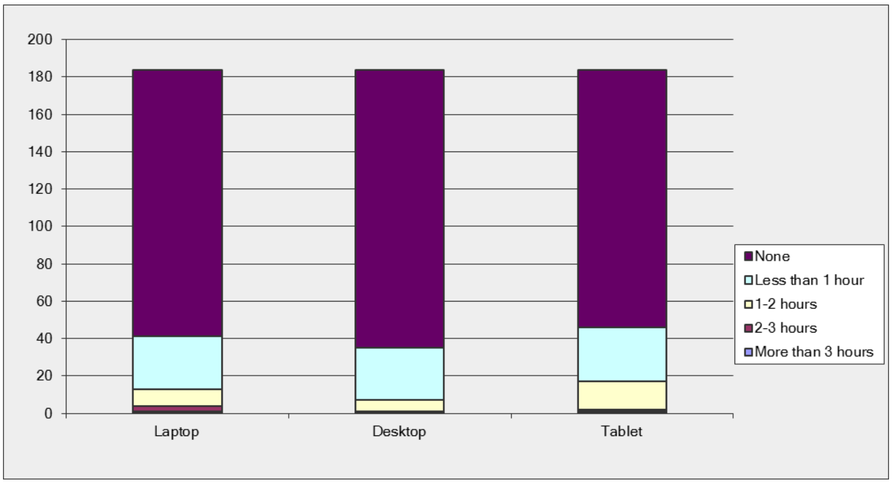

Figure 7. Use Of Laptop, Desktop, And Tablet For Reading (*n*=186, hops= 2)

Most of the students provided that they do not use laptop, desktop, and tablet computers to write dairies, blogs, and posts on to the internet. Among those who write dairies, blogs, and posts, laptops were observed to be the most preferred computer type.

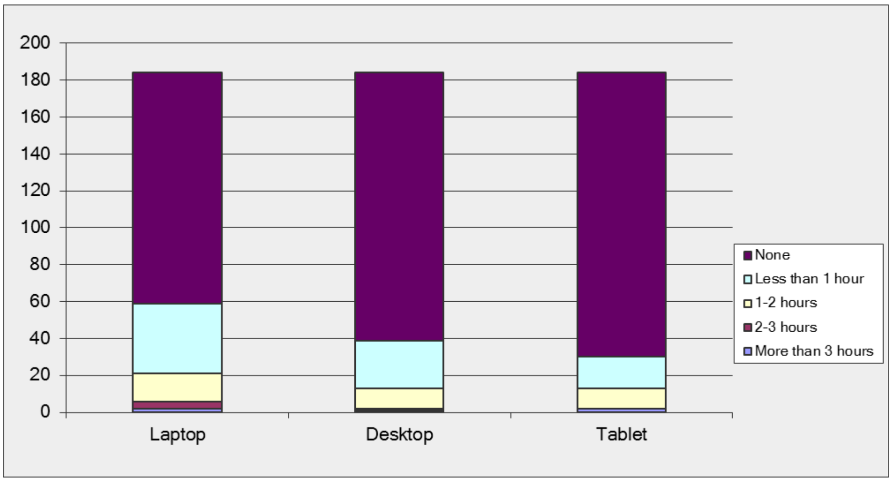

Figure 8. Use Of Laptop, Desktop, And Tablet For Writing Blogs, Posts, Dairies (*n*=186, hops= 2)

Table 3. Place Of Computer Use Mostly (*n*=186)

Place of use	Desktop	Laptop	Tablet
None	34,8%	21,2%	37.0 %
At home	39,1%	73,9%	52.7 %
At school	22,8%	1,1%	3.3 %
Other	3,3%	3,8%	7.1 %

Student participants provided that at home they mostly use desktop, laptop, and desktop computers more than at school and other places. Laptop use at home was observed to be the most common answer provided (73.9%), and this was followed by tablet use at home (52.7%). Because of the mobility of the tablet computers, students stated that they use tablet computer at other places (7.1%) than home and school (table 3).

Table 4. Years Of Computer Use (*n*=186)

	Desktop	Laptop	Tablet
None	33,7%	21,7%	37,5%
Less than 1 year	7,1%	10,3%	14,1%
More than 1 year	59,2%	67,9%	48,4%
Mean	5,53	4,24	3,37
Std. Dev.	3,129	2,322	2,263
Range	1 - 16	1 - 16	1 - 16

Table 4 illustrates that a majority of the students have been using desktop, laptop, and tablet computers for more than 1 year. Even though laptops were stated to be the most common used computer type (67,9%), the mean year of use for desktop computers were observed to be the highest (5,53 years).

Table 5. Feelings Experienced During Computer Use (*n*=186, hops=2)

	Desktop	Laptop	Tablet
None	35.9 %	21.2 %	37.5 %
Frustration	8.2 %	6.0 %	4.3 %
Excitement	18.5 %	21.2 %	25.0 %
Amazement	9.8 %	7.1 %	6.5 %
Suprise	7.1 %	5.4 %	8.2 %
Anger	10.3 %	6.5 %	10.3 %
Irritation	13.6 %	9.2 %	4.9 %
Confusion	9.2 %	8.7 %	6.5 %
Nervousness	7.6 %	4.9 %	4.3 %
Happiness	32.6 %	43.5 %	38.6 %
Other	11.4 %	17.4 %	10.9 %

Table 5 shows that happiness during laptop use was the most frequent feeling experienced by the students, which was followed by happiness during tablet use. Moreover, the negative feelings (frustration, anger, irritation, confusion, and nervousness) experienced were comparatively less than those positive feeling. Thus, this finding suggests that the students are technology friendly, and they are mostly comfortable during desktop, laptop, and tablet use.

Table 6. Physical / Sport Activities Involved (*n*=186, hops=2)

Activity	Response	Activity	Response	Activity	Response
Athletics	13.6 %	Boxing	4.9 %	Table Tennis	5.4 %
Aerobics	0.0 %	Dance	13.6 %	Tennis	9.8 %
Badminton	7.6 %	Fitness	10.9 %	Volleyball	19.0 %
Basketball	23.4 %	Football	39.7 %	Walking	38.0 %
Horse riding	3.3 %	Hentball	6.0 %	Swimming	21.2 %
Biking	26.1 %	Gymnastics	4.3 %	Other	16.8 %
Playing Music Instruments	12.5 %				

The physical / sport activities presented in table 6 were selected from the literature which are associated and can result in musculoskeletal discomforts. The most common physical activities and sports provided by the students were observed to be football (39,7%), walking (38%), biking (26,1%), basketball (23,4%), and swimming (21,3%).

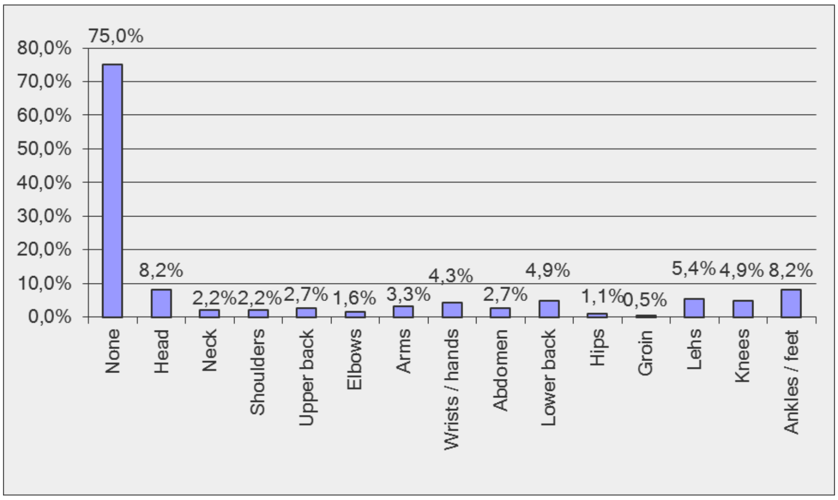

Figure 9. Body Regions Affected In An Accident / Injury (*n*=186, hops=2)

Musculoskeletal discomforts are not only associated with the physical / sport activities involved, but also accidents or injuries experienced can result in these discomforts. Figure 9 illustrates the body regions affected in an accident or due to an injury. The majority of the students (75%) stated that they were not involved in an accident or an injury. However, 8,2% of the students provided that their heads and ankles/feet were affected due to an accident/injury.

Table 7. Use Of Smart Phones For Long Hours During A Normal School Day

Answer	Response
No	57.6 %
Yes	42.4 %
Mean	3,26
Std. Dev.	1,837
Range	1 - 6

Likewise computer use, smart phone use involves in repetitive motions, which also contributes to musculoskeletal discomforts. Table 7 shows that 42,4% of the students use smart phones for long hours in a normal school day, with a mean of 3,26 hours, and standard deviation of 1,837 hours.

Table 8. Experiences Of Ache, Pain, And Discomfort In Body Regions (*n*=186)

Answer Options	Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly Uncomfortable	Moderately Uncomfortable	Very Uncomfortable	Not at all	Slightly Interfered	Substantially Interfered
Neck	48,37%	31,52%	7,07%	2,72%	3,26%	36,36%	16,78%	3,50%	29,08%	24,82%	2,84%
Shoulder (Right)	67,93%	11,41%	2,72%	1,09%	4,35%	11,89%	9,79%	4,90%	19,15%	9,93%	1,42%
Shoulder (Left)	73,37%	8,70%	2,17%	1,63%	1,09%	9,09%	8,39%	2,10%	17,73%	4,26%	2,84%
Upper Back	50,00%	18,48%	14,13%	3,80%	4,89%	25,87%	20,28%	6,29%	29,08%	20,57%	3,55%
Upper Arm(Right)	76,09%	8,15%	2,72%	0,00%	0,00%	9,79%	4,90%	1,40%	18,44%	2,13%	0,00%
Upper Arm(Left)	78,26%	6,52%	2,72%	0,00%	0,00%	11,89%	2,80%	1,40%	19,86%	2,13%	0,00%
Lower Back	48,37%	23,37%	8,70%	2,72%	6,52%	29,37%	16,08%	11,19%	32,62%	17,73%	5,67%
Forearm(Right)	79,35%	5,43%	0,54%	0,54%	0,00%	6,29%	4,90%	0,00%	15,60%	1,42%	0,00%
Forearm(Left)	80,43%	3,80%	1,09%	0,00%	0,00%	9,09%	2,10%	0,00%	17,02%	0,71%	0,00%
Wrist (Right)	66,85%	13,04%	3,80%	0,54%	1,63%	18,18%	6,99%	0,70%	19,15%	7,80%	1,42%
Wrist (Left)	73,37%	5,98%	3,26%	0,54%	1,09%	11,19%	4,90%	0,00%	17,02%	6,38%	0,00%
Hands/Fingers (Right)	73,91%	5,98%	2,72%	1,09%	1,09%	9,09%	4,90%	1,40%	14,18%	4,26%	2,13%
Hands/Fingers (Left)	75,54%	5,43%	2,72%	0,54%	2,17%	9,79%	2,10%	1,40%	17,73%	2,13%	2,13%
Hips/Buttocks	70,65%	9,78%	2,17%	1,63%	2,17%	13,29%	4,90%	4,20%	19,86%	4,26%	2,84%
Thigh (Right)	72,28%	9,24%	1,63%	0,54%	1,09%	11,19%	7,69%	0,00%	17,73%	7,09%	0,00%
Thigh (Left)	73,37%	9,24%	1,63%	0,54%	1,09%	11,89%	5,59%	0,00%	19,86%	4,26%	0,00%
Knee (Right)	76,09%	5,43%	1,09%	2,17%	1,63%	6,29%	7,69%	3,50%	14,89%	7,80%	0,71%
Knee (Left)	75,54%	5,98%	2,72%	2,17%	1,09%	9,09%	5,59%	2,10%	17,73%	5,67%	0,71%
Lower Legs (Right)	73,91%	7,61%	2,17%	1,09%	1,09%	7,69%	6,29%	1,40%	19,86%	2,84%	0,71%
Lower Legs (Left)	72,83%	7,61%	1,63%	1,09%	1,09%	8,39%	6,29%	2,10%	17,73%	4,26%	0,71%

Table 8 illustrates the experiences of ache, pain, and discomfort in the specified body regions of the students. It was observed that such discomforts were reported mostly at the neck (31,52%), lower back (23,37%), and upper back (18,48%) 1-2 times during the last week. However, experiencing the ache, pain and discomforts 3-4 times during the last week were observed at the upper back (14,13%), lower back (8,70%), and neck (7,07%), respectively. Once in every day, and several times every day experiences of ache, pain, and discomfort were not significantly reported by the students.

Similar to the above results, 56.64% of the students reported that their experiences with ache, pain, and discomforts were uncomfortable at the neck and lower back regions, and also 55,44% provided that these were uncomfortable at the upper back region.

Moreover, 27,66% of the students stated that they were interfered to study and perform academic activities due to ache, pain, and discomfort experienced at the neck, which was followed by upper back (24,11%), and lower back (23,40%) problems.

Discriminant Analysis

Discriminant Analysis was applied to determine whether a set of variables is effective in predicting category membership, and to identify statistically significant factor(s) of the effects of laptop, desktop, and tablet computer use. Therefore, the dependent variable was selected to be the type of computer (desktop, laptop, or tablet) used in daily life of the students. The independent variables were selected from rest of the questionnaire questions (explained in the questionnaire section above).

Table 9. Standardized Canonical Discriminant Function Coefficients

	Function				
	1	2	3	4	5
Sch_Des	-,142	-,217	,417	-,328	,812
Locat_Des	-,397	-,311	,753	,084	-,429
Locat_Lap	,946	-,143	,400	-,128	-,113
Locat_Tab	,001	,954	,313	-,013	,009
F_Knee_R	,425	-,047	,199	,892	,301

Table 9 provides the information that desktop computer use at school for lectures, location of desktop computer use, location of laptop use, location of tablet use, and the frequency of experiencing ache, pain, and discomfort in right knee were found to be significant factors (by using SPSS 15).

CONCLUSION

Computer use is proven to contribute to the formation of musculoskeletal discomfort. With the advances in the technology, computers are more involved in education, with various forms. Desktop computers, laptops, and tablets are actively used for educational purposes. This study was constructed to reveal the ergonomic effects of the computer use for educational purposes on the students (n=186, mean age=14,61).

It was challenging to work with students, especially having them to fill out a questionnaire which was made of two sections. In order not to violate the rights of the students, ethic board decision and consent of the students were acquired before the study.

The questionnaire results illustrated that 25% of the students were using all types of computers (laptop, desktop, and tablet). Even though students were observed to use laptops and tablets more in their daily life, our research showed that desktop computer use, especially at school was one of the significant factors contribute to musculoskeletal discomfort.

The majorities of the students have been using desktop, laptop, and tablet computers for more than 1 year. However, our findings provided that students are experiencing musculoskeletal discomforts highly at the neck, lower back and upper back regions. This finding shows that the students do not recognize the importance of ergonomic posture during computer use.

Not only the experience of ache pain, and discomfort, but also their frequency, especially at the right knee, was found to be significant to the formation of musculoskeletal problems. These discomforts were shown to interfere their studies, and academic activities.

RECOMMENDATIONS

As the computer use is integrated into education for effective teaching, students should receive ergonomic trainings not to suffer from ergonomic problems, especially musculoskeletal discomforts which may damage their body during the growth phase. This study should be repeated with the contribution of more students to provide generalizability to the study. Thus, the effects of laptop, desktop, and tablet use for educational purposes could be analyzed with a wider population. Routine exercises should be given to the students to develop their musculoskeletal system in order not to suffer from such discomforts.

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USING COMPLEXITY THEORY TO CONSTRUCT A DIGITAL LEARNING ENVIRONMENT FACILITATING EXPERIENTIAL LIFE EDUCATION PROGRAMS ON ELEMENTARY SCHOOL TEACHERS AND STUDENTS

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ABSTRACT: E-learning has become a global trend, however, the entire globe is facing the problems of social disruption and disorder, overwhelmed with sensual desire, and filled with distorted sense of ethics and morality, it has a strong need to guide the younger generation to understand the meaning and purpose of life through life education. Therefore, there is an urgent need to understand how to develop, implement, and promote experiential life education programs with technology support environment. Complexity theory has been pervasively applied in education and management to adapt multiple environmental changes and multidisciplinary collaboration in recently research. Evolving from chaos theory, complexity theory not only keeps the unpredictability and nonlinearity in education models but also develops mutual-adaptation, co-evolution, dynamic interaction and self-organization. Therefore, it is appropriate to use this theory to construct educational models in complicate educational areas. The study used complexity theory as the theoretical basis and utilized a series of high-definition digital TV programs as teaching materials to develop life experiential education courses model and understand its effectiveness for elementary school teachers and students. The study was conducted by observing volunteer classes to understand the design of digital learning. One unit of a national popular TV program, “Let’s Play Stories”, was be utilized as the teaching materials. Attitudes and behaviors of teachers and students during participating, suggestions from teachers, feelings and learning of students, and interactions were investigated. Purposive sampling was used to collect five schools in northern and central Taiwan. Qualitative research methodology was the major research approach to construct the teaching model. The results of the study showed that four themes, mutual-adaptation, co-evolution, dynamic interaction and self-organization, could be found in qualitative information from teachers, students and volunteers. The study help us to understand how to establish digital learning model and effectiveness of using complexity theory to construct a digital learning environment facilitating experiential life education programs on elementary school teachers and students in real teaching sites.

Key words: complexity, experiential education, life education

INTRODUCTION

Experiential education (EE) is the process of learning through experience to change learning behavior, critical thinking and problem-solving ability (Patrick, 2011). By means of using EE in teaching method, teachers has great capacity to help student achieve: (1) a deeper understanding of subject matter, (2) an application for dealing with complex situations, and (3) the ability in lifelong learning (Eyler, 2009). In the developed process of school-age children, experiential life education (ELE) played an important role to their physical and mental states. Shortill (2011) pointed out that experiential life education might develop a joyful atmosphere that can stimulate the energy, spirt, and emotion. ELE has become a crucial part of educational setting in schools nowadays. However, it is challenge to promote ELE in elementary schools because there are only a few teachers who are able to provide ELE courses correctly. Therefore, with the advancement of technology, it is a valuable approach to combine ELE with technology and to re-examine its outcomes.

Over the past 10 years, technology and media have been developed significantly. Among the massive technology-enhanced learning approaches, e-learning has been used to motivate students' self-learning behavior. Researchers pointed out that e-learning not only can significantly improve individual's cognition but can stimulate their thinking behaviors and problem-solving abilities (Brown, Collins, & Duguid, 1989). E-learning which provides individualized teaching materials for each student was able to decrease lower dropout rates (Njenga & Fourie, 2010). Recently, scholars utilized e-learning into a verity of teaching subjects. For instance, Huang, Nien, and Yeh (2015) mentioned that Automated Composition for Music Software (ACMS) have a better learning effectiveness to students who are unfamiliar with music theories than the control groups in the elementary schools. Other researchers developed software to support classrooms in the elementary English as second language (ELS) class and found that e-learning significantly enhance students' learning effectiveness (Kuo, Yu, & Hsiao, 2015).

The use of technology in the classroom has increasingly noticed in recent year. However, there is no consensus on how to use the digital devices to guide the younger generation. Little is known about the conceptual framework understanding the meaning and purpose of life and social interaction through life educations. In order to understand these multiple phenomena, it is necessary to present a conceptual theory for liking students' behaviors and digital experiential life education (DELE). Complexity theory has been applied pervasively in education and management to adapt multiple environmental changes and multidisciplinary collaboration in recently research (Paley, 2007). Evolving from chaos theory, complexity theory not only keeps the unpredictability and nonlinearity in education models but also develops mutual-adaptation, co-evolution, dynamic interaction and self-organization (Stacy, 1996). That approach can lead eventually to maintain the harmonious situations. Therefore, it is appropriate to use this theory to construct theoretical educational models in such a complicate educational environment. The purpose of this study is to understand how to establish digital learning model and effectiveness of using complexity theory to construct a digital learning environment facilitating experiential life education programs on elementary school teachers and students in real teaching sites.

METHODS

Participants

The study was conducted in two elementary schools in northern and central Taiwan. In order to respect the personal rights in rights in making decision of their own, non-random purposive sampling were utilized in this study. All schoolchild participated in the study were pre-approval by their parents, instructors and school authorities. A total of 65 schoolchild participated in the 4-week DLE program.

Intervention

The study used complexity theory as the theoretical basis and utilized a series of high-definition digital TV programs as teaching materials to develop life experiential education courses model and understand its effectiveness for elementary school teachers and students. Units of a national popular TV children program, "Let's Play Stories", are used as the teaching materials in the study. The accumulated viewers of this TV program reached 35,557,918 times on 2015, January 1. In the beginning of the intervention, observing volunteer read picture books (Figure 1) to the participants. In order to introspect the meanings of the picture books, the participants were asked some question about the stories. Then, the participants watched "Let's Play Stories" TV program (Figure 2, Figure 3) and did the related life experience activities (Figure 4). Every unit of TV program, the picture book and the activity were closely matched to every notion of DELE. Table 1 presents the intervention program.

Table 1. DELE Program Plans

Time	North school in Taiwan DELE program	Central school in Taiwan DELE program
Week1		
picture book	I've been spread myself too thin	That grandma, this grandma
activity	Divvying	Endorsed game
Week2		
picture book	That grandma, this grandma	I've been spread myself too thin
activity	Endorsed game	Divvying
Week3		
picture book	Ms. grey heron and Mr. crane	A-Ci is unwilling to change his socks
activity	Colliding brick	Pyramidal cup
Week4		
picture book	A-Ci is unwilling to change his socks	Ms. grey heron and Mr. crane
activity	Pyramidal cup	Colliding brick

Figure 1. Volunteer described the "picture book"

Figure 2. "Let's Play Stories" TV program

Figure 3. Students were watching TV program

Figure 4. Students did some activities

Measurement

We investigated attitudes and behaviors of teachers and students during participating. It included the suggestions from teachers of feelings, learning of students, and thoughts of volunteers. Qualitative research methodology was the major research approach to gain an in-depth understanding of teachers, students and volunteers and to construct the teaching model. Attitudes and behaviors of teachers and students during participating, suggestions from teachers, feelings and learning of students, and interactions were investigated. A semi-structured interview method was chosen to collect thoughts of schoolchild and their teachers at the end of the 4-week DELE program. An interview guide, containing open-ended questions, was developed from literature reviews and approved by the research team. In addition, three volunteers also described their observation and recalled their reports after each intervention. Core questions from the interview guide are shown in Table 2.

Data analysis

The study used thematic content analysis to analyze the content of the transcripts. During the analysis, the study read through interview transcripts of the students, teachers and volunteers to gain an overall impression of the content, and to conceptualize tentative properties. The short codes, phrases and sentences of the transcripts were managed and assigned into themes based on complexity theory. During coding, the tentative property were revised and refined to more precisely reflect the data into each theme (Dynamic interaction, Co-evolution, Mutual-adaptation, and Self-organization) of complexity theory.

Table 2. Guiding Questions

Groups	Sample of Interview Questions
Students (N = 65)	1. Please tell me how you feel about DELE program. 2. How satisfied are you participating DELE program? 3. Are there any other feedback or thoughts you what to share? 4. Describe how participating DELE program changed your peer relationship. 5. Describe how participating DELE program changed your life.
Teachers* (N = 3)	1. Please describe which part of DELE program makes you impressed? 2. Please describe your thoughts about the necessity of life experience. 3. How satisfied are you participating DELE program? 4. Are there any other feedback or thoughts you what to share? 5. Do you discover any behavior changed from your student? 6. Do you think that DELE program makes your class any changed? 7. Based on your experience, what is different between life education and normal education? 10. What can we change to make DLE program better? 12. Do you think that DELE program is a good fit for students in zero hour physical education? 13. Do you think that DELE program is a good fit for students in elementary education? 14. Would you recommend the DLE program to the schoolchild in elementary?
Volunteers** (N = 3)	1. Please describe students' behavior when they watched "Let's Play Stories" program at the first time. 2. Please describe the peer interactive when you lead the life education. 3. Please describe the behavior changes of students or classmates after they took apart in DELE program. 4. Do the students dislike or compete with each other at first; however, they changed/adjusted their behavior after participating DELE program. If it happened, please describe details about this situation. 5. Do the students' interaction form a new rule after participating DELE program?

* Three teachers are Wu (W1), Wu (W2) and Chen (C)
** Three investigators are Tsai (T), Fu (F), and Wu (W)

RESULTS AND FINDINGS

Four major themes, Dynamic interaction, Co-evolution, Mutual-adaptation and Self-organization, were generated to illustrate the digital learning model in the study.

Dynamic interaction

Compared with the static and one-way rules, complexity theory appears to dynamics and non-linear interaction. Dynamic system is not under domination of single and authoritative rules. In contrast, any interactions can be exchanged their relationship, interrelated parts and some behavior contributing to complexity interactions (Guastello, 1997). Like our observation from (V_T):

> *"Most students were focus on the "Let's Play Stories" TV program. A portion of students made some noises (hubbub…) when they saw something that are familiar with their past experience… they always whispered with their peers and said "Oh! I do know how to play this!" (V_T)*

The results showed that DELE developed good outcomes and feedbacks from students. DELE provided good opportunities for students to have dynamic interactions in play that helped students to understand life education goals because play is a intrinsically, motivated and preserving behavior throughout life. Bergen (2009) noted that people in young age shows interrelated and interdependent play as a result of children often move back and forth between all levels of play and different difficulty of play. He also mentioned that play has both stable and dynamic interactions so that the patterns of play is always changed by the environment. Those students identified that DELE offered great opportunities for them to learn a variety of life educational goals by experiencing activities and dynamic interactions with peers.

Co-evolution

Stacy (1996) considered complexity theory as the unpredictable forms, which may have the contribution of the feedback loop in order to the assist in environmental interaction with nonlinear pattern. Co-evolution in the process of complexity theory played a critical role in helping organizations and individuals to improve the level of renewal necessary for successful evolution (Porter, 2006). When using this concept in the teaching sites, we can see this change from mechanism more clearly. For example, one interviewee remarked that:

"Although these kids have got together for a while, they were too shy to show themselves when doing the activities in the very beginning…, like introducing he/herself on the stage, they were quite bashful. However, some kids vigorously got off the stage and cheered their groups up enthusiastically…, it was very interesting for comparing on and off the stage!" (V_W)

"In very beginning of the activity, students who stood in their groups for taking apart in life experience were always a small portion of them… students who were willing to express themselves liked to participate the activity, vice versa… However, some active students knew that they had limit opportunities to play a part in activity after the first activity. Then, they began to cheer up when they took the lead." (V_W)

Through the observation, we could discover that students involved interspecific changes in the process of co-evolution after participating DELE programs. These students experienced the transmission in the crossing boundary of interrelationship result from the collaboration of social networking. Finch, Peacock, Lazdowski and Hwang (2015) presented that team-based experiential activities could emulate interdependency within groups, which triggered students' emotional responses from negative to positive attitudes. Moreover, EE not only can motivate the passion of students to deal with complex new situation but also make students monitor their own understanding to grapple with alternative perspectives (Eyler, 2009). On the other hand, we can find out that social behaviors and peer relationships evolution from this stage. As one student commented:

"I am able to get alone with other classmates gradually." (S_1)

"One of student (S_2) was timid in groups at the first activity; however, she changed her attitude and became open-minded to other people in the end of the activity." (V_T)

"Originally, I was a very shy person, but I felt much better and was not embarrassed anymore after taking apart in the activity." (S_2)

There is a general agreement from our participators that the increased their acceptance into their peer groups after DELE programs. This transformation is similar to the concept of Complexity theory. Bloom (2009) mentioned that students learning appears as groups working together, groups socializing and teachers interact with student when schooling were consistent with learning as a complex system. The result clearly showed a social process of group members who were willing to adopt each other. Thus, with the mentioned above, DELE program in the process of co-evolution has the potential to incorporate the loners to join the group and develop social adjustments to cope with teamwork.

Mutual-adaptation

Mutual-adaptation identifies that the relationship of competitive partner and cooperative rivalry are coexist in this process. This transformation occurs when group members tried to figure out the possibilities of real-world problems and current issues (Chiang & Chen, 2011). In coping with multidisciplinary cooperation in the groups, students developed by modifying their own nature to suitable for others. The following comment can help enlighten us on this:

"The students had lower acceptance and tolerant toward the outcomes of gaming performance. If they disappointed to the outcomes, they made fun of other group members…even more reluctant to join the activity anymore; however, they started to exchange opinions and accepted other critique, as well as they found their win-win solutions in order to gain their victories and applauses." (V_W)

"Particularly, one student, who considered herself as stranger in the group at first…but, she tried to collaborate with her group members and others tried let her fit in this groups. She was pleased to this process." (V_T)

"Most students talked about that they could become a good friend with unfamiliar classmates after the DLEL programs." (V_F)

"They didn't want me to be their members… unexpectedly! They helped me when we played the game!" (S_3)

"Well…I think a change might be their interaction with each other!" (T_W)

In the reports and interviews, most students indicated that DELE programs bettered their peer relationship. In light of mutual-adaption, these responses were examples of how students provided their pre-conditions and expressed their social behavior changes in order to reposition in the group. During this process, the indviduals usually includes four quardrants: interaction, appropriation, repositioning and publicization (Thi, 2008). Our findings echoed with the studies discussed above. When studensts came into a new environment, they could transform their won disciplinary to the new group. Then, appropriated and reposited experiences to assimilate with the teamwork are possible ways to happen. In the DELE programs, there is no clear distinction beween the role of each group member. The studnents tried to establish the consensus to collaborate with each other and found possible solutions in the process of mutual-adaption. There are viable ways to motivate students to collaborate via utilizing game-based learning (Chiang, Shih, Liu & Lee, 2011).

Self-organization

Self-organization recommends that the individuals can be regularly reconstructed and evolved in order to form the new pattern, rule and law. The notion of self-organization usually evolves in the state of equilibrium and based on three ingredients: (1) strong dynamical non-linearity, (2) balance of exploitation and exploration, (3) multiple interactions (Bonabeau, Dorigo, & Theraulaz, 1999). The principles of self-organization could operate among at schools, teaching and learning. Students in this study perceived the action as inconsistent and dissonance within the group before changing attitudes. Then, they started to justify their behaviors in order to maintain the balance of the group. For example, the interviewee remarked that:

> *"Instead of controlling the group of communication, those students started to care for other people's feelings and thoughts. We could see this clearly from some students who could neglect their disagreements and took the matter on its merits rather than sticking to one's position." (V_W)*
>
> *"Undergoing this DELE program, the students had increased the chances to collaborate with unfamiliar classmates. Therefore, they understood themselves and each other better." (V_F)*

Our results show that those students began to cooperate with each other and started to "self-organize" to accomplish the mission of DELE programs after this 4-weeks intervention. The results are similar to Caulfield and Woods (2013) studies, which implied that ELE might contribute the socially responsible behavior changes. DELE programs may influence students to seek a better understanding to rebuild their friendship by helping them to make sense of complex interactions.

CONCLUSION

Complexity theory is a viable theory for developing a complex DELE model to facilitate successful learning environments on elementary schools. This model has indicated evolved four themes (Dynamic interaction, Co-evolution, Mutual-adaptation and Self-organization) in the direction of developing social adaptation of peer relationship during participating DELE programs. The results of the study also give us comprehensions regarding how students' feelings, interactions and peer collaborations can possibly lead to modify their social behaviors to gain the better outcomes of each DELE mission.

RECOMMENDATIONS

An area of future research that should be considered is long-term interventions of DLEL programs because it could gain more subtle observations from students who may exchange their social behaviors. Besides, the interview questions are subjective to constant revision and changes in order to improve in order to obtain more reliable and objective data. Further research might usefully extend complexity theory to examine impacts of DELE programs to construct a digital learning environment on elementary schools in real teaching sites.

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AUTOMATIC EXAM ATTENDANCE SYSTEM BASED ON ILLUMINATION INVARIANT FACE RECOGNITION

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ABSTRACT: Security systems are used in several ways. In the developing technology, the computer systems are employed to solve different kinds of problems whereas they can be also used for security purposes. Application of the computer-aided security systems are one of the applicable technologies today especially in the crowded places such as entrance gates where high security measure is requested. On the other hand, automatic face recognition is useful in the applications where the recognition of the authorized people should be completed in a limited time. An application, that is the identification of the students for exam security is one of the important issues in universities where crowded exams take place. Unidentified people other than one's own examinations can be defined as problematic in terms of exam assessment. The paper proposes a new automatic class attendance system based on illumination invariant face recognition. System consists of three stages which are the face detection, facial feature extraction and classification. A known method will be employed for face detection part. For the facial feature extraction stage, non-subsampled Contourlet transform is used. The classification is done by the use of a known method which is the correlation coefficient. The system is currently under test and expected to run at acceptable recognition rates to be used in an automatic class attendance system.

Key words: automatic attendance, face recognition, non-subsampled contourlet transform (NSCT), exam security, student authorization.

INTRODUCTION

Recent developments in the areas of image processing and computer vision make real time authorization systems applicable. There are several biometrics to authorize a person like fingerprint or iris recognition. On the other hand, a biometric to be chosen for a classroom attendance system should be adapted to the classroom constraints like limited time. Thus, real time face recognition is the most applicable method of person identification to be used in an automatic attendance system.

We recommend the automatic face recognition system primarily to provide the safety of the university exam halls, which will be used for detecting the identity of the students participating in the exam. In this way, computer assisted system will help invigilators to report the attendance in a limited time. The proposed system will be able to recognize the human faces, and then matching operation through the database of the university will be made by performing the analysis. The faces are to be captured in the classroom environment. Firstly, a known face detection method will be applied to detect faces in the images. Then, by using non-subsampled contourlet transform (NSCT), obtained images are then to be transformed into multiscale and multidirectional contour information for face recognition where the intrinsic geometrical structures are used for characterizing feature vectors. Finally, a correlation matching procedure will recognize the unknown face by comparing with the database of the classroom.

There are recent studies about the implementation of classroom attendance system based on face recognition. N. Kar et al. (2012) implemented a classroom attendance system based on face recognition. Their face recognition method is based on Principal Component Analysis (PCA) algorithm. Patil and Shukla (2014) proposed a face recognition based classroom attendance system in which a hybrid method of PCA and Linear Discriminant Analysis (LDA) with Viola and Jones face detector.

The organization of the paper is as follows. First, the face recognition methodology is presented in three sub sections which are face detection, facial feature extraction and classification. Then the Results section presents the preliminary performance tests. Finally, the article concludes with a summary of the next directions.

METHODS

The methodology can be analyzed in three parts: Face detection, facial feature extraction and classification. The block diagram of the overall system is given in Figure 1.

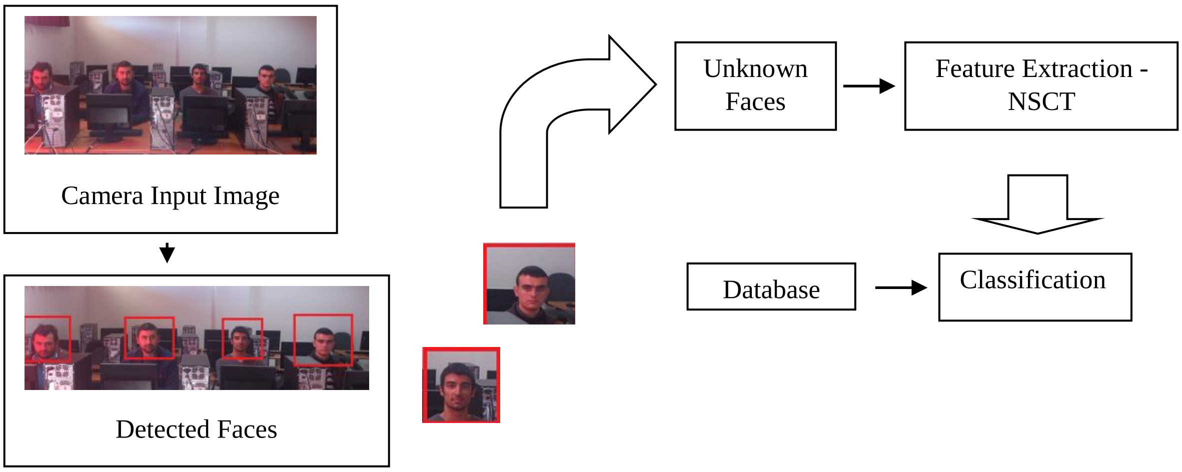


Figure 1: System Block Diagram.

Face Detection

The face detection part is a vital stage for a face recognition system. A false detection decreases the overall recognition performance. A known successful face detector which is the algorithm of Viola and Jones is planned to be used as the face detector (Viola P., Jones J. (2004)).

Facial Feature Extraction Using NSCT

NSCT method is employed for facial feature extraction. The main reason for the choice of NSCT is based on its effectiveness to capture the smooth contours and geometrical structures in the image. Different and flexible number of directions at each scale can be provided by contourlet transform, while achieving anisotropy and shift invariance properties compared with other multi-scale directional systems. NSCT obtains a sparse image representation due to its properties such as directionality and shift invariance by first applying a multiscale transform and then applying a local directional transform to gather the nearby basis functions at the same scale into linear structures. The multiscale transform essentially performs an edge detection operation, and the local directional transform performs contour segment detection. Extracted facial geometric properties from the detected human face will be assumed to be facial features. After that, classification depending on the face geometry could be applied.

Do and Vetterli (2005) proposed contourlet transform (CT) to represent two dimensional singularities, which is composed of Laplacian pyramid and directional filter bank. Due to its directionality and anisotropy, the transform can represent curve more sparsely. Non-subsampled contourlet transform (NSCT) presented in (A.L. da Cunha, Jianping Zhou, and M.N. Do (2006)) based on the theory of CT, and is a kind of multiscale, multidirectional computation framework of discrete images. The whole course of NSCT is still composed of two stages, including multiscale analysis and multidirectional analysis, which are similar to those of CT. The NSCT is also shift-invariant so that each pixel of the transform subbands corresponds to that of the original image in the same spatial location. Therefore, we gather the geometrical information pixel by pixel from the NSCT coefficients. Furthermore, Cheng et al. (2010) reported that feature extraction based on contour analysis is an effective way for face recognition under varying lighting conditions. All directional contour subbands can be expressed by

$$\begin{gathered}\{C_{m,d}\}, m=1,2,...,k; d=1,2,...,l_m; \\ k\in(1,2,...,N), l_m=2^N\end{gathered} \qquad (1)$$

where m and d are the scale and direction of the decomposition respectively, k is the number of contour decomposition scale, l_m is the number of contour decomposition directions of m^{th} scale and {Cm, d}is the coefficient at the d^{th} directional subband of the m^{th} scale.

Directional contour subbands of NSCT only include spectrum information and keeping the most significant coefficients will directly lead to improvement in feature extraction (Po et al. (2006)). Thus in this letter, we propose to represent images under varying lighting conditions by using the directional coefficients having the maximum spectral norm.

$$P(x,y) = \max_{\{C_{i,j}(x,y)\}} \left(\left\| C_{i,j}(x,y) \right\|_2 \right), \quad i = 1,2,\ldots,m;\ j = 1,2,\ldots,d \tag{2}$$

where $\|\cdot\|_2$ is the spectral norm and P(x, y) is the coefficient point (x, y) at the jth directional subband of i^{th} scale. We observe that in the NSCT domain, the illumination component corresponds to those pixels with positive coefficient points and the reflectance component mainly corresponds with negative coefficient points. Since the reflectance component is considered as the intrinsic facial features, it can be directly used for face recognition. Based on this observation, Binary-NSCT, B(x, y), of an image is defined as

$$B(x,y) = \begin{cases} 1, & \text{if } P(x,y) > 0 \\ 0, & \text{if } P(x,y) \le 0 \end{cases} \tag{3}$$

After extracting the intrinsic geometrical information by this simple binarization process, the illumination invariant representation can be reconstructed from the Binary-NSCT coefficients by inverse NSCT. Figure 2 shows an example of constructing Binary-NSCT by using contourlet transform with three scales and four directional subbands in each scale.

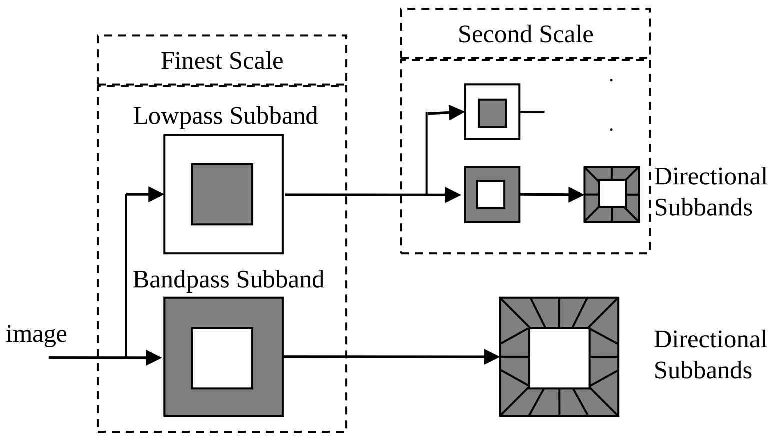


Figure 2: Structure of the Non-subsampled Counterlet Transform with Two Levels of Decompositions.

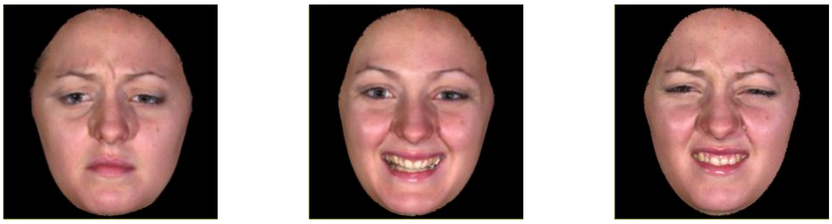
Face Classification

The last stage of the face recognition based attendance system is the face classification where an unknown face is to be classified with one of the known faces in class database. Currently, a correlation coefficient based classifier is employed in order to be a base for future classification method.

The correlation coefficient used r, is given in Equation 4 where A and B are two matrices. $\overline{A}$ and $\overline{B}$ represent corresponding mean values, m and n represent image dimensions.

$$r = \frac{\sum_m \sum_n (A_{mn} - \overline{A})(B_{mn} - \overline{B})}{\sqrt{\left(\sum_m \sum_n (A_{mn} - \overline{A})^2\right)\left(\sum_m \sum_n (B_{mn} - \overline{B})^2\right)}} \tag{4}$$

The inputs to the classifier are the output images supplied by NSCT algorithm. Each unknown face in NSCT form undergoes a matching procedure using Equation (4) where A is the unknown face and B varies among the registered known faces which are planned to be in the database of each classroom. Then, the maximum correlated face image will be selected as the classified face. Figure 3 shows examples of input images to the classifier.



(a)

(b)

Figure 3: Input Face Images (a) and Their Corresponding Illumination Invariant NSCT Representations (b).

RESULTS

The system is currently being tested with two different databases which are Yale database and BU-3DFE database. NSCT based face recognition algorithm already performed at high rates on Yale database reported in H.Soyel, B.Ozmen and P.McOwan (2012). However, in their study, the facial expression constraint was not tested. Differently, in this study, we are testing the system on BU-3DFE database (proposed in Yin et al. (2006)) in order to evaluate the performance under different facial expressions. BU-3DFE is a facial expression database that includes 6 different expressions of the face, anger, disgust, fear, happiness, sadness and surprise in four degrees. Obviously, a face can be in different expressions and in the classroom environment facial expressions should be considered as constraints to the system. Therefore the system performance on both databases, with or without facial expressions, will set the overall system performance.

CONCLUSION

The paper proposes an automatic class attendance system based on illumination invariant face recognition. The contribution of the paper is that it is proposing to employ NSCT transform for expression independent illumination invariant face recognition. The system is currently being tested on two different databases which are Yale and BU-3DFE face databases. The future works are the creation of sample classroom database, completion of offline tests on two databases and the real time tests in the classroom. It is expected to provide expression and illumination invariant robust face recognition system to be used in classroom environment for automatic attendance application. Furthermore, automatic attendance system will be useful in examination halls where there is a limited time to authorize the participants of the exam.

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HIGHER EDUCATION OF INDIA: INNOVATIONS AND CHALLENGES

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ABSTRACT: Education plays a pivotal role in the development of the society and decides the direction in which it has to develop. It has been the salient driver for the achievement of various societal milestones. Since development and advancement is order of the day, education has caught the limelight and turned to be paramount significance. In the present paper, an attempt is being made to throw some light on the current status of higher education, Gross enrolment ratio, state of employability of the output of higher learning institutions. Providing quality education and producing employable output has been a major challenge faced by institutions of higher education. We survive in a society where education is base to go up in the ladder socially, politically, economically etc, in the society. The paper further highlights the innovativeness being developed, persued and followed in the in the wake of changing dimensions of education globally.

Academicians and administrators have to think on serious initiatives to be followed to bring about desired changes. The curriculum and delivery mechanism has to be restructured and updated from time to time to meet the expectations of the society. Though there is a visible growth in terms of increase in number of higher learning institutions i.e. 523 universities, deemed universities and institutions with national importance are functioning in India, but not even a single higher learning institution from India figured in the top 200 institutions in the world, this poses serious question on the education system being followed in the country which can only be answered by adopting innovative changes in higher learning institution. The concerted efforts so initiated may bring desired quality results from the sector. Thus the present paper makes an effort to critically examine the present status of higher education system in the country and offer measures to be adopted in the days to come to make the sector more vibrant and relevant and more societal oriented. Education ultimately should enable the society to attain and achieve the desired changes and enjoy the demographic dividend. Further it should contribute visibly in the development of productive social capital.

Keywords: GER, employability, higher education, higher learning institution, demographic dividend, social capital, curriculum

INTRODUCTION

India has been witnessing a consistently higher rate of economic growth in the recent times. It has now turned to be a major player in the global knowledge economy of the present time. Skill-based activities have made significant contribution to the growth. Such activities depend on the large pool of qualified manpower that is fed by its large higher education system. It is now widely accepted that higher education has been critical to India's emergence in the global knowledge economy. Yet, it is believed that a crisis is plaguing the Indian higher education system. While, the National Knowledge Commission (NKC) set up by the Prime Minister, calls it a 'quiet crisis', the Human Resource Minister calls higher education 'a sick child'. Industries routinely point towards huge skill shortages and are of the opinion that growth momentum may not be sustained unless the problem of skill shortages is addressed. This appears to be endless problems with the Indian higher education.

An unwieldy affiliating system, inflexible academic structure, uneven capacity across subjects, eroding autonomy of academic institutions, low level of public funding, dysfunctional regulatory environment are some of its many problems. Finally, it is widely held that it suffers from several systemic deficiencies and is driven by populism, and in the absence of reliable data, there is little informed public debate. More than 35 years ago, Nobel laureate Amartya Sen, while analyzing the crisis in Indian education, rather than attributing the crisis in Indian education to administrative neglect or to thoughtless action, pointed out that the 'grave failures in policy-making in the field of education require the analysis of the characteristics of the economic and social forces operating in India, and response of public policy to these forces' (Amartya Sen, 'The Crisis in Indian education', Lal Bahadur Shastri Memorial Lectures, 10–11 March 1970). He emphasized that 'due to the government's tendency to formulate educational policies based on public pressure, often wrong policies are pursued.'

Unfortunately, it is believed that policy-making suffers from similar failure even today. Rather than pragmatism, it is populism, ideology and vested interests that drive policy. It seeks to achieve arbitrarily set goals that are often elusive and, more than that, pursued half-heartedly.

Evolution of Higher education:

The tradition of higher education system India is old and inherited an age which has generated knowledge and learning right from the beginning of the Indian civilization. To take into consideration the period of Guptas they encouraged higher learning by patronizing center for higher education at Nalanda, Takshila, Ujjain, vikramshila and vallabhi. Each university as mentioned specialized in a particular group of study. These universities have become popular in 7th and 8th centuries A.D. After the advent of Buddhism people flocked to saranath university to study Buddhist religion and to Ajanta to specialize in art, architecture and painting. These institutions mainly funded by grants of land and donations. Such grants came from kings as well as affluent people existing in the then-society. In fact the historical data figures out a well-established system, which functioned in India as early as 1000 B.C. In that system the construction of knowledge, the beliefs on which the knowledge is based, basic concepts of the organizational learning were very different from the European tradition.

Higher education system during British Raj:

The European system of higher education was introduced by the British regime in India in the year 1857 with the establishment of universities for European education in Bombay, Calcutta and Madras. If we consider the beginning of the British Raj in 1858, the British have done lot of work on the promotion of the English education along with higher education in India. With starting of English schools and promotion of English language in the higher education was a major contribution by the regime.

Present status of higher Education in India:

The higher education in India has grown significantly over the years and played pivotal role in the creation of human capital contributing substantially the economic growth. The education being the concurrent subject, the state and centre playing an important role in the field of higher education by establishing higher learning institutions and enhancing the reach of the higher education. The following tables provides an over view and development of higher education in India.

Table 1: No. Of Institutions During The Year 2010-11

No. of Institutions/enrolment	Year (2010-2011)
Universities	523
Colleges	33023
AICTE Technical Institutions	11089
Distance teaching Institution and Universities	200

Source: MHRD Annual Report 2011-12

Table 2: Enrolment During The Year 2010-11

Enrolment in universities and colleges (In Lakhs)	169.5
Enrolment in open distance learning(In Lakhs)	37.45
Enrolment in post-sec/post graduate diploma (In Lakhs)	18.56
Intake in the AICTE Approved institutions (In Lakhs)	26.5

Source: MHRD Annual Report 2011-12

Higher Education sector in India has witnessed a tremendous growth in the number of Universities/Universities level Institutions and Colleges since Independence. The number of Universities has increased from 20 in 1950 to 677 in 2014. The sector boasts of 45 Central Universities, 318 State Universities, 185 Private universities, 129 Deemed to be Universities, 51 Institutions of National Importance (established under Acts of Parliament) under MHRD (IITs - 16, NITs – 30 and IISERs – 5) and four Institutions (established under various State legislations). The number of colleges has also registered manifold increase of just 500 in 1950 to 37,204, as on 31st March, 2013. There was a time when population of the India was much less and higher education was accessible for everyone to pursue higher Education in India. but due to raise in population has made difficult to seek admission to universities and higher learning institution in India and it is also found that increased high cut-off percentage for admission as 80%, 85% even 90% in some of the discipline in prestigious universities and institutions of the India.

The final onus resides with the teachers of the nation. They, by their precept as well as by their example of uprightness and devotion to perform duties and responsibilities should become the real torch bearers for the student community and win regard and reverence from them. That alone can place the University or the college campus above narrow perceptions. Private coaching has become a wide-spread malady among teachers. This needs to be curbed and controlled even by law, if required.

Innovations initiated by the GOI:

The government of India has come out with appropriate initiatives by establishing more central universities and higher learning institutions to make higher education easily accessible to all at the optimum cost.

1. Establishment of New Central Universities

Central Universities Act, 2009, which came into effect from 15.1.2009, has established 16 new Central Universities in each such States (except Goa) which did not have a Central University; in Jammu & Kashmir, there are two Central Universities, one in Kashmir Division and another in Jammu Division. Besides J&K, the new Central Universities are established in the uncovered States of Bihar, Jharkhand, Orissa, Gujarat, Haryana, Punjab, Rajasthan, Himachal Pradesh, Karnataka, Kerala, Goa, Chhattisgarh, Madhya Pradesh, Uttarakhand and Tamil Nadu. Three State Universities which have been converted into Central University are Guru Ghasidas Vishwavidyalaya in the State of Chhattisgarh, Dr. Harisingh Gour Vishwavidyalaya in the State of Madhya Pradesh and Hemvati Nandan Bahuguna Garhwal University in the State of Uttarakhand.

2. Indira Gandhi National Tribal University

The Indira Gandhi National Tribal University (IGNTU), Amarkantak, Madhya Pradesh, has been established by an Act of Parliament. It commenced its academic activities from the Academic Session 2008-09. The University is running Undergraduate as well as Postgraduate courses in various disciplines. The University is a teaching and affiliating university for facilitating and promoting avenues of higher education and research facilities for the tribal population of the country.

3. Setting Up Of 374 Degree Colleges in Educationally Backward Districts

The Ministry has decided to set up Model Degree Colleges in those educationally backward districts of the country, where the GER or Gross Enrolment Ratio is less than the national average. In a survey, 374 such districts have been identified. Proposals are awaited from the respective State Governments for the establishment of such colleges. This scheme is a part of the Government policy for access, participation and expansion of higher education.

4. Scheme for Incentivizing State Governments for Expansion Of Higher Education Institutions

A scheme is being introduced for incentivizing States for establishing new higher educational institutions/expanding existing higher educational institutions. This new Scheme will provide central assistance to the State Governments in the ratio of 1:2 (1:1 for Special Category States) for establishing new higher educational institutions/expanding existing higher educational institutions. The physical targets for XI Plan and XII Plan include new universities, colleges, engineering colleges as well as expansion of existing colleges.

5. Supporting Uncovered State Universities and Colleges

Affiliated colleges of State Universities are technically under the purview of UGC but do not get assistance as they do not meet the minimum eligibility norms in terms of physical facilities and human resources. The Ministry intends to strengthen those colleges and universities with focus on underserved areas to enable these institutions to fulfill the criteria for UGC assistance.

In the XIth Plan period, it is envisaged to provide additional assistance to universities and colleges which are already declared fit to receive grants under Section 12B of the UGC Act.

6. Strengthening Science Based Higher Education and Research in Universities

Looking at the declining quality and quantum of scientific research in India, an Empowered Committee under the Chairmanship of Prof. M.M. Sharma was constituted for rejuvenation of Basic Scientific Research in Universities. Based on the recommendations of Task Force action for strengthening science based education and research in Universities has been initiated.

The main objective of the scheme is to promote excellence in research in higher education by supporting research programmes of the University and College teachers in various disciplines. The UGC has been striving for promoting teaching and research in emerging areas in Humanities, Social Sciences, Languages, Literature, Pure Sciences, Engineering & Technology, Pharmacy, Medical Agriculture Science etc. Teachers who are permanent / regular, retired / working in the Universities and colleges which are recognized under section 2(f) and declared fit to receive grants under 12 B of the UGC Act, 1956 only are eligible.

New Bill on Innovation Universities to boost Research and Collaboration:

The government of India has introduced a bill in the parliament to establish universities to focus on innovation and research. The aim and intention behind it is to attract the foreign and domestic private investment to boost the nation's research capacity.

The universities for research and innovation bill 2012, tabled in the lower house on 21st May, has been in the drafting process for some time and has been changed from the previous version that aimed to establish 14 new innovation universities. The revised version has no cap on number of universities to be setup.

Under the same bill the existing universities can also be classified as innovation universities after a change in the governance structure. The change is attributed to government inability to reach its target to setup 51 new public higher education institutions- including 8 IIT's and 7 IIM's during the 11th plan period during 2007-12. Several of the planned institutions failed to take off, due to delay in land acquisition and disputes between central and state government on where they should be setup. The changes reflect the government's realization that it cannot do everything by itself. Therefore, there are no numerical targets. At the same time there is an emphasis on encouraging private participation in higher education.

Establishment of NEW IIT's and IIM's:

The government has initiated for establishing new IIT's and IIM's as an expansion strategy of the higher education by giving representation to the states which do not possess existing IIT's and IIM's. The government has planned to start 5 new IIT's and half a dozen of IIM's which is announced in the budget and may be reality and operation from the academic year 2015-16. In this regard MHRD has sent a communication to 10 states where the IIT's and IIM's are likely to come up. According to the plan the nearest existing IIT and IIM's will serve as mentors in managing the new institutions till the appointment of their directors as the process takes 6 months for the appointing the director. In the course the mentor institution will be asked to find out temporary facilities till they get permanent campus.

NISER (National Institute of science Education and Research):

The government of India has earmarked an initial outlay of ₹823.19 crore (US$130 million) during the first seven years of this project, starting from September 2007.It is an autonomous institution which will be operated under the umbrella of department of atomic energy (DAE) of the Government of India. NISER will facilitate the synergy between research and higher education in the field of science. It will be categorically compared with the best institutions in India in terms of facilities and faculties. The atomic energy commission in its 182nd meeting approved the proposal of establishing the NISER at Bhubaneswar.

Presently NISER has five schools namely:

- School of biological sciences
- Schools of chemical sciences
- School of mathematical sciences
- School of physical sciences
- School of humanities and social sciences.

IISER (Indian Institutes of science Education and Research):

The Scientific Advisory Council to the Prime Minister (SAC-PM) under the Chairmanship of Prof. C.N.R. Rao, recommended creation of five new institutions devoted to science education and research to be named "Indian Institutes of Science Education and Research" broadly on the lines of IISc. Bangalore. Five such Institutes have already been established at Kolkata, Pune, Mohali, Bhopal and Thiruvananthapuram.

The vision of these institutes encompasses creation of research centers of the highest caliber in which teaching and education in basic sciences will be totally integrated with state-of-the-art research. These Institutions are devoted to under-graduate and post-graduate teaching in sciences in an intellectually vibrant atmosphere of research and make education and career in basic sciences more attractive by providing opportunities in integrative teaching and learning of sciences. The goals of these institutes, inter alia, are: -

- To create quality education and research in basic sciences.
- To attract and nurture high-quality academic faculty.
- To create integrated Masters Programme in sciences, in order to provide entry into research at a younger age. In addition, the Institutes will have integrated programmes leading to Masters and Ph.D's to those who hold a Bachelor's degree in science.
- To make possible a flexible borderless curriculum in sciences.
- To actively forge strong relationship with existing universities and colleges and network with laboratories and institutions.
- To establish advanced Research Laboratories and Central facilities.

Policy Measures:

The government of India adopted several policy measures to develop ideal ecosystem of higher education following are some of the salient initiatives being followed over the years.
<u>National Knowledge commission (NKC)</u>:

The 21st century has been accorded globally as 'knowledge century' every nation at present is operating in high competition in the education and innovation globally with more focus on quality, infra and knowledge. It is the think tank of India charged with considering policies that were aimed to sharpen the higher education and achieve India's competitive edge in the field of knowledge and intensive service sector. This came into force on 13th June 2005 by Dr. Manmohan Singh, the then prime minister of India. The commission was established to advise the prime minister on the policies pertaining to the education and research and the reforms which can make Indian globally recognized and turn as a major competitive force in the knowledge economy. The commission was to study the reforms which are required in the education sector, research labs and intellectual properly legislation, the same to be recommended to government of India. So that government can upgrade itself and use latest techniques to work in more transparent way.

In the next few decades India will have most number of young people as compared to any country globally. Given this demographic advantage over the countries of west and the china we are optimally positioned in the words of the prime minister of India Dr. Manmohan Singh, i.e ***<u>"Leapfrog in the race of social and economic development"</u>*** . by incorporation knowledge based paradigm of development socially and economically. With this broad view NKC was established and 3 years were given from the date of incorporation to achieve the set objectives.
The objective is:

The overall task of the NKC is to take the steps that will give India 'the knowledge edge' in the upcoming decade and be a competitive force in the world in the field of education and research. To ensure India becomes a leader in the creation, application and dissemination of knowledge.
<u>RUSA (Rashtriya Uchchatar Sikhsha Abhiyan):</u>

In India innovative education policies have yielded significant and remarkable results and achieved huge success. The programmes such as sarva Sikhsha Abhiyan for elementary education and Rashtriya Madhyamik Sikhsha Abhiyan for promotion of secondary education launched in the year 2001 and 2009 respectively have produced great results in the field of education. The UGC is being the regulatory body for the higher education in India has the provision for routine innovation and development in the university education across India. UGC looks after the funding of innovation and development in the universities, funding of the UGC is quite adequate for colleges and centrally funded universities operating in India, which are recognized under the section 12B and 2(f) of the UGC act. As of the statistical data of the year 31st march 2012 India higher education sector consist of

574 universities, 35539 colleges out of which 214 universities are not covered under 12B and 2(f) of the UGC act. This state that large number of universities is run by the government but spending on the higher education and universities is very less to facilitate reforms in the sector and bring innovation, change and development. Therefore a separate scheme for state/UT-managed universities and colleges was proposed by the NDC (National Development Council) as part of 12^{th} five year plan.

It is a holistic scheme of government of India for the development of higher education. This was the initiative taken by MHRD government of India in the year 2013; the centrally focused scheme aims for strategic funding to all the higher education institutions operating in India. Funding is done by the central ministry to the concerned state and union Territories (UT). Which in association with the central project appraisal board will monitor academic, administrative and financial advancement undertaken in the scheme. Which covers a total of 316 public universities and 13024 colleges/institutions.

Accreditation of higher learning institutions in India:

There are various bodies in India accrediting higher learning institutions

NAAC (National Assessment and Accreditation Council):

It is the autonomous body of the university grants commission (UGC) which assess and accredits the universities and institutions in Indian. NAAC was established in the year 1994 with head quarters located in Bangalore-Karnataka in response to recommendations of National Policy in Education (1986). This policy was to "address the issues of deterioration in quality of education", and the Plan of Action (POA-1992) laid out strategic plans for the policies including the establishment of an independent national accreditation body.

At present in India, accreditation is voluntary for Higher Education Institutions. Out of 612 Universities in the country, only 172 of them have been accredited by the National Assessment and Accreditation Council (NAAC). Out of the Universities accredited, 67 have been placed in Grade A, 99 Universities in Grade B and only 6 in Grade C, based on scores awarded during the process of accreditation. A bill - National Accreditation Regulatory Authority for Higher Educational Institutions Bill, 2010 has been introduced in Parliament of India to make it mandatory for every higher educational institution in the country (other than institutions engaged in agricultural education) to be accredited by an independent accreditation agency.

Issue and challenges before Higher Education in India:

The present status of higher education in India is facing various challenges which need to be addressed with appropriate measures. The key challenges are Low gross enrolment ratio, quality in higher education and employability. Significantly inadequately funded state universities. Etc

Some of the key problems faced by the higher education in India. Basically there are several problems which constitutes of lack of infrastructure in universities and institutions, faculty crunch and acute shortage of the teaching staff and poor faculties, low student enrolment and outdated teaching methods, decline in research standards, overcrowded classrooms, lack of motivated students, income and geographic factors etc are the prominent issues to be addressed by the regulatory bodies and government at both the centre and state level. The other major issue is quality of education imparted by the Indian universities and institutions in contrast to private institutions and foreign universities and producing employable output has one of the prime challenge that Indian higher education has to overcome. Ensuring equitable access to quality education to the poor students has turned out to be a major distant dream. The population of India is over 125 crores which is about 16% of the world's population and occupies the space of 2.4% of the total area and is 7^{th} largest country in the world. It's been 6 decades India became independent from the British regime and transformed into a democratic nation. The population, area, history of India and a century old social stratification which are peculiar to the country to have contributed to the issues which Indian higher education is facing. During the launch of the 11^{th} plan prominent issue faced by the higher education are access to higher education, interstate and inter-district disparities, urban-rural disparities lead to low access of the higher education alongside inter-caste, inter religion, male-female, rich-poor disparities have paralyzed the education of India. Imparting and providing the relevant education, academic reforms, governance in higher education, regulations of private sector in higher education and issues related to cross country and collaboration of education system has been major issues and challenges which needs to be attended with required focus. One of the major issues is to increase the GER to convert the society into a knowledgeable and productive society.

Table 3: State wise Gross Enrolment Ratio in Higher Education in the relevant age group of 18-23 Years

Sl. No.	STATES/UTs	ALL CATEGORIES			SC			ST		
		MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
1	Andaman & Nicobar Islands	11.6	14.9	13.1	-	-	-	14.4	25.9	20.0
2	Andhra Pradesh	31.8	23.4	27.6	25.9	20.4	23.1	25.6	16.6	21.0
3	Arunachal Pradesh	36.9	24.9	30.9	-	-	-	43.8	27.4	35.1
4	Assam	14.5	14.2	14.4	11.9	11.4	11.7	14.4	12.9	13.6
5	Bihar	14.7	11.2	13.1	10.5	6.0	8.3	12.2	9.3	10.8
6	Chandigarh	52.4	53.8	53.0	19.4	19.0	19.2	-	-	-
7	Chhatisgarh	12.1	9.9	11.0	10.0	7.5	8.8	5.6	4.6	5.1
8	Dadra & Nagar Haveli	6.2	7.1	6.5	6.7	5.2	6.1	1.6	1.0	1.3
9	Daman & Diu	3.0	7.6	4.2	10.7	22.7	16.2	18.1	9.2	13.6
10	Delhi	35.7	33.6	34.8	19.7	15.6	17.8	-	-	-
11	Goa	34.9	40.4	37.4	27.5	27.5	27.5	22.0	21.1	21.6
12	Gujarat	19.3	15.7	17.6	19.6	16.2	18.0	10.1	9.4	9.7
13	Haryana	28.4	27.3	27.9	18.8	16.9	17.9	-	-	-
14	Himachal Pradesh	25.7	24.2	25.0	14.3	12.8	13.5	21.0	19.7	20.4
15	Jammu and Kashmir	22.6	24.9	23.7	2.8	2.8	2.8	2.3	1.8	2.0
16	Jharkhand	9.1	7.6	8.4	6.5	4.2	5.4	3.9	3.9	3.9
17	Karnataka	25.2	22.8	24.0	17.1	13.7	15.4	14.4	11.0	12.7
18	Kerala	19.3	26.9	23.1	12.3	22.7	17.5	11.4	13.2	12.3
19	Lakshadweep	0.0	0.0	0.0	-	-	-	0.0	0.0	0.0
20	Madhya Pradesh	19.8	14.6	17.4	12.0	11.1	11.6	7.6	6.2	6.9
21	Maharashtra	29.7	24.8	27.4	27.1	22.5	24.9	15.9	9.1	12.5
22	Manipur	32.3	34.4	33.4	76.7	72.4	74.5	24.8	20.5	22.7
23	Meghalaya	14.3	18.3	16.4	48.6	24.0	37.0	8.6	13.4	11.1
24	Mizoram	21.6	19.6	20.6	98.2	128.6	109.2	21.8	19.5	20.6
25	Nagaland	22.0	13.7	17.9	-	-	-	21.3	13.1	17.2
26	Odisha	18.4	14.3	16.3	10.2	8.1	9.1	8.4	6.6	7.5
27	Puducherry	39.1	35.1	37.1	36.8	30.6	33.5	-	-	-
28	Punjab	22.6	17.1	20.0	9.3	7.0	8.2	-	-	-
29	Rajasthan	20.8	14.9	18.0	14.6	8.9	12.0	16.6	9.7	13.2
30	Sikkim	31.2	24.4	27.9	40.0	28.2	33.9	17.4	18.2	17.8
31	Tamil Nadu	41.1	35.2	38.2	28.7	25.6	27.1	34.2	27.9	31.0
32	Tripura	14.2	9.1	11.6	12.3	7.7	10.0	7.7	4.1	5.8
33	Uttar Pradesh	15.6	18.1	16.8	11.5	13.7	12.5	20.8	16.9	18.9
34	Uttrakhand	26.5	27.9	27.2	16.3	16.7	16.5	27.4	32.6	30.0
35	West Bengal	14.7	10.7	12.8	10.0	7.1	8.6	7.2	4.6	5.9
All India		**21.6**	**18.9**	**20.4**	**15.4**	**13.5**	**14.5**	**12.4**	**9.2**	**10.8**

Source: AISHE-2011-12

Gross enrolment ratio for the Indian higher education system is calculated for the age group of 18-23 years. Total enrolment in the higher education irrespective of age, expressed as percentage to the eligible population of the age group in the given school year. The GER is widely used to show the general level of participation and capacity of the higher education. The present data highlights detailed picture on the GER based on gender and all categories along the details pertaining to SC/ST GER in Indian Higher Education. The government of India is making efforts and taking initiatives to increase the present GER 19% to 30% by the year 2020. The GER of the SC category male is at 15.4% and female at 13.5 for the year 2010-11 as per the AISHE 2011-12. The global GER is at 26% as aspirants. India's GER of 19% is very as compared to the global scenario. Certainly the aim of India is to keep the momentum of GER which began in the 11th five-year. To attract students to higher learning institutions quality has to be implemented right from the schools to higher learning institutions. The most prominent issues pertaining to the GER is enrolment in rural and semi urban areas may be due to availability and affordability of higher education and may be fee is a greater constraint for the aspirants. The government not only should think on GER in higher education but also has to take steps to employ the output produced by the higher learning institutions and innovative methods of learning and teaching has to be adopted as per need to get the employment. The government should stress on the continuous updations and modification of the curricula in the wake of employment. The academicians and researchers has to appreciate the aspect of 'standard of teaching' is pivotal in the higher education. The rise in the number of higher learning institutions are aimed to increase the GER but serious questions are posed on huge vacancy of teacher in all institutions who can contribute to 'quality teaching' as per the present details there are 19 central universities established by the act of parliament and there are instances found poaching of good faculties from existing universities. What will be the result if more universities are established with the intention of increasing the GER.

Employability:

More than 20% of the Indian falls in the age group of 15-24 years are available for work according to the population census of 2011. While education system of India has made considerable progress in terms of capacity creation and enrolment in the last decade, it lags significantly in the terms of global relevance and competitiveness as stated by the repot of the FICCI (Federation of Indian chambers of commerce and Industry) and EY.

The reports reveal that low employability of Indian graduates is due to outdated curricula, shortage of quality teaching faculty, high student-teacher ratio, lack of institute-industry linkage and lack of autonomy to introduced new and innovative progarmmes. Small portion of the Indian Graduates are found to be employable with the passage of time and declining in academic stature of high excellence. It is found that drop down in the placement in institutions other than top institutes and this cannot fulfill the total market demand. Further this has resulted to shut down number of small institute of higher education which was failing to provide quality education.

The government has a tough time of generating employment and increasing GER simultaneously. The present phase of unemployment is high so increasing GER is bit difficult for the government. . At the beginning of the academic year 2004, the total number of students enrolled in the formal system of education in universities and colleges was 12.97 lakh -99.53 lakh (13.3 per cent) in university departments and 86.57 lakh (86.97 per cent) in affiliated colleges and 4.37 lakhs teaching Faculty employed making India's System of higher education the second largest in the world.

Quality Of higher education:

The overall higher education scenario of India does not match with the global Quality standards. Hence, there is enough justification for an increased assessment of the Quality of the country's educational institutions. Traditionally, these institutions assumed that Quality could be determined by their internal resources, viz., faculty with an impressive set of degrees and experience detailed at the end of the institute's admission brochure, number of books and journals in the library, an ultra-modern campus, and size of the endowment, etc., or by its definable and assessable outputs, viz., efficient use of resources, producing uniquely educated, highly satisfied and employable graduates. Fingers are raised on the current phase of the quality in HE in India as direct impact on employable factor as most of the output produced by the institutions is jobless. Competencies can be created among the students competencies in the form of recall; problem solving and understanding has to be uplifted to make them get employment. Restructuring of the academic syllabi and it should be free from politics and should hold autonomy for proposing and modernizing the Indian education system with the sole aim of producing talent.

CONCLUSIONS

The current arena is going to be tough for Indian higher education system as government is thinking to globalize the higher education system for transformation and standards in the education system. This will pose a serious question on the existing standards that how well the Indian universities and institutes are meeting the global challenges in the sector. Few feel that globalizing education would lead to quality education and research at large which will enable to capture the current and future challenges and explore the opportunities to excel in getting employment. Today we are producing graduates at high rate but still lot of them are unemployable we need to change this mindset and transform it by making suitable efforts to employ and increase employability. So it's time to transform, adapt change to impart high quality education. We understand that the present higher education is on the cross road and needs to bounce back on the right track so that it can be ray of hope for students of the nation.

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THE EFFECTS OF USING SOMATOSENSORY VIDEOGAMES TO PROMOTE "LIFE-EFFECTIVENESS" OF CHILDREN IN ELEMENTARY SCHOOLS

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ABSTRACT: With dramatic advancement of technology, children in elementary schools have much more opportunities to immerse in technology environment. However, children nowadays are facing a variety of challenges in emotional control, peer pressure, and social interactions and relationships due to rapid changes of social environment on campus. In order to develop their social capacities, it is important to provide appropriate activities with technology to enhance their life-effectiveness. Therefore, there is a crucial need to understand how to improve the life-effectiveness of children in elementary school. The purpose of this study was to explore their life-effectiveness by using somatosensory video games, Xbox 360 Kinect. A total of 84 participants were recruited and divided into an experimental group (n = 40) and control group (n = 44). The experimental group voluntarily agreed to complete 30-minute Xbox 360 Kinect trainings one time a week for total of 4 weeks. The Life-Effectiveness questionnaire was used to measure and complete before and after the intervention in both groups. The Wilcoxon nonparametric test for each two independent samples was used to evaluate time-series training effects. Results showed that experiment group significantly improved their self-effectiveness between pre and post-test ($p < .05$). The study concluded that using somatosensory video games is a potential tool to enhance the life-effectiveness of children in the elementary school. Further studies are suggested to validate possible follow-up benefits of somatosensory video games and to develop the best intervention model.

Key words: life effectiveness, somatosensory videogame, Xbox 360 kinect, educational technology, e-learning

INTRODUCTION

The Department of Statistics, Ministry of Education in Taiwan (2013) pointed out that the total number of public elementary school classes would decrease from 53, 574 to 49, 071, each class would have less then 30 students, and the number of teacher demand would fall from 92, 476 to 86,208 within following 5 years. Schools have begun to reduce the number of classes and teachers, and even school merging to reflect the trend of low birthrate and enrollment numbers. Having more educational resources than before, schools in Taiwan have to develop diverse interactive teaching and learning strategies, such as e-learning and game-based learning. Gros (2007) found that videogames are valuable tools to help students to learn specific teaching goals and knowledge with long term outcomes. Toprac (2008) pointed out that students are able to be motivated by videogame-based courses which create enjoyable and fun learning experience.

“Morning hours” are very common informal period right before the official first period in elementary schools in Taiwan and are used to arrange diverse extra-curricular activities, such as parenting story telling and picture book reading. According to a recent investigation, most common activities are homeroom teacher’s time (25.64%), morning gathering (12.82%), and flag-raising ceremony (8.97%) and most of them are sedentary activities (Wang, 2008). Ratey and Hagerman (2009) published a book named “Spark: The Revolutionary New

Science of Exercise and the Brain" and reported that Zero hour PE (refers to its scheduled time before first period) in Chicago helps students to have better performance in reading and comprehension and to acquire social-emotional development and behavior. Marashian and Khoraml (2012) also identified that children were able to improve their academic performance and decreased the sense of loneliness significantly. Buck, Hillman, and Castelli (2008) studied 74 children aged 7 to 12 and investigated their aerobic fitness, muscle strength and body composition. They found that children with better physical fitness got higher scores in Stoop effect test. Wang & Sugiyama (2014) stated that students with appropriate physical education program intervention could learn social skills effectively, interact with other appropriately, increase independence, and have better self-expression. Therefore, programs in morning hours are important to children's physical and psychological development and academic performance.

With dramatic advances of technology, combining interactive game with education in the classroom was viewed as a viable way for promoting physical and mental health in elementary schools. In Fogel, Mittenberger, Graves and Koehler (2010) research, they evaluated the effects of somatosensory videogame (SVG) on physical activity among four inactive children in physical education (PE) classroom. Their results showed that the inactive children were willing to spend time in physical activities than the standard PE programs and SVG was socially acceptable to the children and PE teachers. Staiano and Calvert (2011) who conducted a literature review on effects of exergames for physical education courses mentioned that SVG, such as Wii and Xbox, have potential for improving young kids' physical, social interactions and self-esteem. Several studies have suggested that the benefits of SVG are promoting children physical and mental health; however, few studies have been done on the effects of SVG in promoting life-effectiveness and group cohesion in elementary schools during morning hours at present. Thus, the purpose of the study is to examine the effect of using SVG in promoting life-effectiveness and group cohesion in elementary schools during morning hours.

METHODS

Participants

Eighty-four participants in Grades 5-6 for this research were enrolled in two northern and central elementary schools in Taiwan. In order to respect personal rights in making decision of their own, non-random purposive sampling were utilizing in this study and all experimental procedures were pre-approval and consented by their parents, instructors, and school authorities.

Intervention

A quasi-experimental design was designed in this study. Experimental group voluntarily agreed to participate in a 30-minute each session, SVG program one time per week for 4 weeks. Controls group did not receive any additional program. Comparing with traditional videogames, Xbox 360 Kinect that does not have to hold any remote controllers is friendlier to players. Thus, Xbox 360 Kinect was used to be the interventional tool in this study. After reviewing all game software of Xbox 360 Kinect, four games including Body clock, Balloon Buster, Car management exercise, and Mouse mayhem in "Dr. Kawashima's Body and Brain Exercises" were chosen. Table 1 showed the SVG program in the study.

Table 1. Intervention Program

Time	SVG program
Week1	Body clock
Week2	Balloon Buster
Week3	Car management exercise
Week4	Mouse mayhem

Measurement

Data were collected in pre-SVG intervention and post-SVG intervention. The data sources used three questionnaires as measurement tools: (1) Life-Effectiveness questionnaire, (2) group cohesion questionnaire, and (3) game enjoyment questionnaire.

Figure 1. Body clock

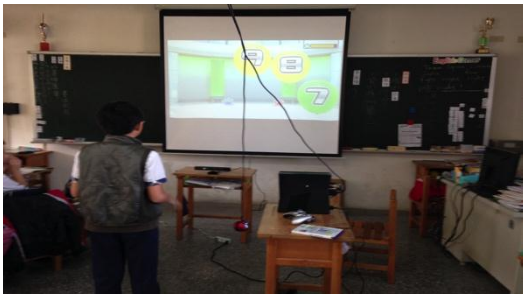

Figure 2. Balloon Buster

Figure 3. Car management exercice

Figure 4. Mouse mayhem

Life-Effectiveness questionnaire

Life-effectiveness is a person's ability to adjust their behavior through the targeted intervention programs. Life-effectiveness of children was assessed with six parts including time management, achievement motivation, task leadership, emotional control, active initiative and self-confidence based upon a measure developed by Wu and Hsieh (2008). The questionnaire was composed of 18 items on 1-5 Likert scales, ranging from "strongly disagree" to "strongly agree". The outcome of the questionnaire is the average of the scores in those items. Reliability of the Life-effectiveness were highly reliable (Cronbach's α=.93) as well as each parts of the questionnaire (time management: Cronbach's α=.77; achievement motivation: Cronbach's α=.71; task leadership: Cronbach's α=.68; emotional control: Cronbach's α=.78; active initiative: Cronbach's α=.65; self-confidence: Cronbach's α=.72).

Group cohesion questionnaire

Group cohesion questionnaire was baesd upon a measure developed by Glass and Benshoff (2002). The test contained of 9 items on 1-5 Likert scales, ranging from "strongly disagree" to "strongly agree". Reliability analyses showed that this questionnaire has a high reiliability (Cronbach's α =.96)。

Game enjoyment questionnaire

The level of game enjoyment was assessed using 8-item questionnaire developed by Ryan, Mims, and Koestner (1983) research to develop the assessment of game enjoyment. Participants were asked to indicate their attitudes toward the SVG (ie., Do you enjoy this game? Does this game draw your attention?). The participants responded on a 1-5 Likert scale, ranging from "strongly disagree" to "strongly agree".

Data Collection and Analysis

The analysis used SPSS 18.0 statistical software package. Descriptive statistics were computed to describe demographic background of participants. A Mann-Whitney nonparametric test for two independent samples was used to evaluate training differences in the SVG group and control group for changes in three measuring tools. The Wilcoxon nonparametric test for each two independent samples was used to evaluate their time-series effects in SVG program.

RESULTS AND FINDINGS

Demographic Background of the Participants

The results showed that 25 males and 15 females in the SVG group and 23 males and 26 females in the control group (Table 2).

Table 2. Participant Demographics (N = 84)

Gender	SVG group	Control group
Male	25 (62.5%)	21 (47.7%)
Female	15 (37.5%)	23 (52.3%)
TOTAL	40	44

Intervention Effect

Table 3 showed that there is no significant difference of three mearuring tools between SVG group and control group before the SVG intervention. However, the data reveal significant differences between two groups in life-effectiveness (z = -2.05, p < .05), emotional control (z = -2.21, p < .05), self-confidence (z = -2.33, p < .05), and game enjoyment (z = -3.08, p < .01) after 4-week SVG intervention.

Table 3. Results of the Mann-Whitney analysis on pre-test and post-tests variance of SVG group (n = 40) and Control group (n = 44).

Measurement	Group	Pre-test Mean (SD)	Pre-test z statistics	Post-test Mean (SD)	Post-test z statistics
Life-Effectiveness	SVG	3.78 (0.71)	-0.10	3.95 (0.80)	-2.05*
	Control	3.79 (0.56)		3.62 (0.72)	
Time management	SVG	3.63 (0.89)	-0.45	3.78 (0.89)	-1.34
	Control	3.58 (0.73)		3.52 (0.90)	
Emotional control	SVG	3.43 (1.01)	-0.33	3.82 (0.92)	-2.21*
	Control	3.59 (0.74)		3.33 (1.00)	
Achievement motivation	SVG	3.90 (0.77)	-0.86	4.13 (0.79)	-1.00
	Control	3.88 (0.90)		3.92 (0.88)	
Social leading	SVG	3.76 (0.93)	-0.15	3.79 (1.06)	-1.44
	Control	3.80 (0.71)		3.54 (0.88)	
Self-confidence	SVG	3.92 (0.78)	-0.42	4.10 (0.85)	-2.33*
	Control	3.95 (0.90)		3.64 (0.97)	
Aggressive	SVG	4.08 (0.79)	-0.41	4.08 (1.23)	-1.69
	Control	3.92 (0.98)		3.80 (0.97)	
Group cohesion	SVG	3.85 (1.05)	-.02	3.87 (0.99)	-.40
	Control	3.91 (0.80)		3.83 (0.83)	
Game enjoyment	SVG	4.00 (1.05)	-1.60	4.29 (0.81)	-3.08**
	Control	3.77 (0.91)		3.70 (0.99)	

*p < 0.05; **p < 0.01.

In comparising with within-group analysis, Table 4 presents that after 4-week intervnetion, SVG group significantly increased in life-effectiveness (z = -2.09, p < .05) and emotional control (z = -2.97, p < .01). Control group significantly decreased in self-confidence (z = -2.35, p < .05)

Table 4. Results Of The Within-Group Variance On Pre-Test And Post-Tests Of Svg Groups (N = 40) And Control Group (n = 44).

	SVG group (n=40)			Control group (n=44)		
	Pre-test Mean (SD)	Post-test Mean (SD)	z statistics	Pre-test Mean (SD)	Post-test Mean (SD)	z statistics
Life-Effectiveness	3.78 (0.71)	3.95 (0.80)	-2.09*	3.79 (0.56)	3.62 (0.72)	-0.89
Time management	3.63 (0.89)	3.78 (0.89)	-1.43	3.58 (0.73)	3.52 (0.90)	-0.67
Emotional control	3.43 (1.01)	3.82 (0.92)	-2.97**	3.59 (0.74)	3.33 (1.00)	-0.78
Achievement motivation	3.90 (0.77)	4.13 (0.79)	-1.76	3.88 (0.90)	3.92 (0.88)	-1.75
Social leading	3.76 (0.93)	3.79 (1.06)	-0.03	3.80 (0.71)	3.54 (0.88)	-1.14
Self-confidence	3.92 (0.78)	4.10 (0.85)	-1.77	3.95 (0.90)	3.64 (0.97)	-2.35*

Aggressive	4.08 (0.79)	4.08 (1.23)	-0.73	3.92 (0.98)	3.80 (0.97)	-0.85
Group cohesion	3.85 (1.03)	3.87 (0.99)	-0.76	3.91 (0.80)	3.83 (0.83)	-0.91
Game enjoyment	3.99 (1.04)	4.29 (0.81)	-1.92	3.77 (0.91)	3.70 (0.99)	-0.49

*$p < 0.05$; **$p < 0.01$.

DISCUSSION

Life-Effectiveness questionnaire

Life-Effectiveness which contained of eight measurements including time management, social competence, achievement motivation, intellectual flexibility, task leadership, emotional control, active initiative and self-confidence have been developed by Neill, Marsh, & Richards (1997). In our studies, SVG group had significant improvements in life-effectiveness after 4-week intervention, especially in emotional control and self-confidence. These findings were in line with Whitaker and Bushman's (2012) research, which showed that playing a relax video game could make people have a good mood. Using SVG in the elementary schools not only could provide joyful stimulation to promote a positive mood for young children but also could enhance their self-confidence to deal with social relationship. Chiang, Lee, Frey, McCormick (2004) used "DDR" to train children with high-functioning autistic spectrum disorders (HFASDs) for 3-6 weeks and found that youth with HFASDs could have more confidence to teach peers without HFASDs. SVG program appears to offer children some opportunities to become a leader in a multiage team (Olson, 2010).

Group cohesion questionnaire

Results showed that there is no significant difference after 4-week intervention in within-group analysis and between-group analysis. The possible reason might be that children were single-players rather than multiply-players in participating SVG programs so that they are lacked of opportunities to collaborate with peers. The other reason might be the game settings of the SVG programs. All the games in this study were focused on their personal abilities so that some children who enjoyed competition tried to beat other down and gained their social status among the group. Peng and Hsieh (2012) mentioned that playing with friends caused a stronger commitment to cooperate goal structures in the group. In order to enhance group cohesion, examining the relationship types among the gaming context plays a key role in structuring social relationship when participating SVG.

Game enjoyment questionnaire

In this study, the participants' game enjoyment had significant difference between SVG group and control group after 4-week intervention. In other word, the SVG group felt joyful in virtual gaming and more likely to participate in SVG again. Game enjoyment plays an important role in influencing the children to partcipiate physical activities (Dishman et al, 2005). Olson (2010) pointed out that feeling fun, exciting, challenge, compete are the top four reasons for playing videogame for young children. However, there is no significant improvement of game enjoyment in SVG group. One possible reason is the fact that their feeling about challenge and exploration were lower than initial perceptions when they played SVG at the first time (Sun, 2013). Thus, designing challenge and exploration in order to sustain young children's interest to participate are needed.

CONCLUSION

Findings suggest that elementary school children had better improvement in emotional control, self-confidence, and game enjoyment after 4-week SVG programs. This study illustrates that SVG programs have positive effects to enhance the life-effectiveness of children in the elementary schools during morning hours.

RECOMMENDATIONS

An area of future promoting that should be considered is providing a variety of SVG for elementary school children in order to sustain their interests in participating. According to our results and discussion, the SVG could enhance the children's self-confidence and emotional control. Thus, further incorporating SVG in school PE classes during morning hours are highly recommended to increase children's physical and mental health. Besides, further studies are suggested to validate possible follow-up benefits of SVG programs and to advance other possible intervention models.

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POSSIBILITY OF USING SOMATOSENSORY VIDEOGAMES TO PROMOTE ZERO HOUR PHYSICAL EDUCATION IN ELEMENTARY SCHOOLS IN TAIWAN: A QUALITATIVE PERSPECTIVE

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ABSTRACT: The purpose of study is to explore how the somatosensory videogames effecting life-effectiveness and its influence on schoolchild' social networking on a zero hour physical education sessions in Taiwan. Participants in this study were students, teachers, and parents in two elementary schools in northern and central Taiwan. Students were voluntarily agreed to complete 30-minute Xbox 360 Kinect game one time a week for total of 4 weeks. Semi-structured interviews were conducted to collect information from participants regarding their subjective attitude and experience about life-effectiveness, team collaboration, and gaming pleasure during somatosensory videogame sessions. Participant observations were also conduct to understand their real behaviors, feelings and interactions during this zero hour physical education session. The results showed that using the somatosensory videogames could positively arouse their self-awareness and competitive attitudes. In addition, the scores in the somatosensory videogames could have equivocal effects on the team collaborations of students due to the social relations in their real life. The results of the study help us to understand how the somatosensory videogames is a tool to construct the social interactions and life-effectiveness on elementary school students in real life. It is worth to develop zero hour physical education classes in elementary schools in Taiwan.

Key words: somatosensory videogames, zero hour physical education, Xbox 360 kinect

INTRODUCTION

Physical education (PE) in schools is one of the major opportunities to promote physical activities for children in school age. However, PE in elementary schools is not adequately playing this role in Taiwan. Teachers often have challenges to design physical education program to motivate students. Most of school administration and teachers focus on improving academic performances in examinations, such as English, history, and mathematic. This causes decreasing/eliminating children participating physical activities during the school day (Wilkins et al, 2003). Therefore, developing diverse PE programs and adding more health-related PE programs in school hours have are strongly needed in Taiwan. "Zero Hour Physical Education" (Zero Hour, PE) is a PE class before the first period of each school day begins. Researchers argued that students' reading comprehension can significantly improve 17% after participating long-term Zero Hour, PE (Ratey & Hagerman, 2009). Marashian and Khoraml (2012) also found that schoolchild could increase academic self-concept and reduced loneliness after one month and 45 minutes physical exercises in their early mornings.

With dramatic advances of technology, video game had changed from "static play" to "active play". Playing video game seems to have positive potentials for schoolchild. Ballaz, Robert, Lemay, and Prince (2011) used Wii Fit on aged 7-11 years old children with cerebral palsy (CP) and found that these children with CP had strong interests and showed similar responses than their healthy counterpart. In terms of social interaction, Chiang, Lee, Frey, McCormick (2004) used popular videogame "DDR" to train children with high-functioning autistic spectrum disorders (HFASDs) for 3-6 weeks and found that youth with HFASDs who were able to teach peers without HFASDs could improve some components of their friendship quality and peer recognition.

The incorporation of somatosensory videogames (SVG), such as Wii Fit, DDR, Xbox 360 Kinect, into physical education for schoolchild is believed to enhance individuals' motivation to join group activities. Marijke et al. (2008) presented that the multiplayer groups had more motivation to play interactive dance simulation video games than the home group. Peer-based playing is an important key in playing video games. According to Olson (2010), the major motivation of children playing videogames is not a variety of game designs but its opportunities for them to make friends. Staiano and Calvert (2011) also mentioned that playing exergame with peers could influence friendship selection, self-esteem, moods, and motivation. Most of the previous studies focus on physical or mental effects of videogame on students; however, there was a noticeable absence of research projects dealing with how SVG effecting life-effectiveness and its influence on children's social networking on a Zero Hour, PE. Thus, the purpose of this study is to understand their behaviors, feelings and interactions when playing SVG during zero hour, PE session.

METHODS

Participants

Sixty-two students enrolled in two northern and central elementary schools in Taiwan participate voluntarily. Twenty-seven students (44%) in central Taiwan were 5th graders and 35 students (56%) in northern Taiwan were 6th graders. In order to respect personal rights in making decision of their own, all experimental procedures were pre-approval and consented by their parents, instructors, and school authorities.

Procedures

Participants agreed to complete 4-week SVG programs one time per week, for 30 minutes during zero hour times. The study utilized "Xbox-360 Kinect" to be an interventional tool. Four games, Body clock, Balloon Buster, Car management exercise, Mouse mayhem were chosen games in "Dr. Kawashima's Body and Brain Exercise". Table 1 and figure 1-4 showed the SVG programs in this study.

Table 1. Intervention Program

Time	SVG program
Week1	Body clock
Week2	Balloon Buster
Week3	Car management exercise
Week4	Mouse mayhem

Figure 1. Body clock

Figure 2. Balloon Buster

Figure 3. Car management Exercice

Figure 4. Mouse Mayhem

MEASUREMENT

The sources of data included semi-structured interviews from 62 children, one parents and 3 teachers, daily observation of investigators, and stimulus recall reports of investigators. Individual interviews were conducted at the end of the 4-week SVG programs. An interview guide and recall reports contained open-ended questions, was developed by the research team. The specific questions that were conducted to collect information from participants regarding their subjective attitudes and experiences about life-effectiveness, team collaboration, and gaming pleasure during SVG sessions. Major questions from the interview guide are shown in Table 2.

Table 2. Guiding Questions

Subject	Question
Children	1. Please tell me how you feel about the SVG program?
(N = 62)	2. How satisfied are you participating the SVG program?
	3. Are there any other feedback or thoughts you what to share?
	4. Describe how participating the SVG changed your peer relationship.
	5. Describe how participating the SVG changed your life.
	6. Tell me about which part of SVG game you like the most?
	7. Do you want to take apart in this SVG again?
Parents	1. Please describe which part of the SVG makes you impressed?
(N = 1)	2. Please describe your thoughts about the necessity of SVG.
	3. Are there any other feedback or thoughts you what to share?
	4. Please describe any behavior changes after your children participated in the SVG.
Teachers*	1. Please describe which part of the SVG makes you impressed?
(N = 3)	2. Are there any other feedback or thoughts you what to share?
	3. Please describe your thoughts about the necessity of SVG.
	4. How satisfied are you participating the SVG?
	5. Would you recommend the SVG to the schoolchild in elementary?
	6. Do you discover any behavior changed from your student?
Investigators**	1. Please describe students' peer appraisal feedback.
(N = 3)	2. Please describe the peer interaction when taking apart in the SVG program.
	3. Please describe the students'emotional reactions when taking apart in the SVG program. And what is the major reasons result in this emotional reactions?
	4. Please describe the impact of SVG to the students in elementary

* Three teachers are Guo (G), Wang (W) and Chen (C)
** Three investigators are Tsai (T), Fu (F), and Wu (W)

Data analysis

Qualitative data were analyzed by content analysis. In the process of analyzing the data, the study read through each response from students, teachers, parents and investigators. Then, the responses were categorized and conceptualized by the authors based on independent interpretation. Categorizations were then discussed in each recurring themes.

RESULTS AND FINDINGS

After analyzing the qualitative data, three knowledge categories emerged: (a) Life-Effectiveness, (b) Group cohesion, and (c) Game enjoyment. In addition, the findings of each categories are consisted of unique subsidiary categories. For instance, Life-Effectiveness can be divided into two subsidiary categories: Self-confidence and Social competence; Group cohesion can be divided into two subsidiary categories: Positive collaboration and Negative competition; Game enjoyment be divided into two subsidiary categories: Auditory or visual stimulation/immediate response and Satisfaction from their improvement of game scores The category structures are shown in Table 3.

Table 3. Category Structures

Category	Subsidiary categories
a. Life-Effectiveness	1. Self-confidence
	2. Social competence
b. Group cohesion	1. Positive collaboration
	2. Negative competition
c. Game enjoyment	1. Auditory or visual stimulation/immediate response
	2. Satisfaction from their improvement of game scores

Life-Effectiveness

Life-Effectiveness is a person's ability to adjust their behavior through the targeted intervention programs. Eight general measurements of Life-Effectiveness have been described in the literature, including time management, social competence, achievement motivation, intellectual flexibility, task leadership, emotional control, active initiative and self-confidence (Neill, Marsh, & Richards, 1997). During the evaluation of the responses, two subsidiary categories emerged. One related to the self-confidence concept that being expressed by interviewees:

> *"I consider that these young children not only understand how to finish their won mission in times but also strive themselves to be the best performance when playing Xbox...They seemed to pursue the applause from other classmates." (I_W)*

> *"The students who have had lower academic performance improve their self-confidence and achievement after participating somatosensory videogame…Those kids have changed their attitude from rejecting to accepting toward this activity." (I_F)*

Such comments would have been viewed as that schoolchild not only developed their life effectiveness skills after playing SVG but also improved their self-confidence to deal with everyday life. Our finding is compatible with Funk, Chan, Brouwer, & Curtiss (2006) research, which found that 17 fourth through sixth graders who were regular video game plyers indicated that they can gain positive psychology such as self-confidence, calm down, and fantasy involvement in the game characters.

On the other hand, the vast majority of the comments from students pointed out that their social relationship has been improved after 4-week intervention. Several examples include:

> *"I will definitely to take apart in this course again. I think that playing videogame can foster friendships so that I consider playing video is a good leisure activity." (S_1)*

> *"The video game makes me and my classmates have more positive communication because we can share our experience with each other how to gain better scores of video game." (S_2)*

Social competence is defined as that an individual has the ability to effectively interact with social peers. In the process of intervention, SVG can create communications platform for sharing experience, feeling, and common thought with peers at the school. The results are similar to Olson, Kutner, and Warner, (2008) studies, which implied that playing video game can help the young children to structure initial conversation with potential friends. Olson (2010) also described further that some young children exchanged "cheat codes" and sharing advice on competition game. A connection with peers through SVG could be built to interact with their social network.

Group cohesion

Group cohesion is a social process that members interact with each other and frost their group members to close together (Eisenberg, 2007). Group cohesion plays an important role in team success. A variety of factors may directly influence group cohesion such as members' similarity, group size, external competition and threats (Eisenberg, 2007). Often, when the individual shares the common events with others, the stronger of group identification will be perceived for the group members. Almost every child reflected their feelings about that they become more collaboration to work with each other. The feedback of children seems compatible with responses of interviewees, parents, and teachers. The following comments can help enlighten us on this:

> *"I found that these kids are more willing to help each other." (T_C)*

> *"I found that some of kids actively taught those kids, who need further help to play videogame." (P)*

These results indicated that young children could share their experience and congregate their common interests to finish the group goals in order to gain the better outcomes. The finding appears to be consistent with Lieberman's notions. Lieberman (2006) argued that young adults could develop more friendships via SVG such as DDR and Wii Fit. Through playing SVG, group members believe their group goals and become willing to collaboration with each other in order to accomplish in groups.
On the other hand, the participants talked about that playing SVG with competitive contents might generate their negative emotions, such as derision and discrimination. As one student commented:

> *"Some students laughed in derision at error when particular students played this game. I think the behavior is inappropriate... " (S_3)*

One investigator also talked about his observation regarding students' negative emotions:

> *"I think some kids only focus their scores of videogame…they not only continuously compared their scores with other peers but also mocked at the people whose score of videogame is lower than his…I believe that these kids had totally forgotten playing videogame with an innocent attitude. Finally, a portion of kids had become passive to play videogame just because they didn't want to be mocked and compared." (I_W)*

Such findings reveal that some children classified overall ability with their score of videogame into good or bad rankings. For some young children, game skills are viewed as crucial factor to their self-esteem and self-confidence, especially when someone has lower success in the academic performance (Olson, 2010). Boys often try to beat other down by winning popular games in order to gain better social status among peers. Funk, Chan, Brouwer, & Curtiss (2006) also indicated that some children lose their social interactions with peers due to the lack of awareness of a world around them when playing the videogame.

Game enjoyment

A number of interesting findings emerged from the feedback of participants, but the study focus on two themes concerning the game enjoyment of the SVG: Auditory or visual stimulation/immediate response and satisfaction from their improvement of game scores. For examples:

> *"I think that somatosensory videogame not only contains of auditory and visual stimulation but also develop immediate responses in the every physical movement. These advantages can make kids realize thier reaction ability in time. Therefore, kids are able to revise their physical movement in order to gain the better results of scores." (I_W)*

> *"These Kids look forward to playing videogame because they have the chances to break through the highest records. They feel satisfaction from their improvement of game scores." (T_G)*

SVG that contained of a fun and entertaining way for young children have potential to enhance their motivations in participating physical activities. With technology advanced, gaming technology can receive players' single by gestures and total body movement. Xbox 360 Kinect that does not need to hold any controls and senses players' movements by using infra-red to detect players' actions. These reasons may explain why many young kids choose the SVG rather than traditional videogames. In Olson et al (2007) survey, they surveyed 7th and 8th grade students of 1254 participants and found that the top three reasons of why they play videogames are "it's just fun", "it's exciting", and "something to do when bored". We can realize that game enjoyment play a key in children's motivations for gaming.

CONCLUSION

Findings of this study show that using SVG to promote zero hour physical education is a viable way in elementary school. With light and sound stimulations, SVG that combine computer games and physical activities can motivate young children to interact within gaming situations. In the process of interventions, making friends and improving self-confidence are the two major factors for increasing the life effectiveness. Also, young children can share their experience with the common platform to congregate the group cohesion. However, SVG may also cause negative effects to their peer relationships. An area of future promoting in elementary school should be considered in avoiding negative competitions and discriminations during playing SVG.

RECOMMENDATIONS

The study of qualitative response cannot be generalized to all young children. Further study in this area should consider more targeted qualitative studies or case study in order to construct the social interactions and life-effectiveness with SVG for students in elementary school. Besides, Future works could combine diverse programs, such as outdoor recreation and life education with SVG, to promote zero hour PE in elementary schools. While this study has its limitations, it is hoped that it can serve as a basis for further study in using SVG to promote zero hour PE in elementary schools.

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PERCEPTIONS OF PEDAGOGICAL AFFORDANCE OF SMART MOBILE TECHNOLOGY

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ABSTRACT: Smart mobile devices are becoming ubiquitous among educators and students in Palestine. Mobile devices can be used to provide learning that is contextualized, personalized and unrestricted by location and time. Although these device capabilities are available, many faculty in higher education are not effectively incorporating this technology into their teaching. This study therefore examined academics' perceptions of the value of integrating mobile devices into their teaching activities. A questionnaire survey collected data from 56 academic staff of the Palestine Technical University - Kadoorie, eliciting perceptions of the pedagogical affordance of mobile devices and challenges to their use in teaching. The findings show that participants were still at the stage of actively experimenting with smartphones and iPads, trialing their use at different levels and for different purposes. In general, although participants were unaware of the full potential of their functionalities, they viewed positively the various pedagogical affordances of integrating these devices into their teaching activities. The most important affordances were linking formal and informal learning spaces by providing anywhere-anytime learning opportunities, and developing interest in the subject matter, thus making learning more enjoyable, meaningful, and accessible. The results also identify various challenges including lack of experience and knowledge, finding the time to design and implement such integration, and selecting appropriate apps for the content being taught. Participants also expressed concerns with the limited connectivity and unreliability of Wi-Fi and 3G/4G networks in Palestine.

Key words: faculty perception, smart mobile devices, mLearning, affordance, self-efficacy.

INTRODUCTION

Smart mobile devices (SMDs), particularly smartphones and tablets, are becoming increasingly ubiquitous among educators and students. Increasing advances in mobile technology, wireless communication networks, physical features of devices and high penetration usage will drive future trends in mobile learning (Johnson, 2011). By 2015, 80% of people accessing the Internet will be doing so from smartphones and tablets rather than PCs (Johnson, 2011). Reflecting global trends, mobile device penetration in Palestine reached 75% in 2012 (GSMA, 2013). Given the ready-at-hand availability of SMDs, it is reasonable to recognize the valuable affordance of these technologies to enhance the practice of teaching and learning in higher education (HE) in Palestine, as well as to meet the needs of a generation for whom mobile devices are becoming an integral part of their everyday lives.

Mobile learning (mLearning) offers many new opportunities in the evolution of technology-enhanced learning (Looi et al., 2010). More than just learning delivered and supported by handheld technologies, mLearning is learning across multiple contexts, through social and content interactions, using personal electronic devices (Crompton, 2013a). mLearning is still at an experimental stage, but one theme emerging from research is the need to integrate mobile devices into a broader learning ecology (Pegrum et al., 2013). mLearning reflects a pedagogical trend towards empowering learners (Pachler et al., 2010), letting them choose when to learn, where and how. Students use their devices to connect with subject content and peers in private or public spaces (Lui and Kao, 2007). However, as lesson delivery changes, this mobile-connected generation of students presents its own set of challenges to educators. From the educator's viewpoint, with these new forms of learning, students can expect learning to be "just in time, just enough, and just for me" (Rosenberg, 2001). Despite the advantages of mLearning, demands for personalized learning can cause instructors to feel apprehensive about using technology (Amado, 2008; Amado & Carreira, 2006).

Recent studies indicate that while technology is used increasingly, many teachers are not effectively incorporating it into their teaching (Groff & Mouza, 2008; Levin & Wadmany, 2008; Russell et al., 2007). This can be attributed to teachers' negative perceptions of technology (Crompton, 2013a). Academics' perceptions of mobile technologies significantly influence the effective implementation of mLearning (MacCallum & Jeffrey, 2009; Handal et al., 2013). Therefore, if academic staff are to enhance teaching and learning practice effectively by integrating emerging mobile technologies, they have positive attitudes towards their pedagogical affordances and recognize challenges to implementing them in education. In Palestine, university teachers' views on integrating mobile technology into their teaching are rarely considered. Therefore, this research explores the perceptions of academic staff at the Palestine Technical University - Kadoorie (PTUK) towards the integration of SMDs in teaching, focusing on the most popular devices in Palestine: Android phones, iPhones and iPads.

LİTERATURE REVİEW

SMDs are revolutionary in combining computing and communication features in a single mobile device (Khaddage, 2013). Their popularity arises from the mobility of the technology, of the learner and of learning, especially in the HE landscape (El-Hussein & Cronje, 2010). Smartphones (e.g. iPhone, Android, BlackBerry and Windows phones) and tablets (e.g. iPad, Galaxy, LePad, Dell Streak) are portable, handheld devices with the processing power and memory capacity to run various applications and store data such as documents, pictures and videos. In addition to calls and messages, they offer e.g. internet access, cameras, global positioning systems (GPS), audio and video recorders, which can be valuable instructional tools (Woodill, 2013). SMDs also provide a wide range of interactive software applications (apps), either pre-installed or freely and cheaply available, to support web browsing, social media, communication, location-based functions, interactivity, media production, entertainment etc. This makes SMDs highly customized, personalized platforms for communication, organization, social networking, information production and content management (Khaddage & Lattemann, 2013). The effective use of SMDs in education requires knowledge of their functionalities and how to use them, but teachers must also understand their pedagogical affordances (Mishra & Koehler, 2006). Klopfer & Squire (2008) summarize these as portability, social interactivity (collaboration), context sensitivity (gathering real or simulated data), connectivity (to data collection devices, other handhelds, networks) and individuality.

More recently, Kearney & Maher (2013) explored mobile learning for pre-service teachers, who used their iPads to mediate their own professional learning, exploiting features of authenticity and personalization in both formal and informal settings. The participants captured out-of-class math phenomena, following up and discussing implications for their teaching. They also used their devices to facilitate an enhanced awareness of math in everyday contexts, then used this knowledge to develop rich, contextualized ideas for their own ICT-mediated math tasks. They exploited the iPad's potential to conveniently and spontaneously take notes, observe lessons and make multi-modal reflections. Finally, they trialed a range of iPad-supported math assessment techniques, involving the generation and annotation of new media. Khaddage & Lattemann (2013) studied the use of three mobile apps (e-Lecture-Producer, Dropbox and QR Code) by 26 second-year students on an e-commerce course at Sharjah Women's College. They found that mobile devices and apps can be used as a form of ubiquitous learning, allowing teachers and students to collaborate, communicate and learn together, bridging formal and informal learning.

A qualitative study of teachers' adoption of iPod and iPad smart devices was conducted in Australia by Pegrum et al. (2013). Mobile devices were seen as enhancing student motivation and engagement, with empirical evidence of improved student learning. Teachers perceived the potential of these devices to be used for both organizational and pedagogical purposes. There were particular benefits for students with special needs, including those requiring early intervention or struggling with the curriculum, and those with visual impairments or dyslexia, who could resize and reformat text, as well as using voice recognition and text-to-speech apps. Participants in a study by Handal et al. (2013) perceived the greatest potentials of mobile technology as facilitating anywhere-anytime learning, improving students' communication beyond the university walls and enhancing autonomous learning. Marinakou & Giousmpasoglou (2014) investigated the adoption of mLearning at four universities in the Kingdom of Bahrain. Most respondents (84.4%) found that mobile devices were very important in facilitating collaborative learning and information retrieval, and in sharing resources, whereas the least important function was assessment.

A mixed-methods study by Bansavich (2011) investigated attitudes towards the potential use of iPads in HE. Forty faculty members at the University of San Francisco indicated that key advantages included the e-reader and electronic textbook capabilities, annotating and note-taking for meetings and classes, multimedia viewing and interactivity, mobile learning inside and outside the classroom, high levels of engagement in language learning, use in clinical settings, apps for the sciences, and strong potential for teacher-student and student-student interactivity. Walters (2011) suggests that portability and kinesthetic interaction help students to develop visual and spatial skills, boosting creativity, while teachers can easily use iPads collect assignments.

Şad & Göktaş (2013) surveyed 1,087 pre-service teachers regarding their perceptions of the instructional value of laptops and mobile phones. Participants did not perceive mobile phones to be effective instructional tools, whereas Thomas et al. (2013) found that a slight majority of teachers did support the classroom integration of mobile phones, stating that they engage and motivate students. Further, Thomas & O'Bannon (2013) found that more than half of pre-service teachers identified anywhere-anytime learning opportunities, increased student engagement, opportunities for differentiation of instruction, increased communication, and increased student motivation as benefits of using cell phones in the classroom.

Alongside these advantages, challenges to the integration of mobile technologies in teaching must also be considered. Many researchers indicate specific physical limitations of SMDs, such as small screens, limited battery time and frustratingly small keypads (Bansavich, 2011; Pegrum et al., 2013; Marinakou & Giousmpasoglou, 2014). Furthermore, the bring-your-own-device (BYOD) model presents a challenge of a different kind in terms of the standards and specifications of the devices permitted to be used in class and, in particular, to log into an institution's network, with all of the attendant implications for institutional policies as well as IT support (Traxler, 2010). Here, network speed, capacity and security are likely to become increasingly important (e.g. Melhuish & Falloon, 2010; Traxler, 2010). Khaddage (2013) argues that mLearning should not be restricted by brand, device or operating system; yet most apps currently in use are pure native apps developed for a particular device and operating system, thus unusable across multiple platforms. Moreover, according to Pegrum et al. (2013), the many available apps are often underpinned by information-transmission or behaviorist drill-and-practice approaches, thus of limited value in social constructivist classrooms oriented towards problem solving and critical enquiry.

According to MacCallum & Jeffery (2009), although today's educators may be more familiar with technology in general, they still may not be fully prepared or able to integrate newer mobile technologies into their teaching. Various studies of mLearning implementation (e.g. Handal et al., 2013; Pegrum et al., 2013; Crompton, 2011) highlight educators' attitudes towards the use of mobile technology and their ability to understand its functionalities and affordances as significant constraints to its meaningful pedagogical integration. Educators see mobile technology as an inappropriate distraction for learners, promoting disruption and cheating (Thomas et al., 2013; Thomas & O'Bannon, 2013; Khaddage & Lattemann, 2013). Other ethical issues concern digital safety, privacy and surveillance, and the blurring of public-private boundaries (e.g. Pachler et al., 2010; Traxler, 2010).

METHODOLOGY

Research questions

The main aim of this paper is to investigate faculty's perceptions of the value of integrating smart mobile devices into their teaching. The main research questions are:

1. What do faculty perceive as the pedagogical affordances of smartphones/tablets in enhancing teaching and learning?
2. In the context of Palestine, what do faculty perceive as the challenges to integrating smartphones/tablets into their teaching?

METHOD

A quantitative descriptive method was used to investigate the perceptions of faculty members regarding the integration of smart mobile technologies in their teaching activities. A questionnaire was developed, based on literature related to mLearning. In addition to personal information, the questionnaire items addressed perceptions of, pedagogical affordances and challenges. There was a mix of question types, including four- and five-point Likert-scale items, checklists and an open-ended question. The content validity of the questionnaire was assessed by two experts in the field of educational technology. Positive feedback was received and some changes were made to the instrument according to their suggestions. The reliability of the constructs was examined using Cronbach's alpha.

RESULTS AND FINDINGS

A total of 56 faculty members at PTUK participated in this study: 30% females and 70% males, representing various disciplines: 63% in sciences and 37% in humanities, agreed to participate in this study. Three-quarters were between the ages of 25 and 45. Older individuals tended to decline to participate, perhaps being less attracted to technology and having less dependency on it. The majority of the 56 participants (91%) owned a smartphone and only 9% owned a basic cell phone. Half had tablets and 43 owned multiple devices, including smartphones, iPads and digital cameras.

Participants identified several pedagogical affordances of SMDs that would be useful to enhance their teaching practices. It is widely believed that by generating content from real-world contexts, SMDs provide learners with authentic tasks, keep them active and support teachers in creating more engaging experiences (Pegrum et al., 2013). Half of participants agreed that SMDs helped them to engage students in exploring real-world issues and solving authentic problems. Smartphones/tablets offer learners various ways to connect the curriculum with real life and to engage through text, voice, image, and video. For example, teachers of English as a second language can ask learners to use their mobiles to access various news sites or podcasts, to listen or read current reports of global interest on e.g. Ebola, sport, economics, finance, technology, science or education, then to prepare a two-minute talk using the VoiceThread app to express their own opinions. This encourages higher-level thinking skills and improves students' reading, listening and speaking skills. Thus, SMDs support teachers in ways consistent with the above assertion of Pegrum et al. (2013), creating a more meaningful learning experience because learners take more responsibility for their learning and feel as though they are contributing in unique ways.

Mobile devices can play an important role in the informal learning environment, as they can be used for communication, collaboration, gathering and sharing of information (Khaddage & Lattemann, 2013). 72% of participants agreed that SMDs help to link formal learning into the informal learning spaces; portability and internet connectivity are significant in creating "ubiquitous learning" (Murphy, 2011). The slim, lightweight devices are easily carried anywhere, while Internet connectivity through built-in Wi-Fi and 3G/4G networks allows learning content to be accessed anywhere at any time (El-Hussein & Cronje, 2010). Learners in the digital mobile world stay connected with their peers and teachers. A teacher can ask learners to collect information using the SMD's camera/microphone, write notes, discuss findings through instant messaging or share them on social apps. 71% of participants found built-in cameras useful. Teachers can motivate learners to take still and video images of real life in diverse locations and to share this user-generated content digitally with their peers. This affordance is particularly important given the political restrictions on movement in Palestine, whereby many young people are unable to visit e.g. Jerusalem or Gaza. SMDs can help teachers to overcome such limitations and to bridge formal and informal reality for students who value anytime, anywhere, on-demand, flexible learning.

Personalized learning environments are important for a generation who expect learning to be "just in time, just enough, and just for me" (Rosenberg 2001). Half of participants agreed that SMDs helped them to personalize learning activities and differentiate their lessons to address students' diverse learning styles. Teaching materials can be customized to learners' learning style, location, time and activity (Isabwe, 2014). Portability, connectivity and social networks allow learners to access material and learn individually, at their own pace and style, "just in time". Another important aspect of personalized student learning is the wide choice of apps and resources available to learners via their SMDs. Students come to the university with these devices; therefore, unlike centrally provided laptops or computers, the BYOD model creates personalized learning on different platforms, rather than a one-size-fits-all roll-out of a particular device (Isabwe, 2014).

Three-quarters of respondents agreed that SMDs help faculty to develop further interest in subject matter, make learning more enjoyable, meaningful and accessible. Features of mobile technology affect content delivery, time and location of engagement, and collaborative opportunities (Crompton, 2013b). Teachers can deliver learning material in different formats and learners can interact with it more easily and enjoyably, using e.g. highlighting, bookmarking or note-taking, then share with peers using touch, movement and even facial expressions. Over half of participants considered smart screens useful for interaction, visualization, annotation and zooming. According to Johnson et al. (2010), human-computer interactions are moving away from the standard keyboard and mouse, towards more intuitive, gesture-based communication systems responsive to natural human movements. To improve learning and maintain motivation, activities should be fun; Isabwe (2014) refers to the "gamification" of mobile learning. Games were considered useful by 43% of participants. Mobile devices have multiple features to support gaming applications; this opportunity should be seized, especially for less motivated students.

A specific affordance of mobile devices is to help faculty to provide a dynamic visualization of concepts to better communicate ideas to students. More than 62% of respondents agreed. Many apps for analyzing and visualizing complex datasets are becoming more readily available. Educators see great potential for apps that allow science students to manipulate data and process statistics, deepening their understanding of complex relationships and concepts (Johnson et al., 2010). For example, infographic apps are increasingly important, combining different types of video and audio to capture rich experiences. It is widely believed that visualization gives a better representation of data that enables learners to better understand and interpret information than inputs in figures and words; this can improve both attention and comprehension.

Nearly two-thirds of participants highlighted the usefulness of SMDs in facilitating educational management of grades, attendance, calendars, reminders, registration etc. This result is consistent with other research including Pegrum et al. (2013), who found that mobile technology could be used to monitor individual progress by keeping track of which courses had been administered to particular students.

A significant affordance of SMDs, perceived by only 25% of participants, is to provide students with varied formative and summative assessments aligned with learning outcomes. Various mobile apps can support formative assessment by means of frequent multiple choice tests of students' performance and progress, enabling teachers to make changes in instruction for those experiencing difficulty. For example, teachers can use i>clickers (a remote device or a web-based multiple choice voting system) and Poll Everywhere (a web-based multiple choice voting system) to assess students' understanding in real time, analyzing misconceptions, displaying responses instantly for discussion, providing formative data to guide instruction, and efficiently administering and scoring quizzes. Teachers can also present a problem or case study to the class, followed by multiple-choice answers using i>clickers. This affordance was perceived as valuable by relatively few respondents, not only because assessment apps are more appropriate for formative than summative assessment, but perhaps also because of institutional policy: security, access control and privacy issues arise, as mobile devices may use a multitude of network access technologies. Assessment must change, along with teaching methods, tools and materials.

The affordances of mobile technology facilitate communication and interaction in the community of learners. Synchronous and asynchronous collaboration is achieved through many communication apps such as email, SMS, file sharing, and social networking (Isabwe, 2014). Communication by texting was perceived as useful by around of 63% of participants, being simple, cheap and almost universally accessible. SMS applications can help faculty to engage learners anywhere and anytime, encourage interaction, and facilitate social learning (Elias, 2011). Although they are limited to 160 characters, SMS applications can work on any mobile device almost instantaneously (e.g. for sending timely alerts). Learners may also interact with each other using instant messaging programs on SMDs. By contrast, Thomas & O'Bannon (2013) found that texting was perceived as least useful, perhaps because their respondents associated it with classroom distraction. Only 27% of PTUK participants saw voice and video calls as a useful means of communication between staff and students. This may be because voice calls are expensive in Palestine, while free calls through social networking apps need an Internet connection, which is not always available.

Mobile learning supports a social-constructivist pedagogy, with emphasis on students' responsibility and ownership of learning. Students working in collaborative groups are more active learners and more accountable to the group for learning (Pegrum et al., 2013). Only 35% of participants agreed that mobile technologies help faculty to promote student reflection using collaborative tools to clarify students' conceptual understanding, thinking and generating content. There are many apps that can help students reflect on their learning, such as VoiceThread and Asana. Students are often strongly motivated to post their reflections, encourage collaborative learning, and build skills in higher-level thinking, oral communication, self-management and leadership. The low score may reflect teachers' concerns about Arab culture regarding female privacy.

Perceived challenges

Mobility needs reliable networks, but 93% of participants expressed concerns with the limited connectivity and unreliability of Wi-Fi and 3G/4G networks in Palestine. While the Internet is commonplace in developed countries today, access remains patchy in developing countries. In Palestine, for example, free 3G/4G web-browsing is not available, due to Israel's refusal to release the frequencies required. 3G/4G is an important requirement for the successful implementation of mobile learning, which is difficult to meet at present (Shraim, 2014).

While almost all respondents used SMDs in daily life, most lacked experience and knowledge of integrating them into their teaching activities. This finding is consistent with many studies of mobile learning implementation (Handal et al., 2013; Pegrum et al., 2013; Yang 2012; Şad & Göktaş, 2013). Faculty still did not understand the concept of mLearning and the pedagogical and technological considerations of integrating mobile technology into their teaching. This indicates that academics need to know when to use mobile technology, when mobile apps are suitable for integration into specific activities, and which content is most effectively presented to learners on small mobile screens. They must also understand the just-in-time nature of mLearning. According to Stayton (2011), mobile solutions are appropriate in creating bite-sized chunks of information, which is especially critical when using devices with very small screens. Therefore, it is important to train faculty in how to integrate these devices, in terms of both content and pedagogy (Mishra & Koehler, 2006). The TPACK framework in teacher training programs is suggested by many studies (Crompton et al., in press; Handal et al., 2013; Pegrum et al., 2013).

82% of participants expressed concerns with finding the time to design and implement their plans. Teaching load in the Palestinian universities is 12 credit hours and majority of teachers prefer to take overload due to the low salary. It is time-consuming to develop new approaches and resources, explore appropriate apps, and keep up-to-date with innovations, adding to teachers' workload. This result is consistent with Handal et al. (2013) and Pegrum et al. (2013), who emphasize the importance of networking as a platform for professional development. This is a sustainable model which could encourage collaboration, save time and energy, and alleviate academic workload (Oakley et al., 2012; Handal et al., 2013).

A perceived challenge for 80% of participants was selecting apps appropriate to the content being taught. Numerous apps are available, but academics need to understand whether to use a native app or a web app, and at what level; to use apps in content transmission, behaviorist apps to reinforce learning, or constructivist apps to promote students' creativity and higher-order thinking (Oakley et al., 2012). Pegrum et al. (2013) conclude that it is important that teachers have access to valid and usable criteria by which to evaluate educational apps for a range of purposes, and access to a database of quality apps, checklists or rubrics; such tools need to be developed and widely disseminated to help teachers to judge quality and appropriateness.

Another widely perceived challenge was getting adequate technology support. Faculty still lack confidence, such as in using mobile apps to construct multimedia objects embedding pictures and animations, or in connecting their mobile devices to projectors. The necessary training should be easy to provide, as unlike computers, mobile devices are readily used without advanced technological skills. According to Khaddage & Zeidan (2012), the rapid development of mobile devices and their applications can simplify the process of integration into teaching and learning for non-technical users of all educational backgrounds. Pegrum et al. (2013) report that in some schools, teachers and other staff have successfully learnt SMD competence alongside and from students.

Institutional support is important to successful implementation of mobile learning. Two-thirds of participants perceived poor institutional support as a barrier to adopting mLearning. Similarly, Marinakou and Giousmpasoglou (2014) highlight the need for institutional support including investment in infrastructure, promoting the adoption of new teaching practices, training staff, and developing clear policy. The use of SMDs in the classroom is banned in Palestine. To be widely adopted, mobile technology must be part of a comprehensive and systematic effort to change education policy (Handal et al., 2013).

The cost of SMDs and apps was of concern to 64% of participants. Although device costs have dropped dramatically and penetration among students and teachers is very high, it is difficult for academics to keep up with their rapid evolution. According to Handal et al. (2013), the new generation of tablets is still too expensive for many students. In addition, most apps are not free. Khaddage et al. (2011) propose that the use of mobile apps to deliver learning content should not impose additional costs on students. However, while some apps are completely free, others are not fully functional unless a subscription is purchased. Sometimes, the teacher should seek a pedagogically and financially effective combination (Oakley et al., 2012).

Half of participants perceived a technological challenge in the limited usability and physical attributes of mobile devices, such as screen size, memory, battery life and storage capacity, especially for basic devices. This finding is supported by other research. For example, Pegrum et al. (2013) found that screens can be too small, especially for reading pages of text. Similarly, Archibald et al. (2014) report negative perceptions of typing data into small devices; they suggest that any electronic data-input form should be designed to collect the most valuable information with minimal effort. According to Texlar (2010), these devices are not designed for educational purposes. However, technical specifications change rapidly and the new generation of SMDs have many refined functionalities (Shraim, 2014).

BYOD was perceived as a constraint to effective integration of SMDs by three-quarters participants. Implementing different apps on different devices and platforms (e.g. iOS and Android) is difficult and requires careful planning. Similarly, Pegrum et al. (2013) found that mobile devices available among students varied from SMDs to non-smart mobiles. Quinn (2000) suggests that a mobile learning solution must work for a wide range of devices. Mobile learning models should be capable of device-independent delivery of learning content and learning management.

A final challenge, identified by 71% of participants, was teachers' own beliefs. Resistance to changes in teaching practice was observed by Khaddage and Zeidan (2012), who reports that older teachers lack confidence in using these devices, seeing them as a distraction (Thompson, 2013), or as potential tools for cheating (Şad & Göktaş, 2013). Teachers need both the pedagogy and the time to think about how to change their practices to incorporate SMDs. Technology provides both a challenge and an opportunity for us to rethink what we are doing and how we are doing it.

CONCLUSION

With the growing use of SMDs among educators and learners, this study has investigated faculty perceptions of using these devices for meaningful instruction. The findings show that while mobile learning (mLearning) is still at an experimental stage in Palestine, respondents had positive perceptions of the affordances of SMDs in their teaching. SMDs offer much functionality and new opportunities in the evolution of technology-enhanced learning, their most useful features being mobility, their use in communication and providing anytime-anywhere access to course material, thus making learning "just in time, just enough, and just for me" (Ref). In order to take full advantage of SMDs in their teaching, faculty must be familiar with how to use them and must understand their affordance and how to incorporate their functionalities into teaching activities, through the use of the TPACK framework. The results also identify various challenges and the need for institutional support to invest in academics' professional development and training in technology, in order to enhance the perception of mLearning in higher education in Palestine.

The limitations of this study include the small and limited sample of faculty from a single Palestinian university. Further research might focus on using the TPACK model to provide faculty with an understanding of the integration of subject content, pedagogical techniques, and mobile technological affordances. There is also a need to develop a set of principles to guide faculty in selecting appropriate apps while designing and applying mobile technologies.

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THE POSITIVE AND NEGATIVE EFFECTS OF DIGITAL TECHNOLOGIES ON STUDENTS' LEARNING

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ABSTRACT: The technology providing quick and easy online access to information and social activities has undeniable effects on academic lives and study hours of students. It was therefore important to investigate what we know about the impact of digital technologies and social networking sites (SNS) on education. This study investigates the effects of developing technologies and social media on the students' daily life. The research was conducted with 220 university students. Data were collected using a survey designed for gathering the students' opinions about the digital devices and social media. The students were asked some questions such as why/how long/when do they use the digital devices and social media. The results of the research indicated that the digital devices and SNS had negative impact on students' knowledge and learning due to distraction from academic tasks. The study reveals that most of the students spent more time on social media (facebook, twitter, youtube etc.) than academic courses. Detailed results and recommendations based on the academic success are presented in the study.

Keywords: digital devices, educational technology, higher education

INTRODUCTION

The digital technologies (e.g. mobile phone, tablet, notebook, etc.) and social media (e.g. Facebook, Youtube, Blogs, Twitter, LinkedIn, etc.) have become increasingly popular in recent years. Most common digital technology is mobile phone. Nowadays, the majority of the mobile phones are called as 'smartphone' as they have more advanced computing power and connectivity than a contemporary mobile phone (Osman, Talib, Sanusi, Shiang-Yen, & Alwi, 2012). It has become popular in a short time among the younger generations (Hakoyama & Hakoyama, 2011). "70% of the world's population own at least one mobile phone. Based on statistics, children in United States now are more likely to own a mobile phone than a book, with 85% of kids owning a phone as to only 73% owing books" (Osman et al., 2012). The smartphone enables to communicate with families and friends in case of emergency, to make connection for international trade, and contributing in their socialization process.

Social media, a virtual platform, was started to be after digital technology became common (Boyd &Ellison, 2008). This platform provides people to make new connections and to strengthen friendly relations with other humans (Coyle & Vaughn, 2008). Timm & Duven (2008) reported that there are over 200 different social media sites. The most popular of these sites is Facebook. The statistical data showed that there are now more than 500 million people with Facebook membership and the majority of these people are members of other social networking sites besides approximately 250 million of these memberships visit Facebook site in each day at least one time. Therefore social media has largely effected on the society. Nowadays, the majority of adolescents exchange views, share feelings, personal information, pictures and videos on social media (Wang, Chen, & Liang, 2011). Bryant, Sanders-Jackson, & Smallwood (2006) revealed that many adolescents who had the difficulty of expressing their feelings and thoughts preferred technological communication to face to face communication.

The educational content has also been affected by internet associated with digital technologies and has become an inseparable part of it (Thanuskodi, 2013). Social networking sites (SNS) allow young adults to discuss about class materials, to share academic information and school related issues, to plan for a project (Salas & Alexander, 2008). Not only students but also instructors, teachers, and researchers in the education system became addicted to the internet to reach the information, follow the latest developments in various fields, search scientific papers, exchange ideas, utilize for academic assistance (Lusk, 2010).

On the other hand, SNS can also make studens into "technocolic or heavy users". Researchers have focused on social interaction, mobile phone dependency/addiction, psychological effect, behavioral changes, etc. (Bianchi & Phillips, 2005; Billieux, Van der Linden, d' Acremont, Ceschi, & Zermatten, 2007; Bond, 2010; Campbell & Park, 2008; Choliz, 2010; Junco, Merson, & Salter, 2010; Zulkefly & Baharundin, 2009). Behavioral deficits, internet addiction, lack of confidence, academic difficulties, loneliness, negative effects on family and community communication were reported for "technocolic" students (Chou, & Hsiao, 2000; Nalwa & Anand, 2003; Thanuskodi, 2013). Schill (2011) claimed that SNS have a series of side effects such as stress, anxiety, mental health problems, severe loss of personal productivity, a sense of guilt and crisis. The grades of extreme-SNS-users were also affected (Duncan, Hoekstra, & Wilcox, 2012; Kalpidou, Costin, & Morris, 2011; Ophir, Nass, & Wagner, 2009; Wang et al., 2011). The SNS still continue to grow and most of the parents are started to worry about their children who are spending plenty of time on SNS, instead of studying courses, doing homework and preparing examinations (Wang, et al., 2011).

The purpose of the research was to examine ***i)*** the concrete effects of both digital technologies & SNS and ***ii)*** how technology usage, habits and daily life activities vary with gender.

METHOD

The present study used survey methodology with questionnaire items measured on Likert scales. The questionnaire was designed to provide the opinions of female and male students related to using digital technologies and social networking sites, activities and study habits. The questionnaire consisted of 14 questions including demographic information (e.g., gender, the educational level of father/mother, age, household income level monthly), digital technologies (smartphone, computer, internet, etc.), social networking sites (facebook, youtube, foursquare, blogs, twitter, etc.) and finally study habits. All of the questions were optional. The students were given approximately five minutes to fill out the questionnaire.

The research was performed on four departments offering two-year programs (Industrial Glass and Ceramics, Geotechnic, Drilling Technology, Natural Building Stone Technology) in Torbali Technical Vocational School of Higher Education at Dokuz Eylul University, Turkey. The study sample consisted of 220 volunteer college students (33% female and 67% male) whose ages were between 18 and 20.

The collected data were analyzed by IBM-SPSS Statistics 22. Twelve different statements were coded on a scale of 1 to 6, with 1 being “Least or None” and 6 being “Most”. The frequency distributions, means and standard deviations of female and male students’ values were calculated and independent-samples *t*-test was conducted to the statistical difference of means between male and female students according to the statements. The difference between genders was considered significant with *p* values less than 0.05.

RESULTS AND FINDINGS

The effects and possible reasons of digital technology and SNS orientation were investigated by the parameters of *educational level and income of their parent*s, *age of smartphone ownership and spare time activities* (reading a book, using computer and/or smartphone, physical exercise, study on the course). Independent-samples *t*-test was conducted to the statistical difference of means between genders for all parameters.

The findings indicated that the half of family members of students had high school degree. Only 2.8% mothers were illiterate. Mean values for the educational level of fathers and mothers of students were 4.01 (standard deviation, sd = 0.75) and 3.76 (sd = 0.94), respectively. The difference in the values between genders was not statistically significant [degree of freedom, df = 218, t = 1.963, $p>0.05$].

When the results are evaluated, the income of the students family was between 400$ and 800$/month. Considering that minimum wage is approximately 360$/month, most of the student declared that they had to work part-time to meet their expenses. Insignificant difference was found between the values of genders [df = 215, t = 0.972, $p>0.05$]. Mean values for female and male students were 2.18 (sd = 1.03) and 2.05 (sd = 0.87), respectively.

Results revealed that the majority of the students had their smartphone between the age of 15 and 20. The number of males who has the smartphone for the first time at this range of age was higher than females. Mean values for female and male students were 3.76 (sd = 0.68) and 3.66 (sd = 0.56), respectively. Most of the students spend their 1 to 2 hours to play with smartphone. Mean values for spent time for female and male students were 3.68 (sd = 1.14) and 3.51 (sd = 1.09), respectively. There was not any significant difference between genders [df = 218, t = 1.017, $p>0.05$]. The students also were asked how they spent spare time on the smartphone. The students’ answers were analyzed in five categories (make phone calls, message, applications, game and study). The majority of female and male students were declared that they were using the phone for calling friends (90%). They also send text messages (70%), listen/download music video (75%), watch sports news (70%), log in SNS (85%) and study (10%).

Most of the students (70% male and 40% female) also indicated that they use personal computer 2 to 3 hours in a day. Mean values for female and male students were 3.58 (sd = 0.97) and 3.58 (sd = 0.84), respectively. It was found that the difference in the values between genders was not statistically significant [df=218, t=0.035, p>0.05]. They used computers for similar activities what they did on a smartphone such as posting on facebook or twitter, listening music, watching a movie, playing games, checking e-mail, studying, and surfing on the internet.
The preference of half of the students on reading printed books, newspaper, etc. was lower than on following social networks. Mean values for female and male students are 1.72 (sd = 1.10) and 1.79 (sd = 1.08), respectively. It was found that the difference in the values between genders was not statistically significant [df = 218, t = 0.435, p>0.05].

Approximately 60% of the student do not find time or prefer going to gym or doing sport. Mean values for female and male students are 1.72 (sd =1.17) and 1.54 (sd=0.82), respectively. The difference in the values between genders was not statistically significant [df=218, t=1.323, p>0.05].

According to students' study patterns presented in Table 1 and Table 2, they do not find studying physical (physics, chemistry, etc.) and social sciences exciting. 80% of female students and 65% of male students study major courses less than one hour prior to the exam. There was insignificant difference between genders for these parameters.

Table 1. Spent Time for Studying Physical Science Per Day

Gender		none	$h<1$	$1\leq h<2$	$2\leq h<3$	$3\leq h<4$	$5\leq h$
F	f	57	13	2	-	-	-
	%	79.20	18.10	2.80	-	-	-
M	f	115	29	4	-	-	-
	%	77.70	19.60	2.70	-	-	-

Table 2. Spent Time for Studying Social Courses Per Day

Gender		none	$h<1$	$1\leq h<2$	$2\leq h<3$	$3\leq h<4$	$5\leq h$
F	f	56	12	4	-	-	-
	%	77.80	16.70	5.60	-	-	-
M	f	116	23	9	-	-	-
	%	78.40	15.50	6.10	-	-	-

CONCLUSION

The positive and negative effects of digital technologies and social networking sites on the students were examined in this study. The research was performed on 220 volunteer college students. The data of the study was collected with a questionnaire. The findings showed that higher educational level of both father and mother enhances the awareness of current technologies and provides easier adaption to community. The income of parents is also a necessary factor to get an idea about the technology perspective. The lower income limit was found to be close to minimum wage. This indicates that the student forces the family members to buy them a smartphone even if their income is not convenient for this expense. This is also supported with finding in which students had their first smartphone at the age of 15-20. In addition, 90% of female and male students do not know how much they pay monthly for calling service.

Research results presented that half of the students spend time one and half hour/day on smartphone. They generally use the smartphone for calling friends, messaging, listening to music, watching video/clips, and especially using social networking sites (Facebook, Youtube, Blogs, Foursquare, Twitter, etc.). Female and male students (65%) spend more than two hours per day on computer and internet for similar purposes. However, to study on a course or science oriented research on internet is the last and least activity they do. The outcomes related to reading book and newspaper, and doing physical activities indicated that 60-65% of responding students do not have enough time for reading books, newspaper, magazine, doing physical exercise and going to the gym.

The time they spent for social media is limiting and taking their studying/learning time. The findings for studying science, major, and social courses presented that over 78% of female and male students do not have time for studying both science and social courses and 15% of them spend less than one hour in one day. It should be noted that students generally do not prefer to study or learn the courses. 80% of female students and 65% of male students prefer to study major courses prior to the exam.

Although the studies on gender revealed that male students technology usage were better, their confidence and attitude towards using of technology were higher than female students (Dhindsa & Emran, 2011; Hwang, Fisher, & Vrongistinos, 2009; Joiner, Iacovides, Owen, Gavin, Clibbery, Darling, & Drew, 2011; Kadijevich, 2010, Kaino, 2008; Li & Kirkup, 2007; Valkenburg & Peter, 2009; Yau & Cheng, 2012), in this study the gender was found not to be a definitive parameter for technology-dependent behavior for each item.

RECOMMENDATION

It is clear that the digital technology and SNS have really become an integral part of students in their daily lives. There are many side effects such as technology addiction, time loss, isolation, lower academic performance together with its benefits. It is obvious that it is not easy and rational way to entirely keep students away from social media. However, the time interval for each vital activity could be organized by increasing the cognition to this situation and auto-control habit.

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A LEARNING STYLE INFERENCY SYSTEM BASED ON FUZZY LOGIC TECHNIQUE AND HONEY&MUMFORD'S LEARNING MODEL

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ABSTRACT: In this study, fuzzy logic based Honey and Mumford's learning system is proposed to characterize learning styles of the students who have various own learning skills, intelligence levels and learning styles. We used Honey and Mumford's model which is based on Kolb's learning style and which identifies four distinct learning styles namely; Activist, Theorist, Pragmatist and Reflector in accordance with the Kolb'model. In Kolb's learning system, effective learning process can be achieved by incorporating four models namely; Concrete Experience, Abstract Conceptualization, Reflective Observation and Active Experimentation. We designed a software system which includes some of the questions in Learning Style Questionnaire which is prepared by Honey & Mumford. We rated the answers of the students and give them as an input to the proposed fuzzy logic engine which has four input models namely Activist, Theorist, Pragmatist and Reflector; and an output namely EducationStyle. The proposed system inferences Education Style, Learning Status and Level of Learning Style of the student. By this way, instructor will be able to match his teaching style with student's learning style.

Key words: Kolb's learning style, Honey & Mumford learning style, fuzzy logic

INTRODUCTION

Education states in a very important part of our lives that many studies have been done in order to increase quality and success of it. In traditional education systems, students are bonded to a single program and an education method that is chosen by teacher is applied. However, every student has various and own learning skills that it can not be expected from students that have individual differences to perform same level of learning. Ignorance of these individual differences causes problems such that students which are more tended to chosen program, used method learning more efficiently, and others who are not tended to chosen program, couldnt learn as required. Therefore it can be concluded that individual differences must be taken into consideration [1,2,3]. By results of these researches, new education and learning methods, and new program types have been developed. Many studies such as Kolb's [4], McCarthy's [5], Honey's [6] and Fleming's [7] learning styles have been proposed about these individual properties that needed to be taken into account on education design.

In this study, fuzzy logic technique is used to inference which learning style is more suitable to the student's learning skilss. Honey and Mumford's Learning Style which is based on Kolb's Model is chosen for implementing and analyzing the developed system. In the following sections, background that includes fuzzy logic technique and Honey and Mumford's learning style are described briefly. After that, the proposed system which is composed of interface and fuzzy logic parts is explained in detail. Lastly, simulation results are given and evaluated.

BACKGROUND

In this section, background subjects of the system such as Honey and Mumford's learning style and Fuzzy Logic Technique are described briefly.

Honey and Mumford’s Learning Style based on Kolb’s Model

In Kolb’s learning system, effective learning process can be achieved by incorporating four models namely; Concrete Experience, Abstract Conceptualization, Reflective Observation and Active Experimentation. Honey and Mumford’s model is modified version of Kolb's learning style and identified four distinct learning styles namely; Activist, Theorist, Pragmatist and Reflector. Activists are open-minded and not sceptical. They tend to act first and consider the consequences afterwards[8]. Their days are filled with activity. They tackle problems by brainstorming. As soon as the excitement from one activity has died down they are busy looking for the next. Reflectors like to stand back and ponder experiences and observe them from many different perspectives[8]. They collect data, both first hand and from others, and prefer to think about it thoroughly before coming to any conclusion. Their philosophy is to be cautious. They are thoughtful people who like to consider all possible angles and implications before making a move [8]. Theorists adapt and integrate observations into complex but logically sound theories. They think problems through in a vertical, step by step, logical way. They like to analyse and synthesise. Their philosophy prizes rationality and logic. Pragmatists are keen on trying out ideas, theories and techniques to see if they work in practice. They tend to be impatient with ruminating and openended discussions. Their philosophy is: There is always a better way' and 'If it works it's good' [8].

Fuzzy Logic

Fuzzy logic deals with reasoning that is approximate rather than fixed and exact. Compared to traditional logic, fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false [9]. Fuzzification, Fuzzy Rules, Membership Functions, Inferency and Defuzzification are basic concepts of the fuzzy logic technique. The aim of fuzzification step is to determine the mapping degree of crisp inputs to fuzzy sets by using membership functions. Fuzzy rules are applied to the fuzzified inputs. Outputs of all rules are aggregated to obtain unificated output. From the fuzzy rules, probability fuzzy output variable can be obtained. The higher probability means that the node has more chance to be selected. Defuzzification is the process of transforming probability fuzzy output variable into a single crisp output [10].

THE PROPOSED SYSTEM

In this study a learning style inferency system which is based on fuzzy logic tehcnique and Honey and Mumford’s learning model is proposed to increase the success of students in education. In order to achieve this, a software which provides an interface including 20 questions in accordance with the Honey and Mumford’s model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student’s education based on the answer’s of the students to the questions.

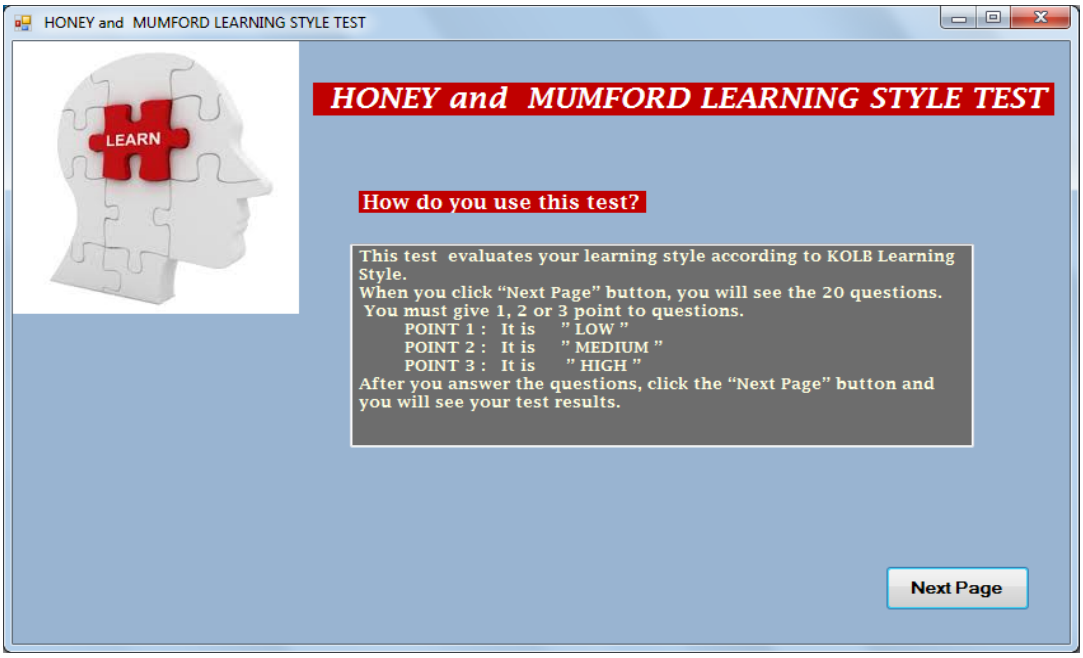
Interface

Interface shown in Figure 1 is developed by using C# programming language and includes 20 questions. A student who participates in this survey gives 1, 2 or 3 point to each question. Point 1 corresponds to LOW, Point 2 corresponds to MEDIUM and Point 3 corresponds to HIGH.

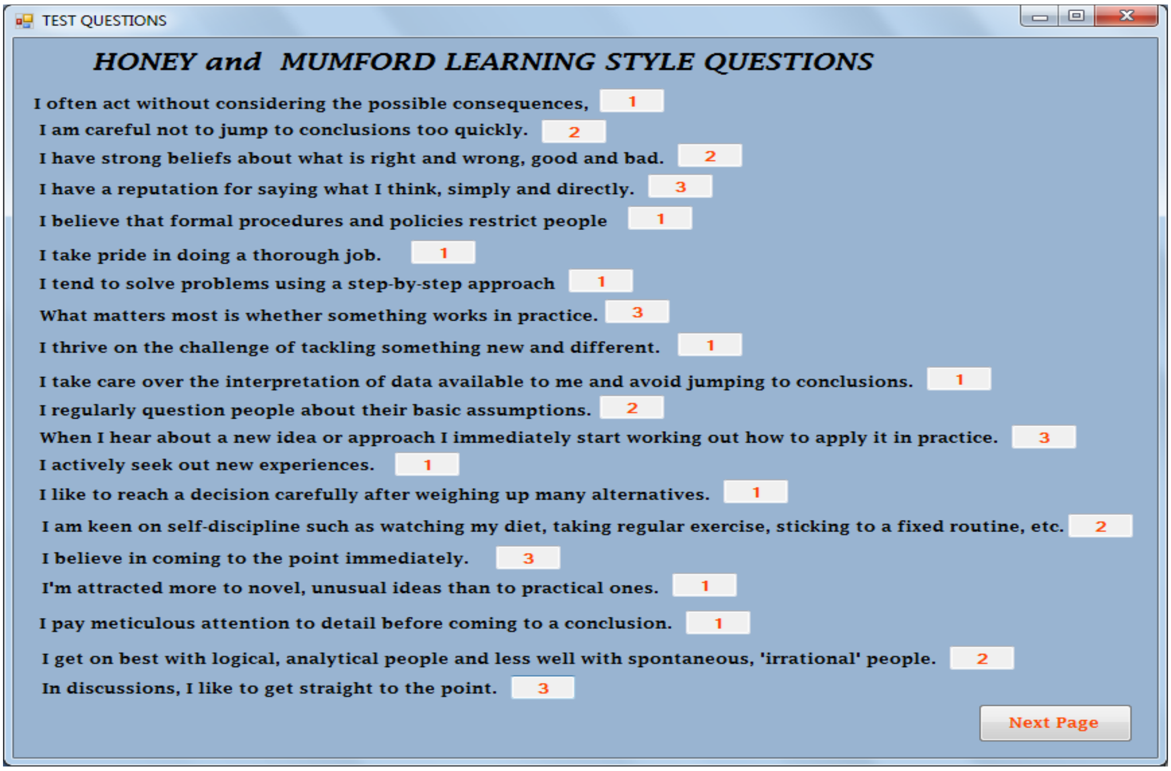
1-5-9-13-17 questions’ total points are for **Activist,**
2-6-10-14-18 questions’ total points are for **Reflector,**
3-7-11-15-19 questions’ total points are for **Theorist**,
4-8-12-16-20 questions’total points are for **Pragmatist**,

Table 1. Linguistic Variables And Their Fuzzy Value Range

Question System Value	Linguistic variables	Fuzzy value
5-6-7	LOW	$0.0 <= x < 0.3$
8-9-10-11-12	MEDIUM	$0.3 <= x < 0.7$
13-14-15	HIGH	$0.7 <= x <= 1$



(a)



(b)

Figure 1. Interface of Honey and Mumford's Learning Style

Education style is decided in accordance with the total points which are obtained from the answers of questions. Figure 2 shows the interface of Honey and Mumford's Learning Style Test Result.

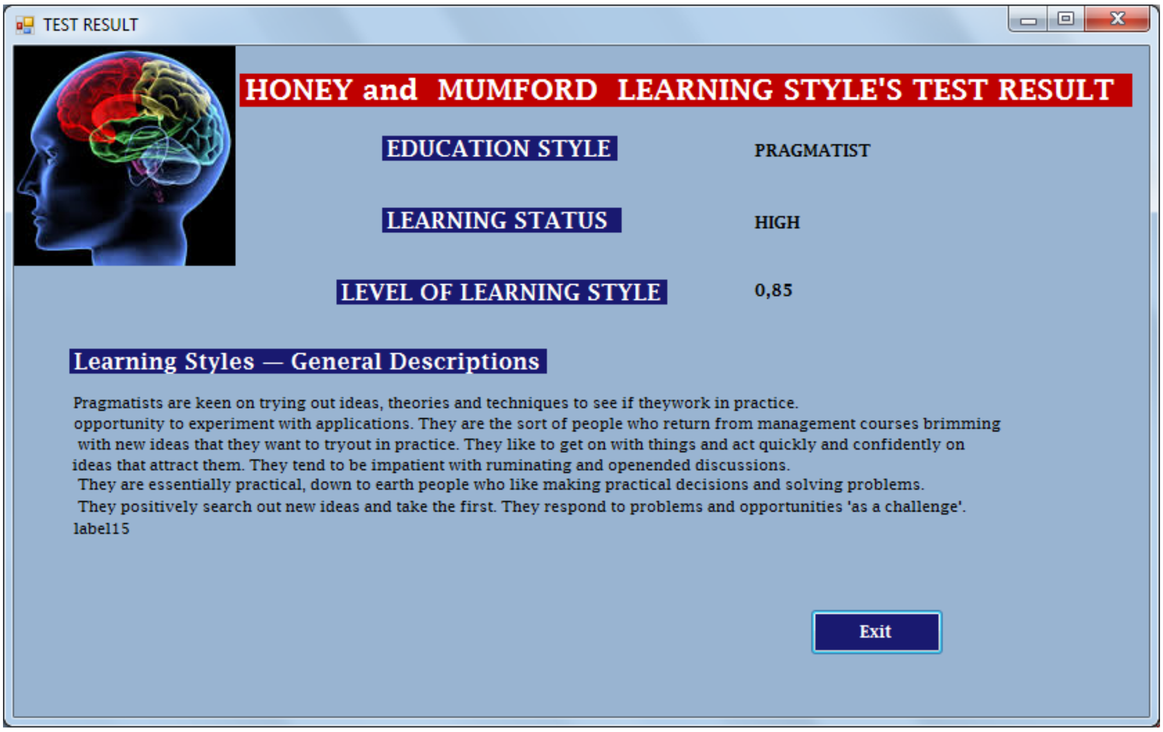


Figure 2. Interface of Honey and Mumford's Learning Style Test Result

Fuzzy Logic Based Inference System

Four input parameters namely Activist, Reflector, Theorist, and Pragmatist and one output namely Education Style (EduStyle) are determined in the proposed fuzzy logic based system which is shown in Figure 3.

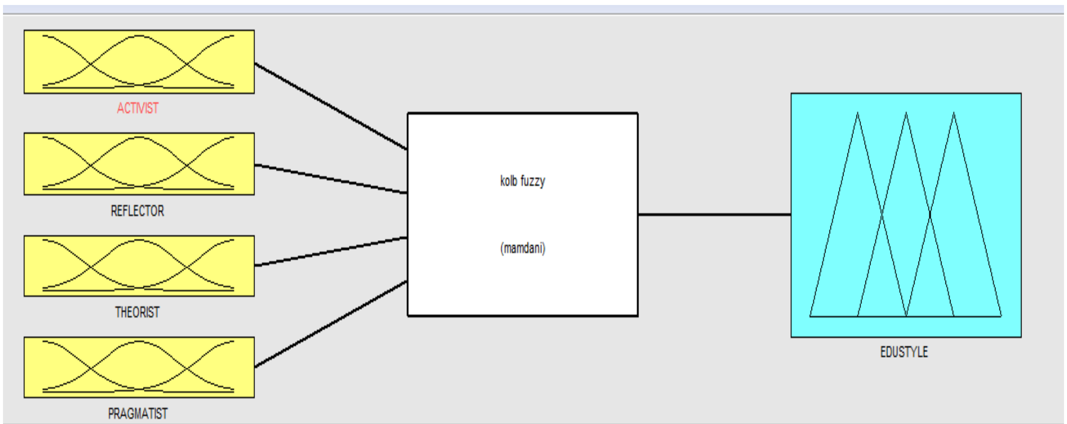
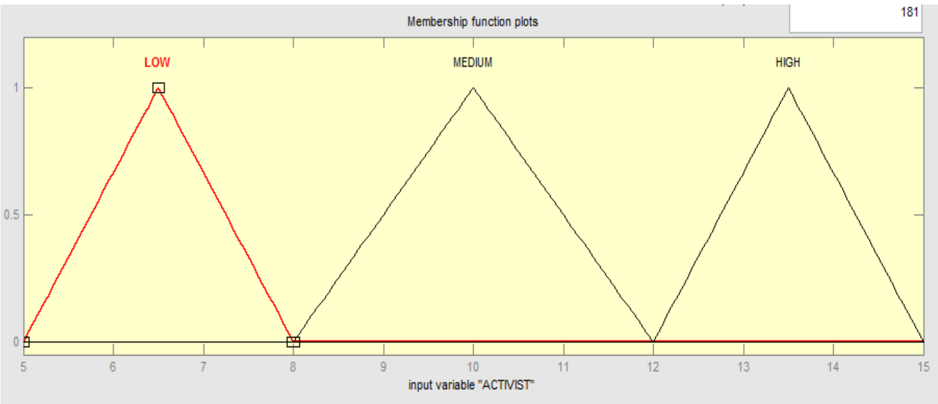
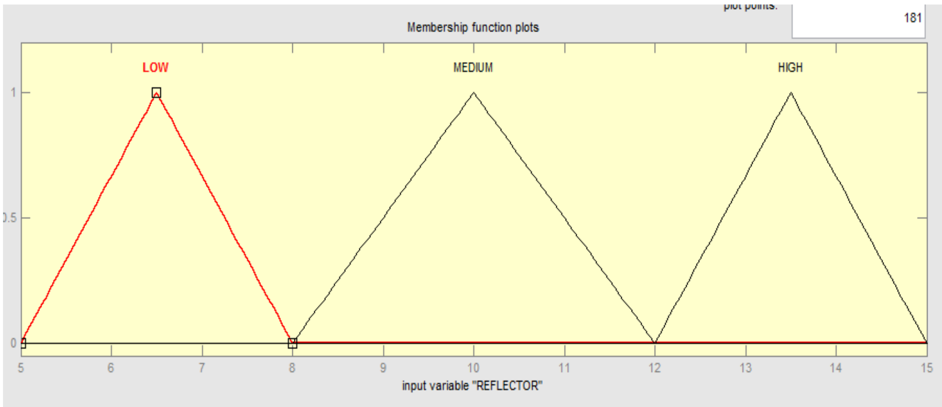


Figure 3. The Proposed Fuzzy Logic Based Inference System

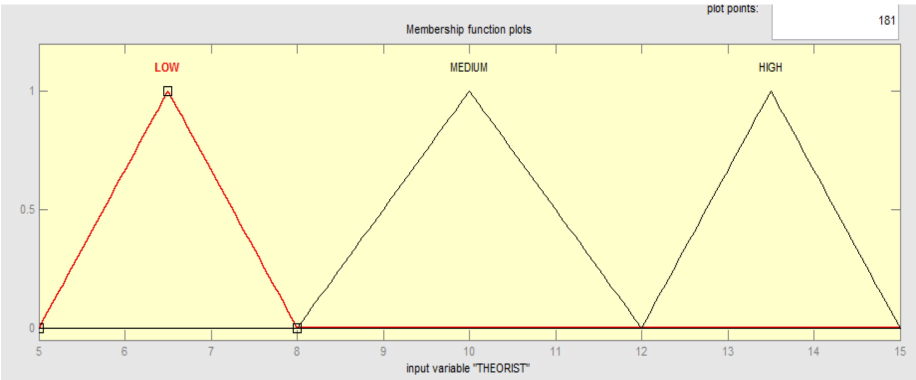
Fuzzification method involves the transformation of raw input variables and evaluation of the linguistic variables using the triangular Membership Functions as shown in Figure 4.



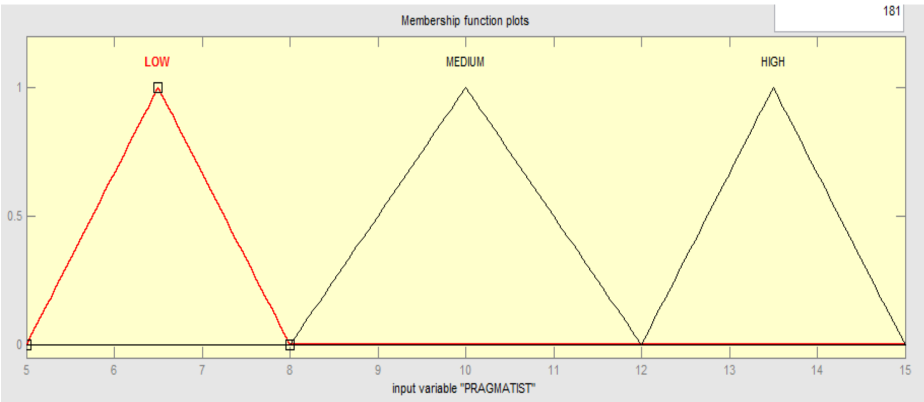
(a)Input for Activist



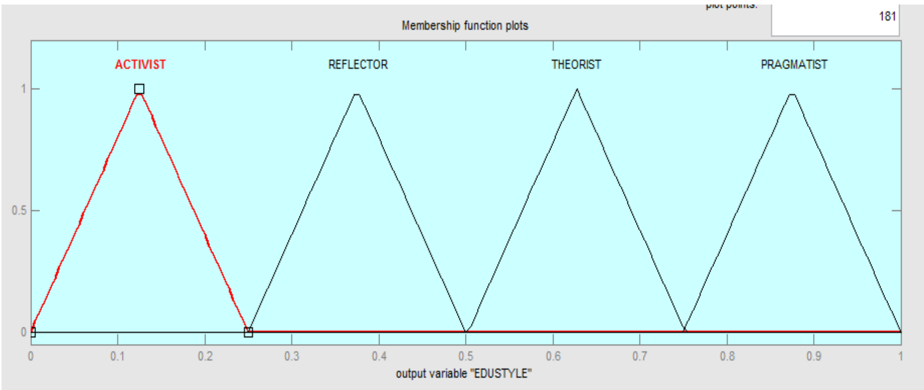
(b)Input for Reflector



(c)Input for Theorist



(d)Input for Pragmatist



(e)Output

Figure 4. Membership Functions of The Proposed System

The rule base of Honey and Mumford's Learning styles testing is characterized by a set of IF THEN rules in which the antecedents (IF parts) and the consequents(THEN parts) involve linguistic variables. An example of rule determined in the system is shown in Figure 5.

IF Activist is MED **AND** Reflector is LOW **AND** Theorist is HIGH **AND** Pragmatist is MED **THEN** LEARNING STYLES is Theorist.

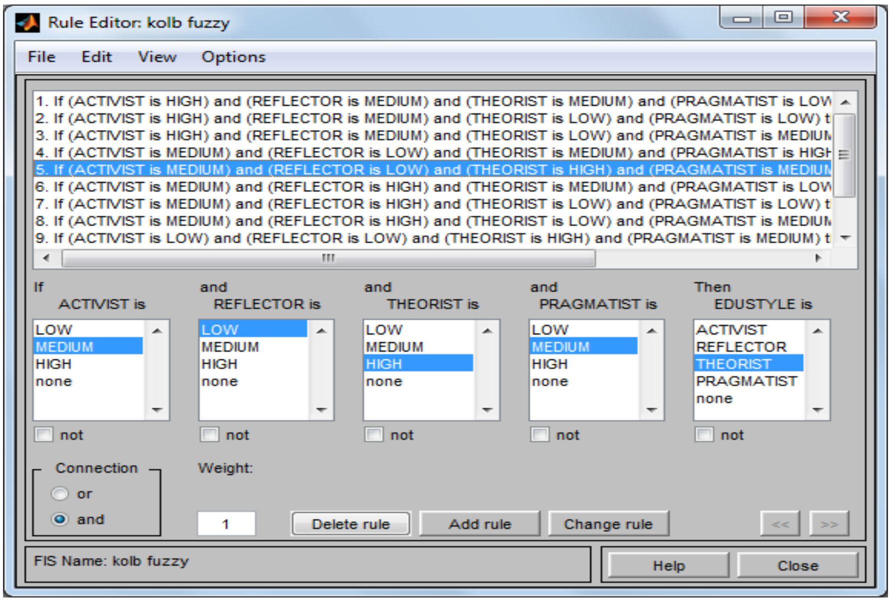


Figure 5. An Example Rule of The Proposed System

Lastly Centroid of Area (CoA) method is used for the defuzzification step.

RESULTS AND FINDINGS

Figure 6 shows an example operation of our system for the input parameters of values: AKTIVIST: 6.14, REFLECTOR: 8.62, THEORIST: 11.1 PRAGMATIST: 13.4 which correspond to LOW, MEDIUM, MEDIUM and HIGH fuzzy degrees respectively. According to the fuzzy rule *"If (AKTIVIST is LOW) and (*REFLECTOR *is MEDIUM) and (THEORIST is MEDIUM) and (*PRAGMATIST *is HIGH) then (LEARNING STYLE is PRAGMATIST)*". The proposed system inferences that, these input values correspond to the value of 0.875 for the *PRAGMATIST* learning style crisp output. The Surface Screen Interface of the Proposed Fuzzy Logic Model is shown in Figure 7.

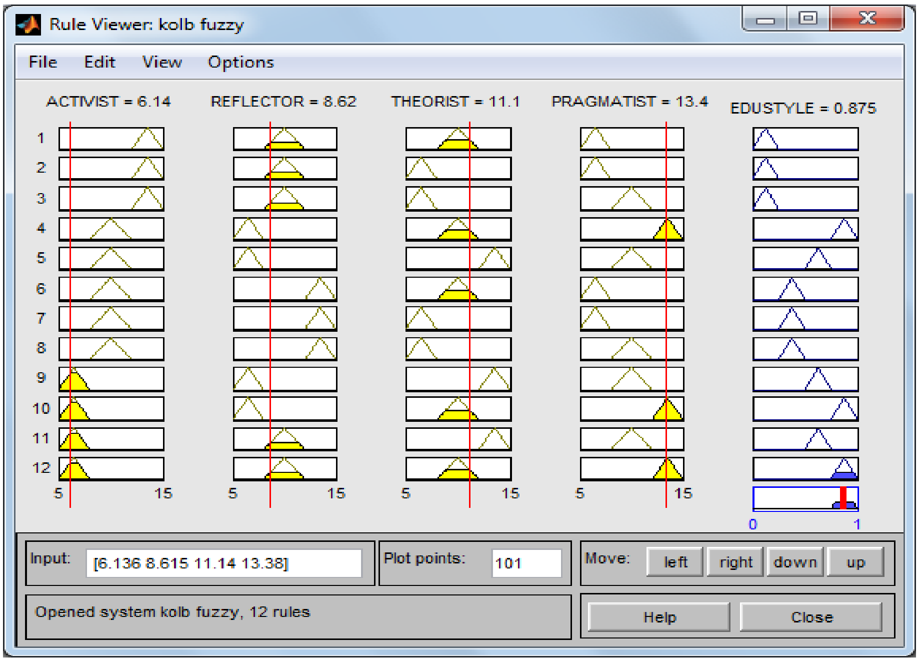


Figure6. An Example Output of the Proposed System

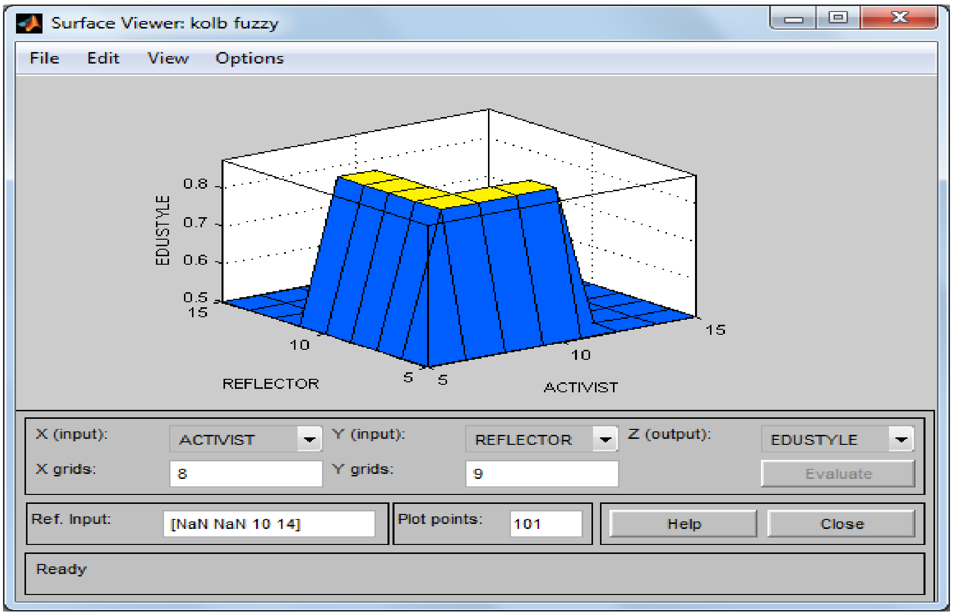


Figure7. The Surface Screen Interface of the Proposed System

CONCLUSION

In this study, a learning style inferency system based on fuzzy logic technique and Honey and Mumford's Learning Model is proposed in order to increase the success of students in education. In order to achieve this, a software which provides an interface including 20 questions in accordance with the Honey and Mumford's model is developed. Fuzzy logic technique is used to inference which learning style is suitable for the student's education based on the answer's of the students to the questions. By categorizing students learning style, instructor will be able to match his teaching style with student's learning style. By this way, it is aimed to increase students success in education considerably.

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FUZZY LOGIC BASED GREGORC LEARNING SYSTEM

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ABSTRACT: In this study, fuzzy logic based Gregorc learning system is proposed to characterize learning styles of the students who have various own learning skills, intelligence levels and learning styles. Gregorc learning system helps student to notice their different ways of perceiving and ordering information. Such that student can learn by reasoning logically and intuitively; by seeing and hearing; by reflecting and acting or by analyzing and visualizing. The goal of this system is to categorize students learning style and to make instructor be able to match his teaching style with student's learning style. By this way, it is aimed to increase students success in education considerably.

Key words: gregorc learning style, fuzzy logic

INTRODUCTION

People spend most of their time by educational activities in order to achieve learning which is the most important part of needs in their daily lives. For centuries, many studies have been done in order to answer following questions "how can i teach best", "how can an individual learn best", "how can the learned information be remembered always". By results of these researches, new education and learning methods, and new program types have been developed [1].

Education can be considered as a product of gain by experiences of family, environment, religion and mass communication mediums [1,2]. However, it should be noted that in almost every society, planned education is a mission of education schools. Regardless what comes up as a result of scientific studies, a part of education that can not be ignored certainly occurs at schools. This is how it is in global educational system of present days.

Large proportion of education occurs in school environment which exposes some problems that need to be surmounted along. One of these problems is excessive amount of students who have education at the same time. In this case, other problems can occur such that; are that much student's characteristics same thus they do have education together by the same circumstances, environment and by the same teacher? Do not these students have any diversity between each other? It can not be expected from students that have individual differences to perform same level of learning. Therefore, when these questions and excessive amount of students in the school are considered, actually, it can be concluded that individual differences must be taken into consideration [1,3].

In traditional education systems, every individual in a student group is bonded to a single program intended to group and an education method that is chosen by teacher. However, every student has various, own learning skills. Ignorance of these individual differences causes problems such that students which are more tended to chosen program, used method learning more efficiently, and others who are not tended to chosen program, couldnt learn as required [4]. Many studies such as Kolb's [5], McCarthy's [6], Honey's [7] and Fleming's [8] learning styles have been proposed about these individual properties that needed to be taken into account on education design.

BACKGROUND

In this section, background subjects of the system such as Gregorc learning style and Fuzzy Logic Technique are described briefly.

Gregorc Learning Style

Gregorc's Mind Styles model provides an organized way to consider how the mind works. This model categorizes learning style into four groups: Abstract sequential, Concrete sequential, Abstract random, and Concrete random [9]. In abstract sequential learning model, learner likes analyzing and applying logic in solving problems. They learn best when they have access to experts or references; placed in stimulating environments and able to work alone. It is very hard for them to being forced to work with those of differing views; Repeating the same tasks over and over; dealing with lots of specific rules and regulations [9]. In Concrete sequential learning model, learner likes ordering, following directions and getting facts. They learn best when they have a structured environment; they can rely on others to complete this task; are faced with predictable situations; can apply ideas in pragmatic ways. It is very hard for them to work in groups; Working in an unorganized environment; Dealing with abstract ideas; Following incomplete or unclear directions [9]. In Abstract random learning model, learner likes to listen to others; bringing harmony to group situations; establishing healthy relationships with others; focusing on the issues at hand. They learn best when they are in a personalized environment; are given broad or general guidelines; are able to maintain friendly relationships; are able to participate in group activities. It is very hard for them being in a competition; Working in a restrictive environment; Working with people who don't seem friendly; Concentrating on one thing at a time; Giving exact details [9]. In Concrete random learning model, learners like experimenting to find answers; taking risks; using their intuition; solving problems independently. They learn best when they are able to use trial-and-error approaches; are able to compete with others; are given the opportunity to work through the problems by themselves. It is very hard for them being restricted and limited; re-doing anything once it's done; keeping detailed records; showing how they got an answer; choosing only one answer; having no options [9].

Fuzzy Logic

Fuzzy logic deals with reasoning that is approximate rather than fixed and exact. Compared to traditional logic, fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false [10]. Fuzzification, Fuzzy Rules, Membership Functions, Inferency and Defuzzification are basic concepts of the fuzzy logic technique. The aim of fuzzification step is to determine the mapping degree of crisp inputs to fuzzy sets by using membership functions. Fuzzy rules are applied to the fuzzified inputs. Outputs of all rules are aggregated to obtain unificated output. From the fuzzy rules, probability fuzzy output variable can be obtained. The higher probability means that the node has more chance to be selected. Defuzzification is the process of transforming probability fuzzy output variable into a single crisp output [11].

THE PROPOSED SYSTEM

In this study a learning style inferency system which is based on fuzzy logic tehcnique and Gregorc learning model is proposed to increase the success of students in education. In order to achieve this, a software which provides an interface including 20 questions in accordance with the Gregorc model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student's education based on the answer's of the students to the questions.

Interface

Interface shown in Figure 1 is developed by using C# programming language and includes 20 questions. A student who participates this survey gives 1, 2 or 3 point to each question. Point 1 corresponds to LOW, Point 2 corresponds to MEDIUM and Point 3 corresponds to HIGH.

1-5-9-13-17 questions' total points are for **concrete random(CR),**

2-6-10-14-18 questions' total points are for **concrete sequential(CS),**

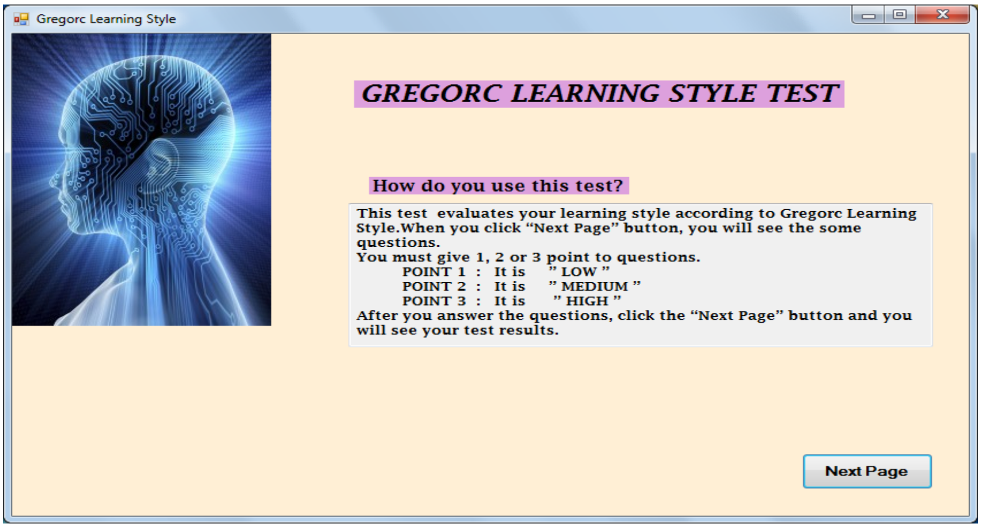
3-7-11-15-19 questions' total points are for **abstract random(AR)**,

4-8-12-16-20 questions'total points are for **concrete sequential(AS)**,

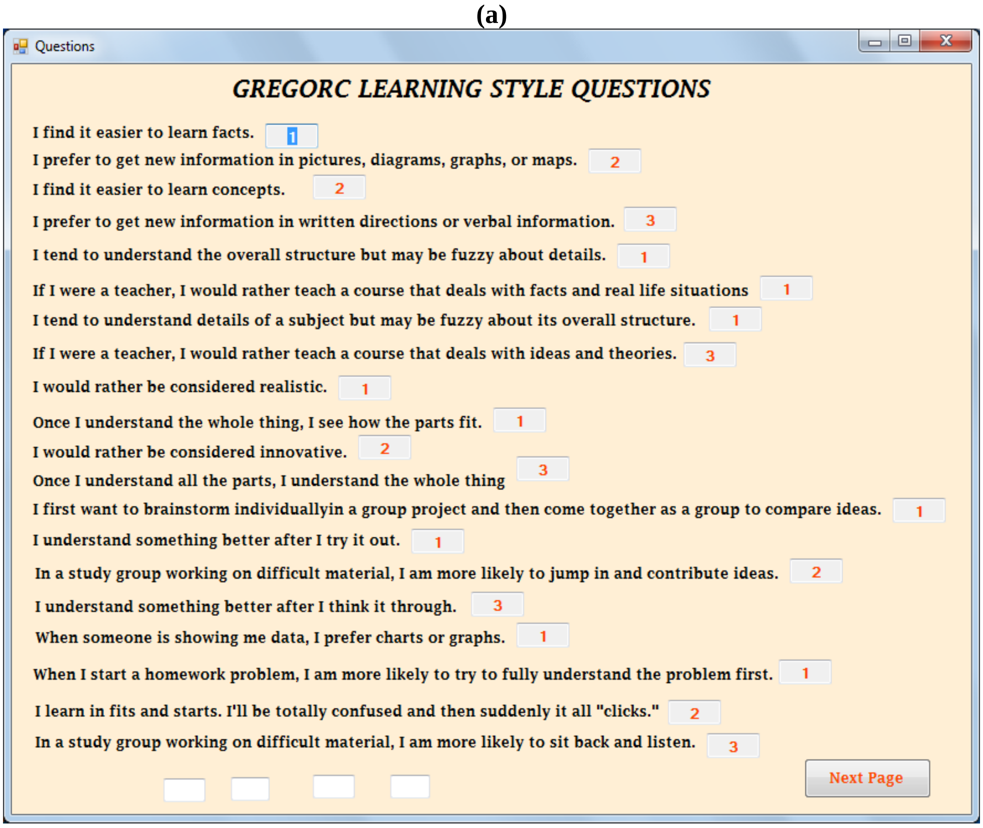
Table 1. Linguistic Variables And Their Fuzzy Value Range

Question System Value	Linguistic variables	Fuzzy value
5-6-7	LOW	0.00<= x < 0.3

8-9-10-11-12	MEDIUM	0.03<= x < 0.7
13-14-15	HIGH	0.7 <= x <= 0.1



(a)



(b)

Figure 1. Interface of Gregorc Learning Style

Education style is decided in accordance with the total points which are obtained from the answers of questions. Figure 2 shows the interface of Gregorc Learning Style Test Result.

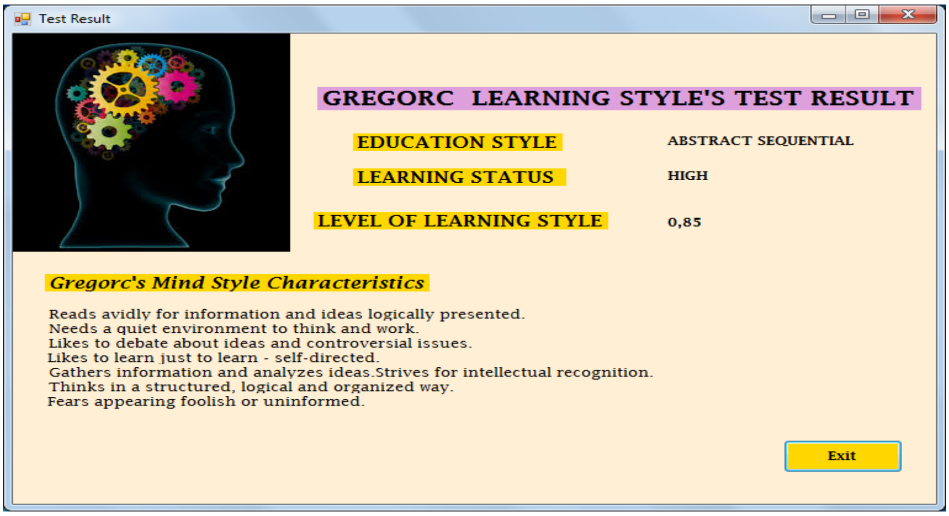


Figure 2. Interface of Gregorc Learning Style Test Result

Fuzzy Logic Based Inferency System

Four input parameters namely Abstract Sequential (AS), Concrete Sequential (CS), Abstract Random (AR), and Concrete Random (CR) and one output namely Education Style (EduStyle) are determined in the proposed fuzzy logic based system which is shown in Figure 3.

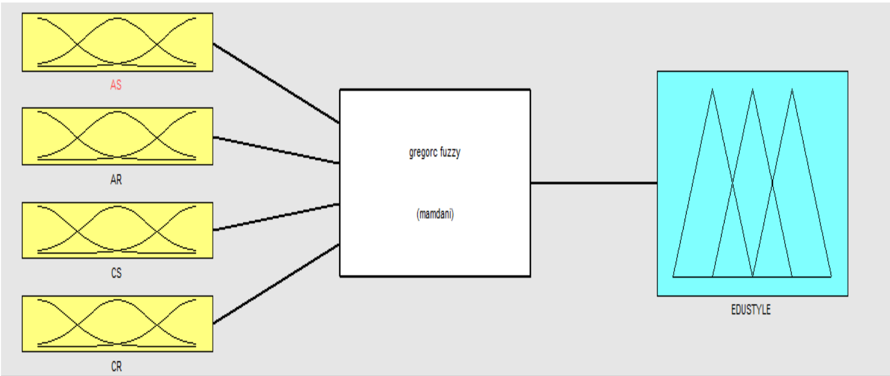
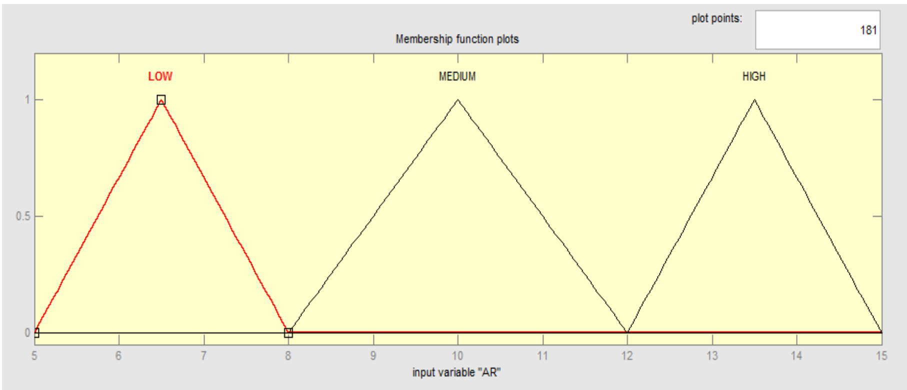
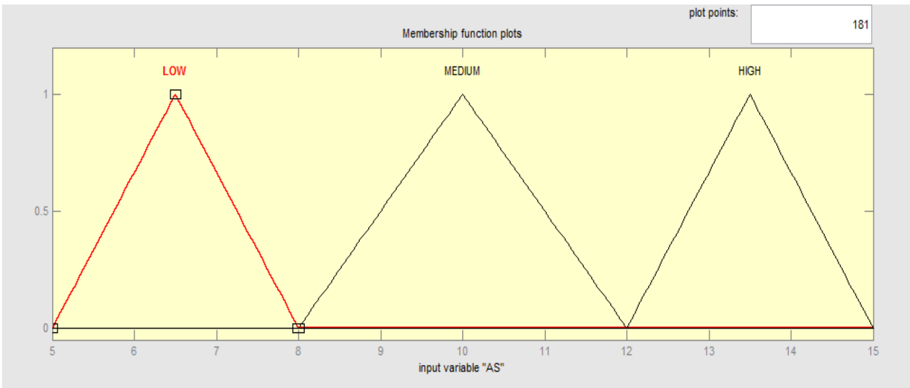


Figure 3. The Proposed Fuzzy Logic Based Inferency System

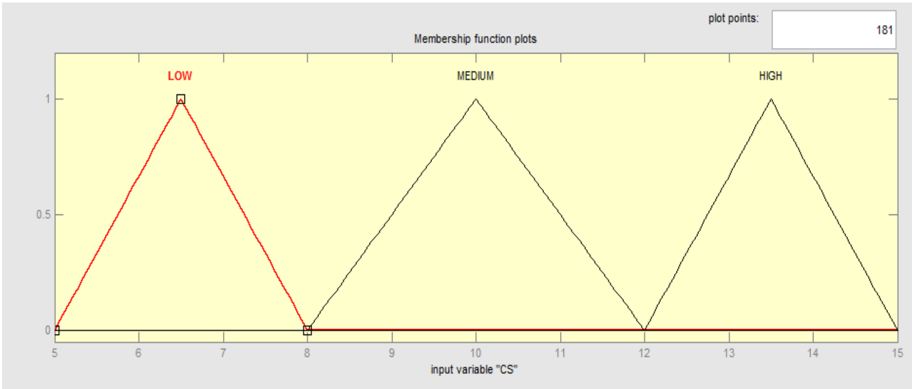
The fuzzification method involves the transformation of raw input variables and evaluation of the linguistic variables using the triangular Membership Functions as shown in Figure 4.



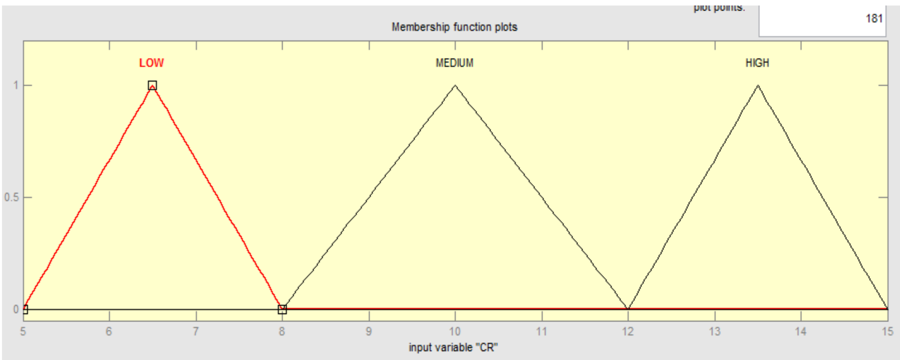
(a)Input for Abstract Random



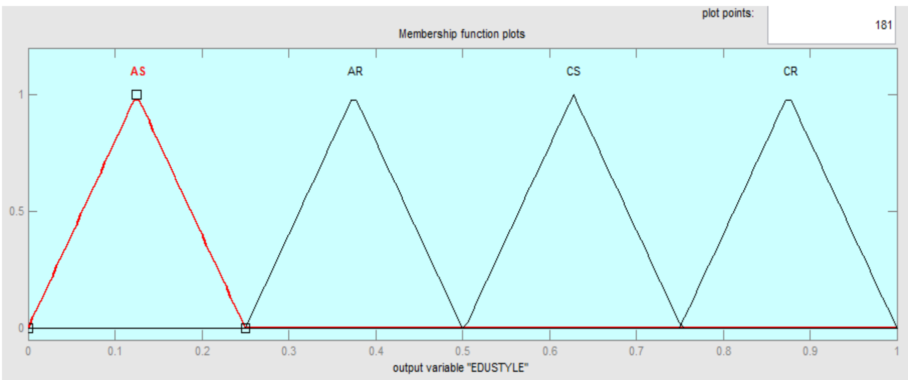
(b)Input for Abstract Sequential



(c)Input for Concrete Sequential



(d)Input for Concrete Random



(e)Output

Figure 4. Membership Functions of The Proposed System

The rule base of Gregorc Learning styles testing is characterized by a set of IF THEN rules in which the antecedents (IF parts) and the consequents(THEN parts) involve linguistic variables. An example of rule determined in the system is shown in Figure 5.

IF AS is HIGH **AND** AR is MED **AND** CS is MED **AND** CR is LOW **THEN** LEARNING STYLES is AS.

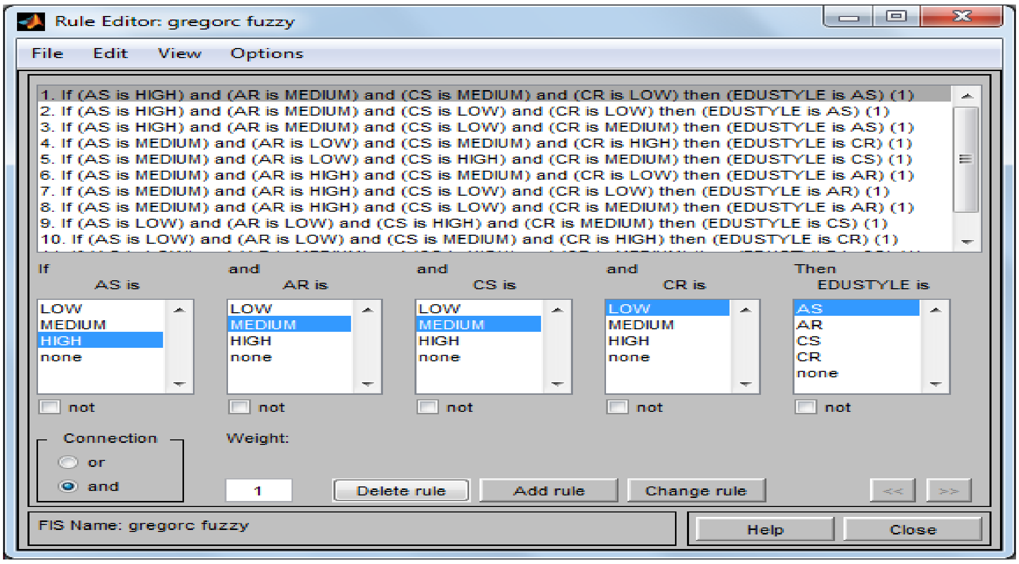


Figure 5. An Example Rule of The Proposed System

Lastly Centroid of Area (CoA) method is used for the defuzzification step.

RESULTS AND FINDINGS

Figure 6 shows an example operation of our system for the input parameters of values: AS: 6.74, AR:9.08, CS: 11 CR: 13.5 correspond to LOW, MEDIUM, MEDIUM and HIGH fuzzy degrees respectively. According to the fuzzy rule *"If (AS is LOW) and (*AR *is MEDIUM) (CS is MEDIUM) and (*CR *is HIGH) then (LEARNING STYLE is CR)"*. The proposed system inferences that, these input values correspond to the value of 0.875 for the *Concrete Random* learning style crisp output. The Surface Screen Interface of the Proposed Fuzzy Logic Model is shown in Figure 7.

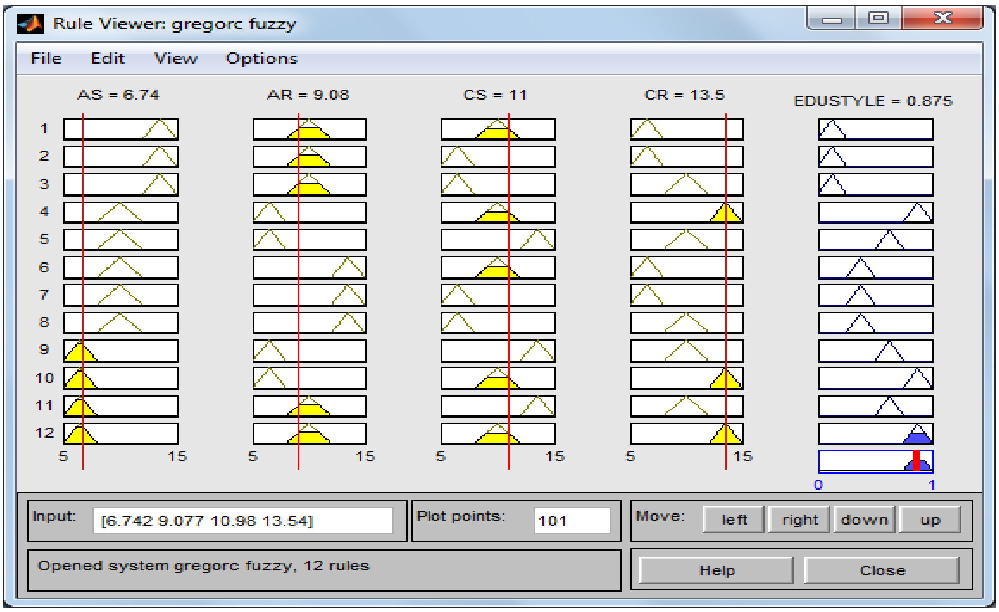


Figure6. An Example Output of the Proposed System

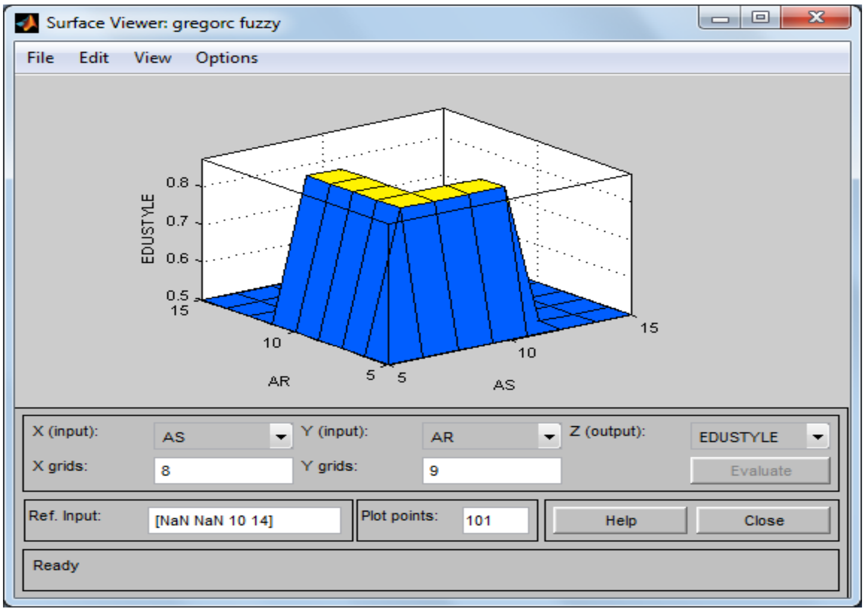


Figure7. The Surface Screen Interface of the Proposed System

CONCLUSION

In this study, fuzzy logic based Gregorc learning system is proposed to characterize learning styles of the students who have various own learning skills, intelligence levels and learning styles. In order to achieve this, a software which provides an interface including 20 questions in accordance with the Gregorc model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student's education based on the answer's of the students to the questions. By categorizing students learning style, instructor will be able to match his teaching style with student's learning style. By this way, it is aimed to increase students success in education considerably.

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AN M-LEARNING TOOL FOR PRE-SCHOOL KIDS

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ABSTRACT: The importance of technology is incontrovertible in today's world. The effects of it surround the life of human in everywhere and every time.

The young students, especially pre-school period children, learn how to share and socialize, to make cooperation and take place in teamwork. During pre-school period they learn new things and their talents. Children have the chance to learn new things which can affect their grown period. They learn how to use their brain for learning new things and so they can be aware of their talents with the help of this study.

In this work, we describe a novel M-Learning process with our M-learning tool. This process is especially developed for pre-school children. The main factor in this process is using the technological devices which affect the education period of children and the teaching period of teachers. This tool also gives a chance for the parents to observe the improvements that occur in the learning capacity of their children and children also can have fun while they are learning new things.

Keywords: e-learning, m-learning, pre-school, education technology

INTRODUCTION

The use of information and communication technology (ICT) improves learning, especially when it couples with learner-centered instructions or convenience (Zhu & Kaplan, 2002). The learning and exchange with the instructor can take place asynchronously at the learners own pace or on an as-needed basis (Palloff, R., & Pratt, K., 2001). Additionally, wireless devices are highly individualized and collaborative communication tools. They give exclusive flexible tools for complementing the existing technologies and extending the learning beyond the classrooms and homes from remote places like airports or trains where students do not have access to computers and the internet (Virvou, M., & Alepis, E., 2005).

E-Learning is an education method with internet, network or standalone computer. This means to use electronic applications and processes in order to learn. E-Learning includes web based and computer based learning processes, virtual classrooms and digital collaborations. The content can be delivered via the internet, intranet/extranet, audio or video tape, satellite TV or CD-ROM. This system was called as "Internet Based Training", and then it was called "Web Based Training". On the other hand, E-Learning does not only cover training and instruction, it also covers the learning process which is adapted individually (Tavangarian D., Leypold M., Nölting K. & Röser M., 2004), (Ajayi & I.A., 2008).

Mobile learning (M-Learning) can be defined as portable technology together with wireless and mobile phone networks. This situation helps to facilitate, support, enhance and extend knowledge transfer for teaching and learning. Mobile learning is a new type of learning model. By M-Learning a person can use the mobile devices in order to learn something. M-Learning is formed in the background of knowledge exploding. It synchronizes the characteristics of modern education thought, computer network technology, mobile communication technology and multimedia technology. M-Learning can also be defined as a highly situated, personal, collaborative and long term applications, which means learner-centered learning. M-Learning also provides more flexible and managing methods for instructors and educational administrators (Mhaisgawali A. Ajayi & I.A., 2008).

There are lots of countries in the world trying to integrate information technologies into their education systems through the policies they follow and the projects they make in order to realize better investments for their future.

In this work, we proposed an M-Learning tool for pre-school children, which is described after given related work.

RELATED WORK

The first M-Learning application is proposed in (Farooq, U., Shafer, W., Rosson, M. B. & Caroll J. M., 2002) as an extension of existing personal computer based online learning, MOOsburg, for mobile devices. It allows students participating in community education programs on environment and ecology to discuss their findings from remote field trips. As students collect and analyze environmental data they can either chat with their peers or interact with a database on the server.

Similar M-Learning project extended an internet based virtual university to mobile devices by developing an M-Learning platform called WELCOME (Wireless E-Learning and COMmunication Environment) (Lehner, F. & Nosekabel, H., 2002). The platform complements the E-Learning environment by translating some contents for mobile devices and supplements new information such as event alerts, phonebook, calendar and other campus services. Both systems combine the browser-based pull technology with WAP-based push technology to enrich the students learning experience and support the conversational theory of learning.

Two other studies at European universities have focused exclusively on the use of SMS technology as collaboration tool for M-Learning. The former one (Bollen, L., Eimler, H. & Hoppe, U., 1999) emulated a mobile device on a PC in order to allow students sending SMS messages on various discussion topics which were aggregated and categorized by the instructor by using an electronic whiteboard in the classroom. The categorization can be done by criteria such as sender, receiver, time and others. And, the latter one (Stone, A., Briggs, J. & Smith, C., 2002) evaluated the effectiveness of SMS campaign as a conversational mechanism in context of developing the quality of mobile teaching and learning environment. The effectiveness of SMS campaign was measured by quickness of the response, the quality of data collected, the impact of message complexity on number of responses and the method of campaign announcement on quality and quantity of messages. These studies show that students liked using SMS and they were responsive to the use of mobile devices for interaction and learning. The response rates were high, the quality of the messages was acceptable and SMS responses were much quicker than e-mail responses. Both these studies experiment with popular mobile messaging services in order to see they would work in M-Learning environment and provide support for the conversational theory of learning.

The examples and existing works demonstrate the potential of M-Learning applications in education. Considering the usage and popularity of mobile devices with the student population, they cannot be ignored in any learning environment, especially for pre-school ages.

SYSTEM DESIGN

We proposed an M-Learning tool for pre-school children, at the same time it covers all features of E-Learning tools. The beta version of the system is ready and children can use computers, tablets or mobile phones to learn, play and relax. Our application is made of four modules, three of which support learning and one is analysis of activities.

The first module is learning module. By this module, children can learn many concepts like animals, colors, fruits, numbers in levels and they can examine what they should get. Parents can trace their children's progress from gains page. The second is the game module. By this module, we can provide educational games such as memory games, painting and math games. In game module, children reinforce what they have learned with these games. The third one is the story module. By this module, children can listen stories and watch animations. This module helps parents so they can be relax about reading stories to children or children can also listen stories from phone. The last one is the statistics module. By this module, parents can easily check the analysis of learning processes of the application.

Figure 1. Main Screens Of Applications.

The learning and examining processes are divided into levels in each of concepts. As level goes higher the difficulty of concepts goes higher and upper levels cannot be reached before the lower is complete. In the first version of our M-Learning system, the learning module includes 14 types of basic concepts which are supported by visual and sound effects and animations. Besides interaction with the touch screen is provided.

Table 1. Concepts Included In Learning Modules

Concept Name	Number of Levels
Colors	3
Numbers	4
Fruits	4
Vegetables	3
Animals	6
Family	1
Objects	1
Rooms	1
Toys	1
Travel	1
Stuff	2
Clothes	2
Food	1
Body	2

We have yet developed 5 games to strengthen to learned concepts, in the game module.

Memory: Classic memory match game with pictures of what children learn in the learning module.

Which one is the different: Finding and choosing the different one from random pictures of what children learn in the learning module.

Mathematics: Simple addition operations with numbers (1-9).

Finding Differences: Finding differences between two images.

Shape Painting: Painting the shapes such as triangle, square, circle and learning them.

Figure 2. Games Module Of Application.

Story module includes 3 classic stories. These are Rapunzel, Puss in the Boots and Cinderella. In story module parents can read the stories to their children or children can easily listen the stories themselves.

Figure 3. Stories Module Of Application.

The statistics module is the most important module for parents to observe the progress of the children. The parent who logs in our application will be able to see success, mistakes and learning abilities of their children.

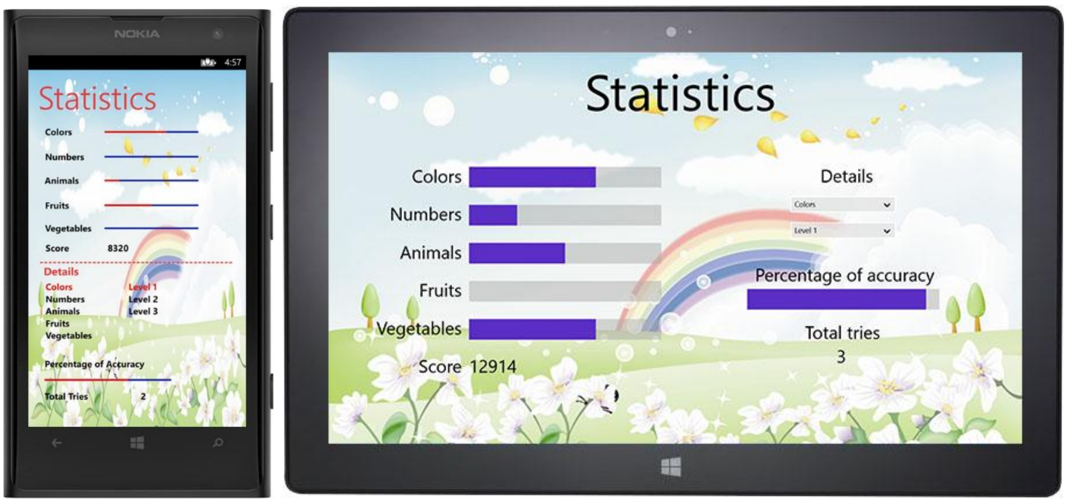

Figure 4. Statistics Module Of Applications.

For now, the application can operate in three languages which are English, German and Turkish but our design allows us to add more languages easily. In this way, the application will also contribute to the learning of foreign languages, at least familiarizing with the words in other languages.

RESULTS AND CONCLUSION

The beta version is now available in Windows 8 Store and Windows Phone 8 Store currently. In addition, as a future work it is planned to implement and make it available in the Google Play Store. The current version of the application has downloaded about 15 thousand times in first 6 months.

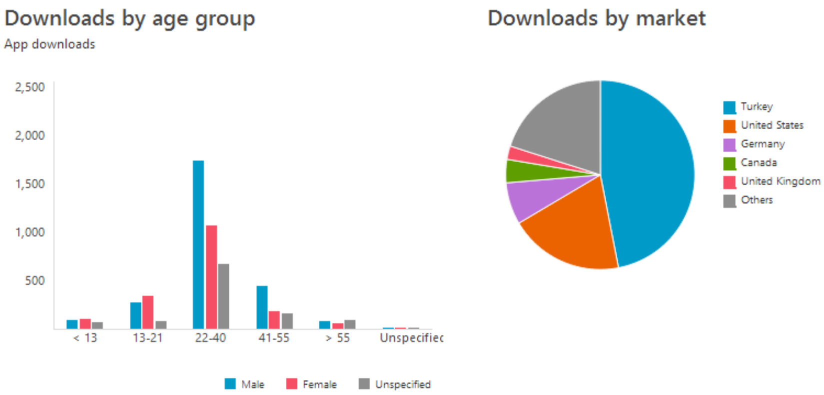

Figure 5. Windows Market Download Statistics.

When we look at the data, we see that the majority of downloads is coming from the middle-aged parents. The markets that have downloaded most are Turkey, US and Germany because of language support.

We created a parent satisfaction survey and published on the web. Currently some of parents had been fill out our survey. Their children are between 2-7 ages and 64 % of children go to kindergarten. In the results, %60 of children uses our app at least twice a week. We asked parents some questions. Here the ratings out of 5 stars.

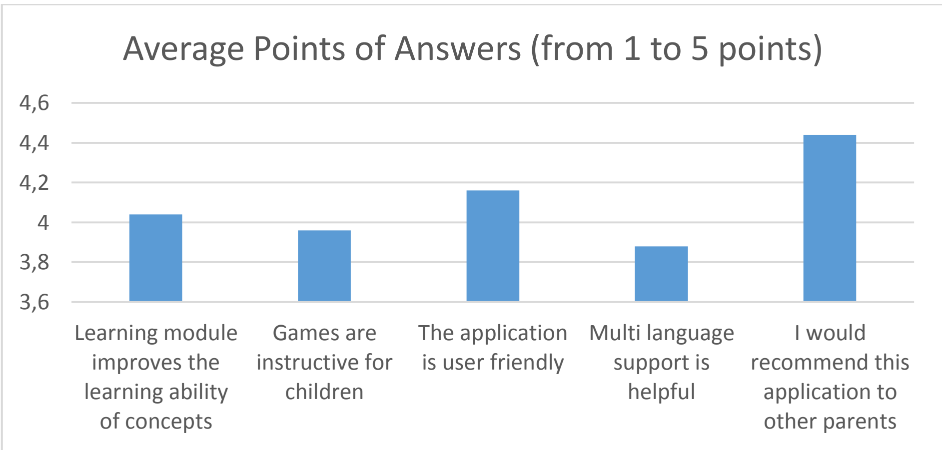

Figure 6. Results of Parent Satisfaction Survey.

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EDULABS – THE AGIRE PROJECT: OBJECTIVES, MONITORING AND EXPECTATIONS

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ABSTRACT: The AGIRE project is a partnership between the University of Aveiro, a consortium comprising 26 companies related to teaching and learning, and one School Grouping, with the financial support of QREN. The project is embedded into the Edulab concept (school laboratories with technological equipments, as tablets, laptops, whiteboards, and educational materials such as eBooks and learning platforms) to promote the adoption of innovative teaching practices.

The project stems from identified contextual needs and aims to monitor the project implementation within an interventional perspective, concerning educational innovation with the use of digital technologies. The goal is to promote teachers' and students' digital literacy, by developing Teacher Training Courses (TTC) and taking advantage from the school technology environment on a pedagogical level. After attending a short-term (15 hours) technological TTC, a 64-hour TTC involving 13 teachers of Basic Education during the current school year is being conducted. The TTC, developed in a blended learning environment, follows the flipped classroom methodology comprising autonomous tasks for consulting multimedia resources at a distance and face-to-face sessions for discussion, reflection and collaborative work. This fits into a design-based methodology (Parker, 2011), allowing the analysis of the intervention outcomes and it's successively refinement towards a solution, following the phases: i) Analyze the problem; ii) Design and develop potential solutions; iii) Implement and evaluate; and iv) Reflect and report. A set of data collection instruments developed under this project allowed its monitoring, as well as the redefinition of the TTC and its previewed activities. For example, the questionnaire on the trainee teachers' digital literacy, the grid to monitor the strategies implemented in classrooms, as well as the autonomous work tasks allowed each teacher to position its practice at the level of technology integration and to raise his/her expectations towards the educational technologies.

Key words: edulabs, ICT in education, teacher training, collaborative learning, flipped classroom.

INTRODUCTION

This ongoing research, the AGIRE project, falls within the context of the Edulabs network, promoted by the e-xample consortium that comprises 26 companies related to teaching and learning, particularly Grupo Leya®, JP-inspiring knowledge®, b-bright®, Globaltronic®, PT Inovação®, among others. Being focused on creating experimental learning ecosystems, Edulabs are student classrooms technologically and didactically equipped to promote innovation in education.

AGIRE is a collaboration project between the e-xample consortium, the University of Aveiro and the School Grouping of Gafanha da Nazaré (Aveiro), focused in promoting the following main dimensions: i) digital literacy of the actors (students, teachers and parents); ii) teacher training on the integration of technologies in education; iii) innovation of educational practices; iv) community involvement - parents; and v) digital contents.

The Edulab concept

The project is embedded into the Edulab concept (school classrooms with technological equipment, as tablets, laptops, whiteboards, and educational materials such as eBooks, digital educational resources and e-learning platforms) to promote the adoption of innovative teaching practices, seeking to respond to the needs of knowledge and skills required for future generations and fostering the interaction between teacher and students as well as family involvement.

This model is based on the premise that information technologies applied to Education allow the implementation of new models of teaching and learning, using multimedia digital contents and support platforms for teaching and learning and a set of tools to create a new teaching generation. The Edulab classrooms technology model (Figure 1) comprises: i) one teacher laptop; ii) tablets/laptops for students; iii) internet access points; iv) e-learning platforms; and v) educational resources provided by publishers - eBooks, and digital educational resources.

Figure 1. The Edulab Classrooms Technology Model (adapted from e-xample, 2014)

The Edulab concept induces pedagogical innovation by providing educational technology attractive to students as well as teacher training courses, not only technically but also pedagogically. Its main goals are: i) to improve the teaching and learning environment, by the integration of technology in educational context; ii) to increase the students' academic success and iii) to prepare students for their future employability. The Edulab network also promotes and supports the sharing of practices and experiences between schools that adopt the Edulab model at a national level. This network involves 10 school groupings, 20 schools and about 1000 students in Portugal.

The AGIRE Project

The AGIRE project, embedded in the Edulab concept, is a partnership between the University of Aveiro, the e-xample consortium and the School Grouping of Gafanha da Nazaré (AEGN), in the region of Aveiro (Portugal), with the financial support of QREN – "Quadro de Referência Estratégica Nacional" (ref. T377783477-00030493).

The goal of the project is to promote teachers' and students' digital literacy, by developing Teacher Training Courses (TTC) and taking advantage from the school technology environment (provided by the Edulab concept) on a pedagogical level. Thus, it was implemented two types of TTC: i) a short-term 15 hours training focused on the technological aspects; and ii) a long-term 64 hours training focused on the pedagogical concepts for the integration of technology in classroom including practical exercises of the training strategies with students. An online community of practice was developed in order to support the sharing of resources and experiences within the tasks of the TTC. The project also aims to find and share 'best practices' on the Edulab in order to inspire other teachers/schools.

The AEGN Edulab includes the participation of 13 teachers and 5 classes from the three Basic Education Cycles, and a diversified set of disciplines (Math, Natural Sciences, History, Geography, English, French, Visual Education and Information and Communication Technology). Being in line with the Edulab model, the main technological resources in class, within the AEGN Edulab, include JP-inspiring knowledge tablets and laptops, B-bright interactive whiteboards, Leya teaching and learning platforms and Mythware e-learning software.

The contribution of University of Aveiro to the project consists in two main strategic actions: i) monitoring the project (identifying contextual needs, monitoring educational innovation processes with the support of digital technologies and assess the pedagogical innovation outcomes); and ii) implementing a Teacher Training Course based on pedagogical principles in line with the Edulab concept. Thus, the University of Aveiro involvement focuses on three main domains, within a technologic context: i) educational practices, ii) digital literacy and iii) teacher training.

Attending to the Edulab model described above and the educational technology and teacher professional development topics discussed, the AGIRE project stems from identified contextual needs and aims to monitor the project implementation within an interventional perspective, concerning educational innovation with the use of digital technologies.

Educational technology and teacher professional development

As noted by Horta (2013), the introduction of computers in schools led to the need to prepare teachers for its use. Among the many studies developed in teacher training in Information and Communication Technologies (ICT) and its impact in their teaching practice stands out the importance of Lifelong Learning (LLL) and in service teacher training (Costa & Garmston, 2015). Also, several studies point to extensive evidence of the importance of ICT in improving student learning, and it also appears that these benefits are dependent on the strategies and pedagogical practices used, that is, the way the teacher selects and organizes ICT resources (Cox, Webb, Abbott, Blakeley, Beauchamp & Rhodes, 2004). Studies indicate therefore that the main training needs in this area are in the educational use of ICT, namely enabling teachers to be autonomous users of technology in their teaching practices and promoting the use of ICT with students.

According to the literature the most favourable conditions for the integration of ICT by teachers in their teaching practice include: i) the creation of a training environment where teachers collaborate and reflect on the work that they can develop with ICT to promote powerful learning environments (Sipila, 2010; Horta, 2013); ii) the development of practical activities with ICT, planned and implemented in classroom with appropriate pedagogical practices, such as problem solving with the use of ICT (Yelland, 2006), and selecting meaningful methodologies such as collaborative work and flipped classroom; iii) using, during the teacher training course, the same technology that later will serve teachers in their teaching practice, in classroom. It is also important to note the potential effect of promoting access to these resources on family context for strengthening school learning, reducing inequalities in the use of ICT and bringing school contexts to family (Silva & Diogo, 2011).

METHODS

Project monitoring in design-based research cycles

A set of data collection instruments developed under this project allowed its monitoring, as well as the redefinition of the TTC and its previewed activities. For example, a questionnaire on the trainee teachers' digital literacy, a grid to monitor the strategies implemented in class, as well as an autonomous work task allowed each teacher to position its practice at the level of technology integration and to raise his/her expectations towards the educational technologies. Thus, the monitoring process comprises surveying the different members of the educational community, classroom observations, observation mediated by platforms and document analysis. The aim of this methodology is to understand in depth the relationship between innovative educational practices, learning ecosystems enriched by technology, and the improvement of student learning and their academic success, by the combination of the techniques and tools for collecting information mentioned before.

Classroom observation

Classroom observation occurred in two moments. Some preliminary face-to-face observations were conducted during the end of the first school year in which the AGIRE project started. Considering the 1st cycle of Basic Education (6-10 years old students), 5 classes were observed, on a 1st grade class, in which it was developed various activities with the student's personal laptops and using the Mythware® synchronization platform. For the 3rd cycle of Basic Education (11-15 years old students), two classes were observed (a 7th grade class in French discipline): i) a presentation of Leya on teaching and learning platform using tablets; and ii) the first class of use of tablets with the Leya digital book.

The second moment comprised classroom observations mediated by a platform, of classes conducted after the beginning of the long-term TTC. Thus, an online registration classroom grid was conceived and made available online, and filled by trainees (teachers of different disciplines and grades).

Questionnaire survey

In order to assess the initial representations of teachers of the School Grouping of Gafanha da Nazaré (AEGN) on the integration of technology into their teaching practices, an online questionnaire survey was conducted at the beginning of the school year, which comprises the following dimensions: i) profile (age, gender, educational background, and years of teaching experience); ii) access to technological equipment (at home and at school); iii) degree of familiarity in performing various digital tasks; iv) how emerged the contact with technologies; v) in educational practice, what kind of activities use involving ICT; vi) perceptions about the use of ICT in school, from the point of view of student learning; vii) perceptions about barriers to use of ICT. The results helped to identify the teacher´s training needs and to define the structure of the TTC.

Teacher training course

After attending a short-term (15 hours, from October 7th to November 26th) technological TTC, a 64-hour TTC (from December 2nd to June 2nd) involving 13 teachers of Basic Education (1st cycle of Basic Education - 6-10 years old, and 2nd and 3rd cycles of Basic Education - 11-15 years old) during the current school year is being conducted. The TTC, developed in a blended learning environment, follows the flipped classroom methodology comprising autonomous tasks for consulting multimedia resources at a distance and face-to-face sessions for discussion, reflection and collaborative work. This fits into a design-based methodology (Parker, 2011), allowing the analysis of the intervention outcomes and it's successively refinement towards a solution, following the phases: i) Analyze the problem; ii) Design and develop potential solutions; iii) Implement and evaluate; and iv) Reflect and report (Figure 2). Therefore it includes a sequence of planning cycle's strategies, of implementation and reflection, setting new interventions in real context (Carlos, Pombo & Loureiro, 2014).

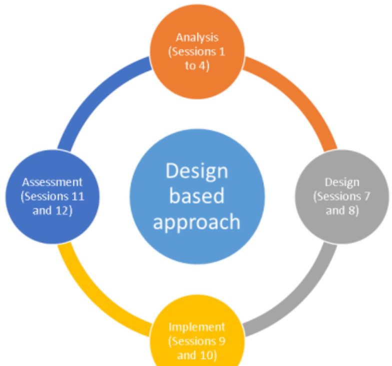

Figure 2. Training Dynamics Scheme Following The Design-Based Approach (Parker, 2011)

The short-term TTC had several stages with training in technological components and training in a workshop environment, considering the components of the learning and classroom management platforms and all technologies available in the classroom.

The long-term 64-hours TTC aims to develop innovative teaching and learning scenarios, changing teachers' practices and answering the following questions: How can teachers develop and implement, in the classroom, practical activities with ICT? And how students can play an active role in carrying out those activities? Assuming the importance of the teachers' role in decision making concerning the use of ICT in classrooms, the key aims of this TTC are the following: i) implement a proper training environment for the integration of ICT in the classroom, conceiving practical activities to be undertaken by students; ii) monitor the implementation of practical activities with students in the classroom, with the use of ICT. In order to achieve those aims, the basic contents are defined to be developed under the TTC, that constitute the innovative learning scenarios mentioned above, such as: i) ICT and parenting involvement; ii) flipped classroom as a methodology for the evolution of quality of teaching scenarios and learning and for the improvement of school-family relationship; iii) collaborative work and collaborative learning on the evolution of the quality of teaching and learning scenarios; and iv) digital learning resources (Figure 3).

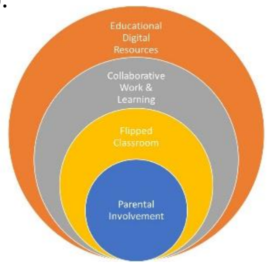

Figure 3. Teaching And Learning Innovative Scenarios Using ICT, In The Long-Term Teacher Training Courses (TTC)

The methodology of this TTC is theoretical and practical, in blended learning (b-learning) (face-to-face sessions and autonomous tasks), where collaborative work situations are created in small groups of trainees, to be followed by discussions with the whole group, promoting the sharing of knowledge, experiences and resources created during the context of the TTC. An online platform is used in order to facilitate the communication and collaboration among trainers, trainees and their respective students.

Moreover, the b-learning program of the long-term TTC implements itself the flipped classroom methodology, so that the trainees become familiar with this methodology to subsequently implement it with their students (Figure 4). This method, first introduced by Baker (2000), Lage, Platt & Treglia (2000) is an active learning approach, where the transmissive teaching happens outside the classroom (using videos and online activities) and where the formal classroom time is used for students to undertake collaborative activities and targeting the interaction (Strayer, 2012).

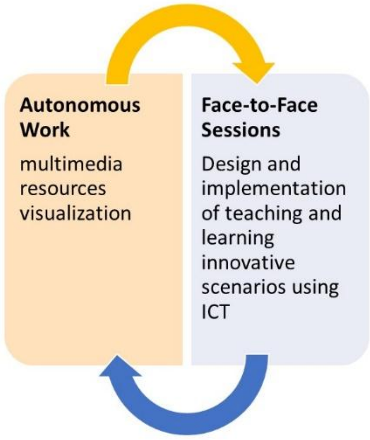

Figure 4. ***Flipped Classroom*** **Methodology Implemented In The B-Learning TTC Program**

Taking into consideration the implementation of the b-learning format, the first autonomous task included filling a questionnaire, based in the Technology Integration Matrix (TIM matrix - http://fcit.usf.edu/matrix/) in which the trainees had to position their teaching practice considering the level of integration of technology in the curriculum, as well as the type of learning environment that the use of ICT helps to promote. Its results will be presented on the following topic, along with preliminary classroom observations and questionnaire survey.

RESULTS AND FINDINGS

The main results and findings start from the identification of contextual needs in terms of the use of technology by teachers at the initial phase of the project, right after the first introduction of technology: laptop computers for students of three classrooms of the 1st cycle of Basic Education (6-10 years old) and tablets for students of two classes of the 2nd and 3rd cycles of Basic Education (11-15 years old), interactive whiteboards, eBooks, digital educational resources and an e-learning platform for classroom management. For the identification of those technical and pedagogical needs, some preliminary classroom observations were made along with a survey applied to teachers.

Preliminary classroom observations

In the 1st cycle of Basic Education were observed five lessons in the 1st grade class, where various activities were developed with the laptop computer and the e-learning platform for classroom management. In these activities it was always observed students enthusiasm and the initial tension of the teacher in the first activities was naturally decreased during the classes. Overall we found it was developed an active learning environment, encouraging the participation of students, but few constructive and still very focused on the teacher. In what concerns the level of integration of technology into the practices, and according to the classification of the Technology Integration Matrix - http://fcit.usf.edu/matrix/, it relays at the level of "adoption", although admittedly briefly switch to a level of "adaptation". Considering the natural climate of cooperation observed among students, we encourage the development of activities where collaboration can be encouraged.

For the 3rd cycle, it was observed two classes in the 7th grade class of French discipline. The first class comprised the presentation of the teaching and learning platform features on tablets and the other class corresponded to the first use of tablets, specifically using the e-book and the interactive whiteboard. It was not used the classroom management software Mythware for technical problems. We considered that the classroom was still very teacher-centred and little constructivist: the teacher follows the e-book and performs the multimedia activities available to it, requesting the participation of students. It was considered, in this class, that there has been an "adoption level" (according to the matrix referred above). To this observation adds some felt monotony in the final part of the class, and it is suggested the diversification of activities, in addition to the eBook.

Teacher's representations from a survey questionnaire

Considering teachers' agreement concerning the statement "My school is well equipped at the ICT point of view" (13 answers) (Figure 5) it is revealed a discrepancy between agreement and disagreement; while 4 teachers totally agreed, 6 agreed and 3 disagreed. We remind that those teachers are from 3 different schools (the 1st cycle school is a new school only with five years of existence, while the 2nd cycle school is old and the 3rd cycle was completely renewed and has now fairly good conditions).

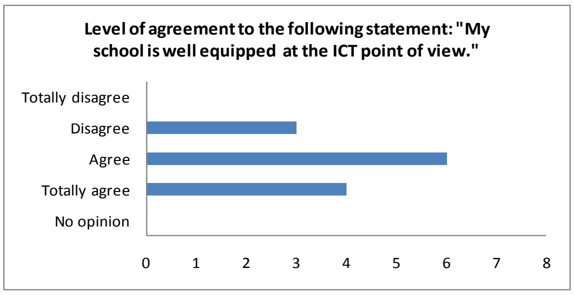

Figure 5. Level Of Agreement To The Statement: "My School Is Well Equipped At The ICT Point Of View."

In what concerns the statement "I use ICT very often to prepare my classes", all the teachers surveyed agree (4) or strongly agree (9) (Figure 6).

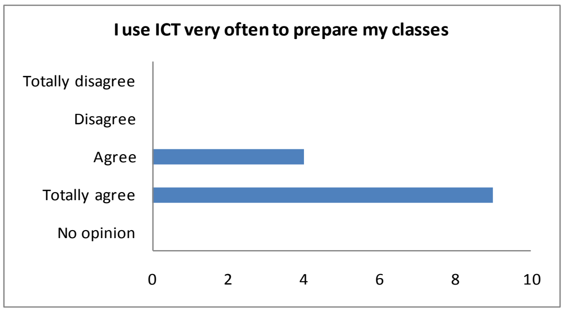

Figure 6. Level Of Agreement To The Statement: "I Use ICT Very Often To Prepare My Classes".

However, when asked about their usage of podcasts and/or video casts for educational purposes only one teacher surveyed agreed (Figure 7), and when asked to their familiarity in creating wikis to use with students (Figure 8), only one teachers answered "completely agree". Probably is the same teacher who is ICT teacher the only one who has facilities in using those kinds of tools to integrate them in classroom for education purposes.

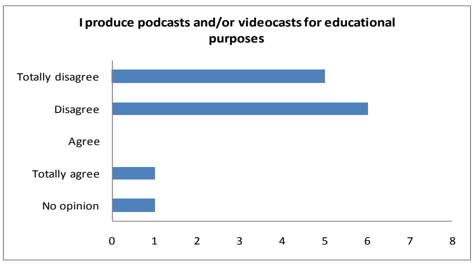

Figure 7. Level Of Agreement To The Statement: "I Produce Podcasts And/Or Video Casts For Educational Purposes."

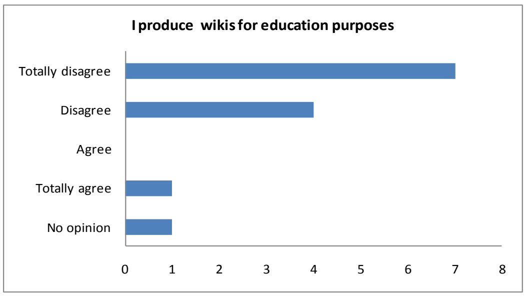

Figure 8. Level Of Agreement To The Statement: "I Produce Wikis For Educational Purposes."

Those results helped us to design the long-term training for teachers focused on the pedagogical concepts for the integration of technology in classroom including practical exercises of the training strategies with students, namely we found important to include a face-to-face session to create videos for the flipped classroom methodology and other session to develop strategies and resources that promote collaborative work.

As for the teachers' perceptions on the use of ICT in schools, in general, the teachers surveyed agree that the use of ICT in education contexts motivates or stimulates students for learning (5 agreed and 8 strongly agreed) (Figure 9), encourages collaborative work (7 agree and 5 strongly agree) (Figure 10), and promotes a student centred learning (5 agree and 6 strongly agree) (Figure 11), but that requires new skills for teacher (7 agree and 5 strongly agree) (Figure 12), being particularly significant in this last dimension, which reinforces the need of a long-term training course for teachers.

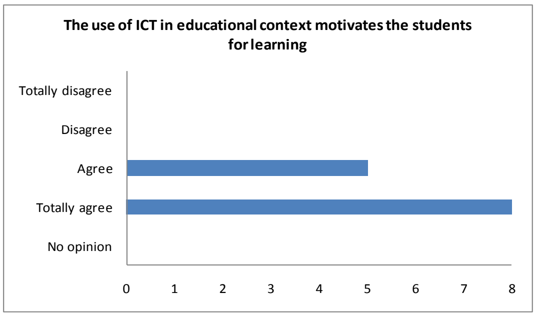

Figure 9. Level Of Agreement To The Statement: "The Use Of ICT In Educational Context Motivates The Students For Learning."

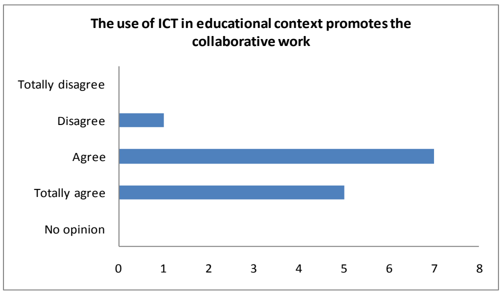

Figure 10. Level Of Agreement To The Statement: "The Use Of ICT In Educational Context Promotes The Collaborative Work."

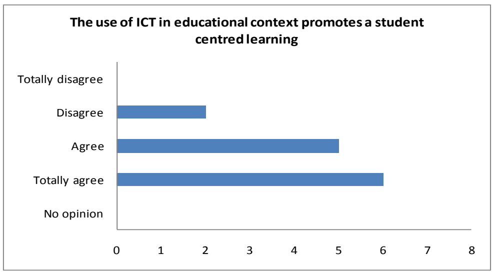

Figure 11. Level Of Agreement To The Statement: "The Use Of ICT In Educational Context Promotes A Student Centred Learning."

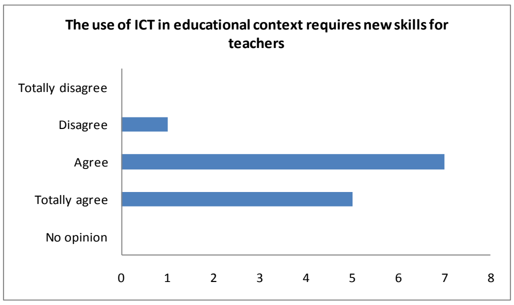

Figure 12. Level Of Agreement To The Statement: "The Use Of ICT In Educational Requires New Skills For Teachers."

Teachers were asked about how they have learned how to use ICT in education and the results revealed the following: training courses (10), self-training (9), family support (7), colleagues support (6), initial training (2). Triangulating these results with those testifying that teachers are willing to learn more to innovate their practices, the best way to accomplish that would be a training course that allows teachers to learn how to use properly ICT and apply it in their practices at the same time. However, it was observed that teaching practices still privilege a teacher centred environment in classrooms, and that the integration of ICT may enhance active learning, and also may develop transversal skills, such as digital literacy, which is vital to prepare students for the future job market. Broadly, governments and education authorities emphasize the need for students to develop technology knowledge and skills (Cooper, Lockyer & Brown, 2013).

Concerning all that was expressed above we have data that support the pertinence of the training course applied during the school year of the implementation of the project, where a set of technologies were available to those pilot classes. Additionally, monitoring the process is fundamental to evaluate what is doing well and what should be changed, in order to make decisions about how to integrate properly ICT in schools.

Monitoring the process

After the technological equipping of the Edulab, and after the preliminary observation classes and the survey applied to the teachers involved, it is important to monitor the process of integration technologies in the pilot classes. To accomplish that, the group of researchers of the AGIRE project developed a registration classroom grid to be filled by teachers in situations they had used technology on their classes and there were no observations programmed. That way it was possible to follow the process indirectly. The main results will be discussed below.

Registration classroom grid

Considering the list of resources that teachers were using most, the table 1 shows that the most used ones were the tablet and the laptop (21 times used from 23 registrations) and then the eLearning software and the projector (14 and 13 times used, respectively, from 23 observations). Other resources as eBook, worksheets, interactive whiteboard and videos were some other resources that teachers were using in their teaching practices. These results already show that teachers were using different resources that they were not used to use before the project, when they had not available such equipments or habits to use them.

Table 1. List Of Resources That Have Been Used During The Project School Year (The Total Number Of Registrations Is 23)

Resources	number of times	%
Tablet	21	91
Laptop	21	91
eLearning software (Mythware)	14	61
Projector	13	57
e-book	9	40
Worksheet	7	30
Interactive whiteboard	5	22
Video	5	22

According to the adopted strategies (Table 2) it is possible to note that teachers still give importance to application questions, like activities that students have to fill to prepare them for tests. In spite of formative assessment is valued in the Portuguese educational curriculum, the privileged way to assess students are still the tests along the school year. Individual work is still more chosen than the collaborative one, the flipped classroom (strategy completely new for all the involved teachers) were also implemented in classrooms with good reply of students. Demonstration and experimentation were also other kind of strategies that find the potentialities of the tablet very useful for laboratory classes, as the tablet includes a lab camera working as a microscope.

Table 2. List Of Adopted Strategies That Have Been Used During The Project School Year (The Total Number Of Registrations Is 23)

Adopted strategies	number of times	%
Application questions	16	70
Individual work	12	52
Oral exposition	7	30
Collaborative work	7	30
Flipped Classroom	6	26
Demonstration	3	13
Experimentation	3	13
Research	3	13
Debate	2	9
Other	1	4

Generally students did not have difficulties in using technologies and teachers are convinced that ICT could help them in what concerns: engagement, motivation, participation, development of digital skills, communication skills, problem solving skills, creativity and critical thinking, autonomous work, collaborative work and development of specific skills (disciplinary). In addition, concerning teacher’s registrations, the use of ICT in their practices enhanced teachers' enthusiasm for teaching, their ability to motivate students, improved the dynamism of classroom activities and contributed to the development of teachers digital skills.
In addition, some registrations point out some benefits of using technology in class:

> "The integration and the selection of the technology allowed "earning time" for other tasks (...) and the use of GeoGebra software allowed the teacher to previously draw the angles"

> "The Mythware software proved to be a very effective tool to lesson objectives. The software allows students to control the time to solve problems and answer questions. The teacher has access to a list of students and she can see the progress of individual work. In addition, teacher has the access to the 'state of students': number of students who completed the activity and number of students who have sending it. The students were pleased and motivated with this form of assessment, mainly because they get an almost immediate feedback. Also for the teacher this was a facilitating tool especially concerning the correction process";

as well as some constraints were identified:

> "As a first activity with the eLearning software (Mythware®) there were some difficulties in using it, which slowed the rhythm of the class. After resolved technical issues and with regular use of the software seems to me that the rhythm and development of the classes can improve."

> "Despite the motivation and commitment being high for the students, this type of work (group, with practical activities and technologies) makes the class noisier."

It's important to have a period of adaptation of new technology, as classes using technologies can be somehow motivating but also they can disturb the routine work of a classroom.

Monitoring the process - Platform observation during the training course

To monitor the process it was also used the platform in the training course as an indirect observation method of analysis, specially the autonomous work that teachers (trainees) are supposed to develop as autonomous tasks between the face-to-face sessions. The first challenge proposed to teachers was that they reflect into their own practices and evaluate their current and future (they intend to reach) integration of technology in their pedagogical practice, based on the Technological Integration Matrix (http://fcit.usf.edu/matrix/download/tim_table_of_teacher_indicators.pdf). The results of that activity can be seen in tables 3 and 4.

Table 3. Evaluation Of Teacher's Current Integration Of Technology In Their Pedagogical Practice, According To The Technological Integration Matrix

	Entry	Adoption	Adaptation	Infusion	Transformation
Active	23%	54%	15%	8%	0%
Collaborative	8%	77%	15%	0%	0%
Constructive	0%	92%	8%	0%	0%
Authentic	8%	85%	8%	0%	0%
Goal-directed	38%	46%	15%	0%	0%

Table 4. Evaluation Of Teachers Future (They Intend To Reach) Integration Of Technology In Their Pedagogical Practice, According To The Technological Integration Matrix

	Entry	Adoption	Adaptation	Infusion	Transformation
Active	0%	8%	8%	54%	31%
Collaborative	0%	0%	23%	54%	23%
Constructive	0%	0%	15%	62%	23%
Authentic	0%	0%	15%	31%	54%
Goal-directed	0%	0%	23%	62%	15%

According to the first autonomous work, teachers seems to be aware that they still are in a low level of integration of technologies, as they positioned mostly in the adoption level (Table 1), but they are willing to reach a higher level of integration and they seem to reach the infusion level (Table 2). Considering the adoption level in a constructive way, the teacher provides some opportunities for students to use technology in conventional ways to build knowledge and experience. The students are constructing meaning about the relationships between prior knowledge and new learning, but the teacher is making the choices regarding technology use.

Considering the infusion level in a constructive way, that teachers inspire to reach, the teacher consistently allows students to select technology tools to use in building an understanding of a concept. The teacher provides a context in which technology is supportive of student autonomy in choosing the tools and when they can best be used to accomplish the desired outcomes. In a goal-directed way, the teacher creates a learning context in which students regularly use technology tools for planning, monitoring, evaluating learning activities and the teacher facilitates students' selection of technology tools.

This can be triangulated with teachers' citations they had as justifications of their choices.

> "I want to have a deeper knowledge, to enrich and create moments of true passion for learning."

> "In my opinion, the integration of technology in teaching and learning is very important and it is of obvious advantages, however I believe that this process can not only be controlled by the use of technology."

It's possible to note that teachers are completely motivated to integrate this pilot project in order to change things in their practices, but they have conscious that technology for itself is not sufficient, it has to be accompanied by pedagogical innovation that suits the technology itself and according to the learning aims and not according to the tools potentials.

CONCLUSION

The recognition of the potential of technologies in educational contexts has led the implementation of several initiatives involving programs to integrate ICT in teaching and learning. The Edulab concept intends to be a new educational model aiming at testing new technologies in terms of usability, effectiveness and transformative potential of the teaching process and learning. Its originality and innovative nature are different from similar projects once implemented because this model put the focus not only on the integration of technology in the classroom but also in the training and support of teachers and evaluation of its impacts on teaching and learning, optimizing the technologies and educational formats.

From previous national project results (for example, the "Minerva project", "Nónio-Século XXI" program and the "Mission Team on Computers, Networks and Internet at School"), it is not the technology itself that make the difference. Teachers may have the technology to use in classes but if they don't know how to use it properly, it is a waste of time and money. Given the results discussed above it is possible to conclude the relevance of conducting a training course comprising two different modules: the first (and short) more technological and the second (and long-term) more pedagogical focused on the integration of ICT in the context of teaching and learning of various disciplines of the three cycles of Basic Education (students from 6 to 15 years old). With that training course it was intended to develop new skills in teachers, so that the limitations observed in the first classes of integration of technologies could be solved and that the teachers may have the competences needed to take advantage of that technology available from a pedagogical point of view. As Prensky (2005) mentioned, even if it is guaranteed access to technology in the classroom, this is not a sufficient condition for teachers to integrate into their teaching practice. It is necessary that teachers are willing to use it, putting technology at the service of an educational process with higher quality, which implies the adoption of teaching practices that fit this new model.

In addition, the project intends to encourage, by training teachers, the adoption of educational and performance formats with impact into their teaching practices using innovative strategies, such as the flipped classroom methodology and collaborative work. Taking this into account and according to the defined aims, this research was helpful to identify and characterize a set of teaching strategies developed using technology included in the Edulab. It was also observed that the available technologies, when optimized and accompanied by suitable teaching formats, can be very valuable in the whole process of teaching and learning, turning the classes more dynamic, effective and motivating, contributing to an active and significant learning. This is in accordance to Balanskat, Blamire & Kefala (2006), and Jonassen (2007) that mention that the use of ICT cause a positive impact on the level of motivation and concentration contributing to positive effects on students behaviour and learning, turning it more active, meaningful and lasting.

Monitoring the process

At this stage of the project, we highlight the gradual implementation of strategies that make use of technologies and the gradual diversification of technological resources. Importantly, training teachers and monitoring the process have had a central role, acting as the engines of the project. There are, however, some aspects that need to be improved, including the functioning of some technological features and equipment as well as student access to resources at home, a fact that destabilize the implementation of innovative teaching strategies.

As on the one hand, the monitoring instruments provide significant contributions to the training sessions of the course and, on the other hand, the autonomous work has also been used to monitor the process.

The results obtained so far allow us to state, although in a general way, that the use of technology, when used adequately and associated to strategies to meet the aims of the lessons, has a positive impact on the educational process. However, it is a process that requires time of maturation, because although teachers are apparently very motivated, there is still some resistance to the use of technology when it implies extra time to prepare the classes. The other constraint is that if technology does not work perfectly well, and some fails are detected, it can be a factor of discouragement for teachers.

Future work

During the training course it is previewed peer observation of classes, which can be an innovation if this kind of projects, so that teachers can feel accompanied by their peers, sharing common problems, in order to increase the sense of belonging to a community, while promoting the spirit of mutual help, collaborative work and team spirit.
It is also previewed the application of a questionnaire on students and their parents to have the view of all actors of the process (teachers, students and parents) to triangulate data, so that we may have a wider perspective of the project in order to make decisions to the next school year.

RECOMMENDATIONS

The project aims to find and share 'best practices' on the Edulab in order to inspire other teachers of other schools of different contexts. Through the collection and processing of data to support the outlined goals of the project, we hope to obtain a set of evidences that demonstrate the positive impact of teaching based on Edulab model, and from this develop a "model based on best practice" that can be a support to the implementation of these strategies by other teachers and other school clusters. It shall include the teaching strategies developed using technology used in the Edulab AEGN model, accompanied by educational formats and appropriate actions that may enhance the process of teaching and learning, making it more dynamic, effective and motivator, so that, it can provide support for the implementation of these strategies by other teachers and other schools.

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TECHNOLOGY- BASED TEACHING AND LEARNING: A QUANTITATIVE ANALYSIS ON EFFECTIVENESS OF ICT INTEGRATION IN SCHOOLS

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ABSTRACT: The rapid global technological advancement and development of ICT (Information, Communication, and Technology) has placed teaching and learning processes into a more challenging profession, where teachers are required to integrate technology and replace the traditional teaching methods with a technology-based teaching and learning tools and facilities. This is because, ICT incorporation supports students' learning performance in terms of critical thinking, problem solving and practicing the lessons' main focus through surfing in online resources. In Malaysia, ICT has been included as one of the main elements in transform shift in the latest Malaysian Education Blueprint (2013-2025) as the national education that focus on the future development. The Ministry of Education insights the importance of technology-based teaching and learning into the schools' national curriculum. The main focus of this paper is to identify the effectiveness of ICT integration for teachers and students in teaching and learning in public secondary schools. A survey questionnaire was distributed randomly to the total of 101 teachers from 10 public secondary schools in Kuala Lumpur, Malaysia. The data for this quantitative research were analyzed for both descriptive and inferential statistic using SPSS (version 21) software. The overall findings show that ICT integration has great effectiveness for both teachers and the students. Results show that teachers should always be prepared and well-equipped in terms of ICT competencies and positive attitude to provide technology-based learning opportunities for students to improve their academic outcomes. For the future studies, there is a need for consideration of other aspects of ICT integration especially from management point of view in regard to strategic planning and policy making.

Key words: technology-based teaching & learning, ICT integration, technology effectiveness, education, Malaysia.

INTRODUCTION

In this 21st century, the term "technology" is an important issue in many fields including education. This is because technology has become the knowledge transfer highway to all human beings. Nowadays, majority of people from all age groups know how to use at least a basic form of technology. Technology tools and equipment has become the main medium of connectivity all over the world, and we have the urge and tendency to be connected online.

In education, integration of Information, Communication, and Technology (ICT) refers to the use of computer-based communication that incorporates into daily classroom instructional process. The aim of ICT integration has been pointed "to improve and increase the quality, accessibility and cost-efficiency of the delivery of education, while taking advantage of the benefits of networking learning communities together to equip them to face the challenges of global competition" (Albirini, 2006, p.6). Usually, it included computer hardware and software application to fully support teaching and learning and information resources. Process of adoption of ICT is not a single step, but it is an ongoing and continuous process (Young, 2003). As we are heading into the 21st century education, ICT use in school more specifically in the classroom is crucial because students are familiar with this technology and they will learn better within this environment. ICT integration in education generally means technology-based teaching and learning process that closely related to the utilization of learning technologies in schools. This is due to the result of ICT integration in enhancing effectiveness of teaching and learning process. Moreover, the use of technology in education contributes a lot in the pedagogical aspects in which the application of ICT will lead to effective learning with the help and supports of the ICT elements and components (Jamieson-Procter et al., 2013). It is right to say that almost all ranges of subjects' starts from mathematics, science, languages, arts and humanistic and other major fields can be learned more effectively through technology-based tools and equipment. In addition, ICT provides the help and complementary supports for teaching and learning for both teacher and students where it involves effective learning with the aide of the computers to serve the purpose of learning aids (Jorge et al., 2003). Computers and technology does not acts as a replacing tools but instead they are considered as an add-on to teachers in which it is the supplements needed for better teaching and learning. The use of ICT in education will greatly help the development of teachers as well as the students in terms of attitudes, abilities and skills related to effective use of ICT.

The need for ICT integration in education is crucial because information and communication technology can be used in million ways where it helps both teacher and students to learn about their respective subject area in school as well as own learning can be amend at home with condition that the students really master what they have learn at school. It is not one-stop learning but it is a continual process of learning that discovered a lot of use and benefits from the technology provided (Young, 2003).

A technology- based teaching and learning offers various interesting ways which includes educational videos, stimulation, storage of data, the usage of databases, mind-mapping, guided discovery, brainstorming, music, world-wide web (www) and more that will make the learning process more fulfilling and meaningful (Finger & Trinidad, 2002). On the other hand, students will benefit from ICT integration where they are not bounded to the limited curriculum and resources, instead hands-on activities in the lesson designed for them to be able to stimulate their understanding about the lesson. It also helps teachers to design lesson plans in an effective, creative and interesting approach that would result in students' active learning. Use of ICT in teaching for sure will enhance the learning process and maximizes the students' abilities in active learning.

Hermans, Tondeur, Van- Braak, and Valcke (2008) have identified three main stages for ICT to be highly valued and regarded by the teachers; integration, enhancement and complementary. Integration approach is about implementing right use of ICT in particular subject area that involved complex concepts and skills to improve student's achievement and attainment. Besides, the review of curriculum is also needed so that only related ICT resources and appropriate software will be installed for the main aims and objectives of curriculum to be achieved. Enhancement approach is about using ICT to give great emphasize on the topic introduced. For instance, Microsoft PowerPoint can be used to present the topic in a very innovative and creative way that will lead into discussion and exchanging ideas and thoughts. Finally, complementary approach is when the ICT is used to aid and support the student's learning. This approach allow students to be more organized and efficient in which they can take obtain the notes from computer, submit their works by email from home as long as they meet the deadline and looking for information from various sources provided online to fulfil the task given to them (Hermans et al., 2008) .

Technology-based teaching and learning can make many changes in school that requires for proper planning and policy making. Researchers and policymakers must both have the same insight about the future plan. Dudeney (2010) noted that national ICT policies can serve several crucial functions. They provide a rationale, a set of goals, and a vision of how education systems run if ICT is integrated into teaching and learning process, and they are beneficial to students, teachers, parents and the general population of a given country. Ministry of Education Malaysia has formulated three main policies for ICT in education. The first policy insists on all students are given opportunity to use ICT. This is aimed to reduce the digital gap amongst the schools. The second policy focuses on the role and function played by ICT in education. Besides that, another policy stressed on the use of ICT for accessing information, communication and as productivity tool (Chan, 2002).

However, infrastructure and facility of ICT is then needed to supply to the schools throughout the nation. A key factor in use of ICT is sufficient computer labs and ICT equipment. This is to ensure that subject teachers are easily access to ICT tools whenever needed (Hennessy, Ruthven, & Brindley, 2005). Lack of adequate ICT equipment and internet access is one of the key problems that schools specifically in rural areas are facing now. For example, results of a research shows that in Kenya, some schools have computer but this could be limited to one computer in the office only. Even in schools with computers, the student-computer ration is high. In addition, the report continues revealed that the schools with ICT infrastructure are supported by parents' initiative or community power (Chapelle, 2011).

In most schools, technical difficulties sought to become a major problem and a source of frustration for students and teachers and cause interruptions in teaching and learning process. If there is lack of technical assistance and no repair on it, teachers are not able to use the computer for temporarily (Jamieson-Proctor et al., 2013). The effect is that teachers will be discouraged from using computers because of fear of equipment failure since they are not given any assistance on the issue. Türel and Johnson's study (2012) revealed that technical problems become a major barrier for teachers. These problems include low connectivity, virus attack and printer not functioning. However, there are a few exceptions. Schools in the countries like Netherland, United Kingdom and Malta have recognized the importance of technical support to assist teachers to use ICT in the classroom (Yang & Wang, 2012).

In addition, teachers' readiness and skills in using ICT are playing essential role in the use of ICT in education. Teachers need sufficient ICT skills to function the technology and to have high confident level to use it in a classroom setting. Besides, teachers require insight into the pedagogical role of ICT, in order to use it meaningfully in their instructional process (Hennessy et al., 2005). According to Winzenried, Dalgarno and Tinkler (2010) teachers who have gone through ICT course are more effective in teaching by using technology tools as opposed to those that have no experience in such training. A school in Ireland reported that teachers who did not develop sufficient confidence avoided using ICT. Similar case happened in Canada, some teachers admitted they were reluctant ICT users because they worried they might get embarrassed that the students knew more about the technology than they did (Hennessy et al., 2005).

Beyond basic skill training, schools had used a variety of strategies to provide further professional development for teachers. According to Warwick and Kershner (2008) the significance and advantages of ICT should be known by teachers in order to conduct a meaningful lesson with the use of ICT. Indeed, teachers should be sent to attend training courses to learn about integration ICT in teaching and learning process. Nonetheless, many school schools used peer-tutoring systems. A more skillful teacher in ICT would assist and guide another teacher who has less experience with ICT along the preparation work for teaching and learning process.

As what has been discussed, there are many factors to enable the use of ICT in classroom teaching and learning. Begin with policy, follows by the supplement of all the ICT hardware and software facilities, continued by readiness and skills of teacher to integrate it into pedagogical process (Agbatogun, 2012). Besides, technical support and continuous professional development in ICT should be conducted from time to time. In short, all parties must cooperate in order to bring the nation to become a country advance in technology.

The main purpose of this study is to analysis the effectiveness of ICT integration in. Specifically, this study aims to identify; (I) the effectiveness of ICT integration form teaching and learning perspectives and (II) the effective elements of ICT integration in teaching in public schools in Kuala Lumpur.

Teachers' Belief on Technology-based Teaching & Learning

With the development of learning technologies in the late 20th century, education system has changed rapidly. This is due to the capability of technology to provide a proactive, easy access and comprehensive teaching and learning environment. Nowadays, Ministry of education in all over the world has provide a lot of facilities and training in order to enhance the use of advanced technologies in the countries' teaching and learning process. A high budget has been placed in order to provide the equipment needed by teachers to improve the education system. Despite all the efforts, most of the countries are facing similar problem whereby the teachers are not maximizing the usage of the technology provided (Albirini, 2006). This has become a serious matter as many previous researches have proven the usage of ICT in teaching and learning process could improve students' achievement (Nakayima, 2011, Jamieson-Proctor et al., 2013). Many, researchers have taken an effort to analyse the factors that affecting teachers' acceptance of ICT usage in the classrooms (Capan, 2012; Virkus, 2008; Zhang, 2013; Dudeney, 2010). It shows that, the major barrier of the implementation was the teachers' belief as the teachers are the person who implements the change in their teaching and learning process. Moreover, previous research (Cassim & Obono, 2011) shows that the correlation of teachers' belief and the use of ICT are high. Teachers' role is getting more important especially in usage of ICT in pedagogy which could increase the achievement of the students, their creativity and thinking skills.

Furthermore, a research by Chien, Wu and Hsu (2014) has shown that students in school are having high expectation on ICT integration in classroom as the new generation are born and grown with technologies and could be define as the digital – native phenomenon. The younger the students, the higher their expectation are on ICT integration in classroom. It also proved that the integration of ICT is mostly dependent on the personal factors which define as self-perceptions. This research also shows that the acceptance of ICT of teachers and students in classroom and outside of classroom whereby both are more likely to use technologies outside the classroom. They found that the barriers of ICT integration in classroom are confidence, competence and attitudes of teachers reduce the percentage of ICT integration.

Results of a previous research (Cox & Marshall, 2007) shows that teachers only need a traditional – centered approach when developing ICT skills in the classroom. The teachers are having high confidence and competency in using ICT in classroom even though it does not represents the types of ICT used. This is because they believe that ICT is a tool could help in learning process especially to relate with real life practices. This factor has reform the teaching method to integrate ICT in order to create and construct knowledge for the students. The research shows that the relationship between competency and confidence could reflect the balances between training and pedagogically focused approaches in ICT professional development. With this, the school management could make sure that there are sufficient supports for the teachers to integrate ICT in the classroom.

However, teachers' efficacy in urban schools changes as the years of experience of working and age of teachers (Cuban, 2001). It shows that the teachers' efficacy are decreasing as the years of experience and age increases but somehow the decrease and the efficacy belief depend on the school management. School management here means the opportunities for collegial interaction, and the use of the instructional resources. Schools that could provide opportunities for teachers to reflect on teaching and learning with their colleagues and for administrators and teachers to collaborate and communicate, as well as support the use of instructional resources. From this research, the teachers efficacy belief is depend on the school management and culture. Therefore, if the school has always implant the culture to change and teachers are always sent for training for upgrading themselves, and then the integration of ICT in classroom will be easier to be enhanced in the classroom.

Integration of ICT in the Malaysian Context

The integration of ICT in classroom is getting more important as it help student in enhancing their collaborative learning skills as well as developing transversal skills that stimulates social skills, problem solving, self-reliance, responsibility and the capacity for reflection and initiative. All these elements are core values that students need to achieve in an active teaching and learning environment (Ghavifekr et al., 2014).

Similarly, in Malaysia the government has implemented the integration of ICT in learning and teaching process in early 1970's. This is due to the importance of technology literate which produce critical thinking workforce to face and involve the country in the global economy (Hamidi, Meshkat, Rezaee, & Jafari, 2011). Accordingly, many schools were upgraded with computer's lab, the internet connection, smart white boards, LCD and other ICT tools and equipment. Despite all these, the problem faced was the teachers' skill and aptitude, technical support and stability of the system in order to implement the policy successfully. However, the government is still improving and upgrading the systems to be fully utilising by ICT. As a developing country, exploration of the factors that affecting Malaysian teachers' ICT usage in schools can help to increase the integration of ICT in country's teaching and learning process.

The Ministry of Education launched a comprehensive review of the education system in Malaysia in October 2011. In order to raise the education standards, government developed a new national education blueprint; the latest one is the Education Blueprint 2013-2025. This blueprint provides the plan for the sustainable educational transformation of the Malaysia education system until 2025 (Ministry of Education, 2012). This document also includes the plan to raise the role of ICT in the whole education system. In order to complete the transformation mission, Blueprint proposed 11 strategic and operational shifts.

ICT has been mentioned on the 7th shift , which requires scaling up quality learning in Malaysia by providing internet access and virtual learning environment via 1BestariNet for all schools in Malaysia by 2013 (Ministry of Education, 2012). It ensures possibilities of maximizing the implementation of ICT for self-guided learning.

In line with global attempts on the deeper needs of educational performance, incompetence of teachers and inadequateness of hardware and software was also recognized by the Malaysian education authority (Education and Manpower Bureau, 2008). It indicates that the ICT culture in schools should be improved with using ICT among teachers in terms of training (Hussain, Morgan, & Al-Jumeily, 2011).The main goal of ICT implementation in education proclaimed the vision and missions of the government to promote ICT in education for the following intentions:

1) To surround schools with dynamic and innovative learning environments for students to become more motivated and creative;

2) To enable students to gain wider range of knowledge and be able to access to internet for developing a global outlook;

3) To nurture students with capabilities of processing information more effectively and efficiently; and

4) To develop students with attitudes and capability of life-long learning

The new era of ICT in education should be developed rapidly to appropriate extent in order to matching the capability of students as well as teachers in educational experience due to the development of new information technology. Results of a study by Abd Rahim and Shamsiah (2008) suggest that trainee teachers in Malaysia have confidence to integrate ICT in their teaching practices. And the male teachers are more confident than female teachers in using ICT integration in teaching. Moreover it shows that vocational teachers are more confident to integrate ICT in teaching, because they can handle technical subjects and their experience enable them to integrate ICT effectively in teaching (Abd Rahim & Shamsiah, 2008; Yunus, 2007). Furthermore, only minority of teachers in Malaysia professionally know the basic of ICT. The majority of them just had average knowledge in ICT, and even a group of the teachers are poor in the related knowledge of ICT in Malaysia (Rosnaini & Mohd Arif, 2010). It indicates that level of ICT knowledge among teachers is one of the key factors for Malaysia society to make successful adoption of ICT in its education.

METHOD

Research Design

In this research, quantitative methodology was used to collect and analyse the data obtained from all the respondents. The researchers developed the questionnaire and finalized it before being distributed to the targeted group of respondents. Few sections on the questionnaire were designed specifically to address research objectives in regard with the effectiveness of ICT integration for students in learning and effective elements of ICT integration in public school in Kuala Lumpur. Therefore, the questionnaire was distributed to obtain the data from the respondents.

Population and Sampling

The overall total of respondents for this research was 101 teachers from public primary and secondary schools in Kuala Lumpur. The questionnaire was randomly distributed to the respondents with teaching background regardless of gender, race, teaching experience as well as highest teaching experience. There are no preferences set by the researchers as long as the respondents come with teaching background especially in public primary and secondary school in Kuala Lumpur. Since the targeted respondents for this research are meant for individuals with teaching background, the researchers tried to get especially teachers from public primary and secondary schools in Kuala Lumpur to be part of this research. Hence, the questionnaires distributed are not equal in numbers where teachers from secondary schools dominate the overall population as compared to teachers from primary schools.

Instrument

A survey questionnaire with a total of 43 items was used as the main instrument in this study to analyse the effectiveness of ICT integration in teaching and learning in public schools in Kuala Lumpur. A total of 101 questionnaires were distributed where all respondents were asked to read the statements given and choose their answers based on 4-Likert scale ranged from 4= Strongly Disagree, 3= Disagree, 2= Agree and 1= Strongly Agree. The questionnaires were consist of 4 sections. Section A is about the demographic background of the respondents consists of 8 items that includes gender, race, teaching experience, type of school, school area, preference of teaching style, highest academic qualification and the ability of handling ICT in teaching. The other 3 sections in the questionnaire focus more into teacher's perception and the elements of effectiveness of ICT integration in schools. Section B comes with 15 items that looks into teacher's perception of ICT in teaching , section C consists of 10 items that looks into the effectiveness of ICT integration for students in learning meanwhile section D comes with 10 items that looks into the effective elements of ICT integration in teaching . The questionnaire used for this quantitative study was adopted and modified from the original questionnaire designed by Gulbahar and Guven (2008) that is considered suitable for this research. Some of the items are designed and developed by the researchers accordingly with the title chosen so that the items developed are able to provide the answers needed for both research questions.

Data Collection Procedure

The researchers modified the questionnaire before it is being finalized and distributed to the target group of respondents. Then, each researcher takes up 50 and 51 questionnaires respectively that made a total of 101 questionnaires being distributed to all respondents. The data was collected within 2 weeks through random distribution and some of the questionnaires were sent to respondents email. The respondents were given 3-5 days to complete the questionnaire and send it back to the researcher for data analysis. After 2 weeks, all the complete filled-up questionnaires were gathered and collected for further data analysis by the researcher to get the output and findings for the research.

Data Analysis Process

All the data collected from the respondents were gathered together to be analysed using Statistical Package for the Social Sciences (SPSS) version 21. The analysis includes both descriptive and inferential analysis. The researchers used descriptive analysis to analyse the frequency and percentage of the overall population in the demographic background. Besides, it is also used to determine the mean, standard deviation, frequency and percentage to identify the effectiveness of ICT integration for students in learning as well as the effective elements of ICT integration in teaching in public schools in Kuala Lumpur.

RESULTS AND FINDINGS

The findings of this research will give the output needed by the researchers to answer the research questions. The findings are done according to the sections in the questionnaire and some inferential analysis that includes reliability testing and Mann-Whitney U testing is also conducted towards the overall data.

Table 1. Demographic Background of Respondents

Factors	Frequency	Percentage (%)
Gender		
Female	82	81.19
Male	19	18.81
Race		
Malay	36	35.64
Indian	22	21.78
Chinese	39	38.61
Others	4	3.96
Teaching Experience		
<1 year	20	19.8
1-5 years	36	35.64
6-10 ears	34	33.66
>10 years	11	10.89
Type of School		
Primary	37	36.63
Secondary	64	63.37
School Area		
Urban	79	78.22
Rural	22	21.78
Preference of Teaching Style		
Conventional/Traditional	42	41.58
Modern/Contemporary (Use of ICT)	59	58.42
Highest Academic Qualification		
Diploma	10	9.9
Degree	63	62.38
KPLI	19	18.81
Master	9	8.91
The Ability of Handling ICT in Teaching		
High	25	24.75
Medium	67	66.34
Low	9	8.91

From the overall population (n=101) based on gender, there are 82 female respondents with a percentage of 81.19% as compared to only 19 male respondents with 18.81%.

From the overall population based on race, the highest frequency of respondents are Chinese with a total 39 (38.61%) followed by Malay with 36 (35.64%), then Indian with 22 (21.78%) and also others with 4 (3.96) specified as 1 Dusun, 2 Iban and 1 Melanau whom referred as an Ethnic race in Sarawak.

From the overall population based on teaching experience, most of the respondents have 1-5 years of teaching experience with 36 (35.64) followed by 6-10 years of experience with 34 (33.66%), then < 1 year of teaching experience with 20 (19.8%) and 11 respondents with > 10 years of teaching experience with 11 (10.89%).

From the overall population based on type of school, there are 64 respondents who are teaching in secondary school with 64 (63.37%) as compared to primary school with 37 (36.63%).

From the overall population based on school area, there are more respondents who are teaching in city school area with 79 (78.22%) as compared to respondents who are teaching in rural school area with 22 (21.78%).

From the overall population based on preference of teaching style, more respondents preferred modern/contemporary teaching style with 59 (58.42%) as compared to respondents who preferred conventional/traditional method of teaching with 42 (41.58%).

From the overall population based on highest academic qualification, most of the respondents come with degree qualification with 63 (62.38%), followed by KPLI (Post-Degree Teacher's Training) with 19 (18.81%), then diploma qualification with 10 (9.9%) and respondents with master qualification with 9 (8.91%).

From the overall population based on the ability of handling ICT in teaching, most of the respondents believe it that they possess medium ability with 67 (66.34%) followed by high ability in handling ICT with 25 (24.75%) and low ability with 9 (8.91%).

Teachers' Perception on Technology-based Teaching & Learning

Table 2. Teacher's Perception of ICT Integration in Teaching

NO	STATEMENT	STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE	MEAN	S.D
		Frequency and Percentage (%)					
1.	I feel confident learning new computer skills.	0	6 (5.9%)	70 (69.3%)	25 (24.8%)	1.81	0.52
2.	I find it easier to teach by using ICT	0	12 (11.9%)	70 (69.3%)	19 (18.8%)	1.93	0.55
3.	I am aware of the great opportunities that ICT offers for effective teaching.	0	8 (7.9%)	57 (56.4%)	36 (35.6%)	1.72	0.60
4.	I think that ICT supported teaching makes learning more effective.	1 (1%)	8 (7.9%)	54 (53.5%)	38 (37.6%)	1.72	0.65
5.	The use of ICT helps teachers to improve teaching with more updated materials.	1 (1%)	6 (5.9%)	56 (55.4%)	38 (37.6%)	1.70	0.63
6.	I think the use of ICT improves the quality of teaching.	1 (1%)	8 (7.9%)	61 (60.4%)	31 (30.7%)	1.79	0.62
7.	I think the use of ICT helps to prepare teaching resources and materials.	1 (1%)	10 (9.9%)	59 (58.4%)	31 (30.7%)	1.81	0.64
8.	The use of ICT enables the students' to be more active and engaging in the lesson.	0	9 (8.9%)	58 (57.4%)	34 (33.7%)	1.75	0.61
9.	I have more time to cater to students' need if ICT is used in teaching.	0	26 (25.7%)	55 (54.5%)	20 (19.8%)	2.06	0.68

10.	I can still have an effective teaching without the use of ICT.	3 (3%)	19 (18.8%)	58 (57.4%)	21 (20.8%)	2.04	0.72
11.	I think the use of ICT in teaching is a waste of time.	24 (23.8%)	48 (47.5%)	27 (26.7%)	2 (2%)	2.93	0.76
12.	I am confident that my students' learn best without the help of ICT.	12 (11.9%)	63 (62.4%)	23 (22.8%)	3 (3%)	2.83	0.66
13.	The classroom management is out of control if ICT is used in teaching.	23 (22.8%)	54 (53.5%)	22 (21.8%)	2 (2%)	2.97	0.73
14.	Students' pay less attention when ICT is used in teaching.	24 (23.8%)	54 (53.5%)	23 (22.8%)	0	3.01	0.69
15.	Students' makes no effort for their lesson if ICT is used in teaching.	23 (22.8%)	56 (55.4%)	20 (19.8%)	2 (2%)	2.99	0.71

From the data obtained above about teacher's perception of ICT in teaching , it shows that most teachers are aware of the goodness and usefulness of ICT in teaching. Most teachers realized that the use of ICT helps teachers to improve teaching with more updated materials that shown the lowest mean of 1.70. It is undeniable that teaching resources and materials provided online are more updated and teachers can refer to it in order to design more interesting and engaging lesson for students.

Besides, most teachers agreed that the use of ICT will definitely provide lots of opportunities for an effective teaching as well as ICT supported teaching makes learning more effective with the sharing mean of 1.72. This situation shows that teachers view the use of ICT in teaching and learning process as something positive where ICT is the aid needed by teachers to ensure the effectiveness of both teaching and learning process.

Next, from the data obtained, it also shows that the use of ICT in teaching enable the students to be more active and engaging in the lesson prepared by the teachers with score mean of 1.75. This is because students are familiar with ICT and they find it easier learning by ICT and allows them to be engage more in the lesson.

Teacher's familiarity and competency in handling ICT also obtained from the data where the mean of 1.81 shows that most teachers feel confident learning new computer skills and they are able to use ICT to find teaching materials and resources. In this context, it shows that teachers are open towards the use of ICT in teaching, not being resistant and feels comfortable in learning new things.

Other than that, teachers believe that it is easier to teach by using ICT with the mean score of 1.93 but at the same time, they still believes in the conventional way of teaching where teachers are the centre of learning and stated that they can still have an effective teaching without the use of ICT with recorded mean of 2.04.

On the other hand, most teachers disagrees that the use of ICT allows them to cater to students need with score mean of 2.06 because of clerical works and other works that needs to be completed other than teaching responsibility. The use of ICT just makes it easier for them to teach but other things in school remain the same.

Most teachers believe that the use of ICT benefits teaching and learning in various ways and saying that ICT integration is not a waste of time with total mean of 2.93. However, there are also negative part of ICT integration where the result shows that classroom management is out of control when ICT is used in teaching with mean of 2.97, followed by students make no efforts for their lesson and learning process with score mean of 2.99 and most teachers agreed that the use of ICT in teaching only cause students' to pay less attention with the highest mean recorded of 3.01 which shows teacher's less acceptance towards ICT integration due to student's attitude whom being too dependent on ICT and not taking responsibility for their own independent learning which frustrating and disappointing the teachers.

Effectiveness of Technology-based Teaching & Learning for Students

Table 3. Effectiveness of ICT Integration for Student's Learning

NO	STATEMENT	STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE	MEAN	S.D
		Frequency and Percentage (%)					
1.	ICT allows students' to be more creative and imaginative.	1 **(1%)**	7 **(6.9%)**	64 **(63.4%)**	29 **(28.7%)**	1.80	0.60
2.	The use of ICT helps students to find related knowledge and information for learning.	1 **(1%)**	4 **(4%)**	61 **(60.4%)**	35 **(34.7%)**	1.71	0.59
3.	The use of ICT encourages students to communicate more with their classmates.	11 **(10.9%)**	0	63 **(62.4%)**	27 **(26.7%)**	1.84	0.60
4.	The use of ICT increases students' confidence to participate actively in the class.	10 **(9.9%)**	0	65 **(64.4%)**	26 **(25.7%)**	1.84	0.58
5.	I think students learn more effectively with the use of ICT.	6 **(5.9%)**	0	60 **(59.4%)**	35 **(34.7%)**	1.71	0.57
6.	I think the use of ICT helps to broaden students' knowledge paradigm.	8 **(7.9%)**	0	54 **(53.5%)**	39 **(38.6%)**	1.69	0.61
7.	I think the use of ICT helps to improve students' ability specifically in reading, writing.	10 **(9.9%)**	0	53 **(52.5%)**	38 **(37.6%)**	1.72	0.63
8.	The students' are more behaved and under control with the use of ICT.	2 **(2%)**	16 **(15.8%)**	51 **(50.5%)**	32 **(31.7%)**	1.88	0.74
9.	The use of ICT enables students' to express their ideas and thoughts better.	3 **(3%)**	13 **(12.9%)**	47 **(46.5%)**	38 **(37.6%)**	1.81	0.77
10.	The use of ICT promotes active and engaging lesson for students' best learning experience.	1 **(1%)**	6 **(5.9%)**	53 **(52.5%)**	41 **(40.6%)**	1.67	0.63

The results obtained from the data in section C that would want to examine the effectiveness of ICT integration for students in learning shows that the use of ICT promotes active and engaging lesson for students' best learning experience with recorded of the lowest mean score of 1.67. In the previous section, most teachers agreed that the use of ICT enables the students to be more active and engaging in the lesson. This shows that both teachers and students agreed that the use of ICT provide the chances for students to be active and take more parts or roles for their best learning experience.

The use of ICT also helps to broaden student's knowledge paradigm with mean score of 1.69 where students are able to integrate their prior knowledge into the current learning systems as well as sharing and exchanging point of view with the teachers and classmates. ICT helps to provide latest and current issues where students can obtain it very easily and integrate it into their learning process.

Besides, ICT helps students to learn more effectively as well as it helps students to find related knowledge and information for learning with shared mean of 1.71. The technology always acts as a medium for students to find related knowledge and information for their learning. It is best when the students are able to gather information, relate it back with what they have learnt and have a discussion on the information with teachers and their classmates so that they can see the relation of what is new and what the latest issues they need to catch up for effective learning.

Other than that, there a lot of educational videos provided for students online which it helps to improve student's ability in language learning skills such as reading, writing, listening and speaking with total mean of 1.72. It is good for students to watch videos and learn from it so they can gather the confidence needed when it comes to argumentative issues in the classroom where they are able to provide clear clarification and their judgments on certain issues. The use of ICT also allows students to be more creative and imaginative with mean score of 1.80 followed by their ability to express their ideas and thoughts better with mean of 1.81. This shows that the use of ICT enhances students thinking and enables them to think out of the box and make the best use of their learning process.

The result shows that the effectiveness of ICT for students in learning are it encourages students to communicate more with their classmates as well as it increase the students confidence to participate actively in the class with shared mean of 1.84. It is effective in a sense that students are occupied with adequate knowledge that enables them to be more confident in sharing and exchanging their opinion with their classmates. Lastly, it shows that students are more behaved and under control with the use of ICT in learning but it is also considered as fewer acceptances by teachers as the score mean is the highest of all with 1.88. This might give the ideas to teachers that students are a little bit out of control when ICT is used in teaching as teachers are not the main focus of learning process.

Effective Elements in Technology-based Teaching and Learning in Schools

Table 4. Effective Elements in ICT Integration in Teaching and Learning in Public Schools

NO	STATEMENT	STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE	MEAN	S.D
		Frequency and Percentage (%)					
1.	The ICT facilities in my school are well-functioning and can be used.	34 **(33.7%)**	36 **(35.6%)**	22 **(21.8%)**	9 **(8.9%)**	2.94	0.96
2.	The technical supports are provided if teachers are faced with difficulties.	29 **(28.7%)**	36 **(35.6%)**	26 **(25.7%)**	10 **(9.9%)**	2.83	0.96
3.	Little access to ICT prevents me from using it in teaching.	3 **(3%)**	16 **(15.8%)**	62 **(61.4%)**	20 **(19.8%)**	2.02	0.69
4.	Lack of supports from the school top management discourage me from using ICT.	6 **(5.9%)**	20 **(19.8%)**	51 **(50.5%)**	24 **(23.8%)**	2.08	0.82
5.	Teaching time are not enough for me to use the ICT for teaching and learning purposes.	1 **(1%)**	21 **(20.8%)**	53 **(52.5%)**	26 **(25.7%)**	1.97	0.71
6.	There is enough training and professional development provided for teachers about ICT use in teaching.	19 **(18.8%)**	57 **(56.4%)**	17 **(16.8%)**	8 **(7.9%)**	2.86	0.81
7.	All ICT tools in my school go to waste and less used by teachers.	6 **(5.9%)**	21 **(20.8%)**	39 **(38.6%)**	35 **(34.7%)**	1.98	0.89
8.	Teachers are given more time to learn and be comfortable with the use of ICT in teaching.	25 **(24.8%)**	55 **(54.5%)**	17 **(16.8%)**	4 **(4%)**	3.00	0.76
9.	There is computer lab in my school in which I can bring students there to watch educational videos.	28 **(27.7%)**	34 **(33.7%)**	29 **(28.7%)**	10 **(9.9%)**	2.79	0.96
10.	Teachers' are given the freedom to design their own teaching with the helps from the ICT.	26 **(25.7%)**	33 **(32.7%)**	33 **(32.7%)**	9 **(8.9%)**	2.75	0.94

From the data obtained, it shows that teaching time are not enough for teachers to use the ICT for teaching and learning purposes with score mean of 1.97. It means there is no unhurried times provides for teachers so that teachers can at least use ICT for effective teaching and learning process. It is good if teachers are given more time to teach so that ICT integration in teaching can be a success.

Most teachers agreed that all ICT tools provided for their school goes to waste with mean of 1.98 due to teachers lack of knowledge and skills in using it. Sometimes, ICT facilities are completely provided but little access to ICT prevents teachers from using it in teaching with score mean of 2.02.

Some teachers feels the urge and motivated to use ICT in teaching but there is lack of supports from the school top management that hinder and discourage them from using ICT with mean of 2.08. The school top management must provide an encouragement for teachers to use ICT in teaching and convince them that ICT can benefits both teaching and learning process.

Besides, teachers are not given the freedom they need to design their own teaching with the helps they received from ICT with a total mean of 2.75. Some schools are not provided with at least computer laboratory in which students will get the chances to integrate the use of ICT in their learning process that shown mean score of 2.79. Teachers must be given the freedom to design their own teaching and make full use of ICT but they must be remembered to keep it in track with the curriculum designed by the Ministry of Education (MOE).

Technical supports if teachers are faced with difficulties as well as training and professional development are less provided for teachers about ICT use in teaching with the score mean of 2.83 and 2.86 respectively. The school top management must find ways to provide enough technical supports as well as training and professional development for teachers in order to ensure success implementation of ICT in teaching.

Other than that, ICT facilities provided in school are not well functioning and in not a good condition as it is not being used by teachers with the mean of 2.94 and there is no maintenance to make sure the facilities are well taken care of by the schools management. Finally, the worst findings shows that teachers are not given enough time to learn and to be comfortable with the use of ICT in teaching with the highest mean recorded at 3.00. It is better if teachers are given time to learn and be comfortable with ICT for them to explore its use and make the best use of it.

The overall findings shows that there is none effective elements identified from the data collected regarding the effective elements of ICT integration in teaching and learning in public schools in Kuala Lumpur. However, the researchers made up of some suggestions and recommendations for teachers and school top management to cater to this issue found from the research conducted towards teachers.

Hypothesis Testing

In this study, the Mann-Whitney U Test is used to test the hypothesis developed by the researcher. The test is used to compare the differences between two independent groups towards one dependent variable. Mann-Whitney U Test is used as an inferential analysis by the researcher to test the null hypothesis created by the researcher. Mann-Whitney U Test is used for comparing the efficacy of two treatments in clinical trials where it often presented as an alternative to a t-test when the data are not normally distributed (Hart, 2001).

H01 - There is no significance difference between teachers' perception of ICT in teaching with the type of school (Primary & Secondary)

Table 5. Mann-Whitney U-test between Teacher's Perception of ICT Integration and School's Type

	Type of School	N	Median	Range	Mean Rank	Mann-Whitney U	P
Score_B	Primary	37	2.33	2.20-2.33	59.89	855.00	0.02**
	Secondary	64	2.20	1.95-2.33	45.86		

** Significant P < 0.05

From the result, it shows that there is significance difference between teachers' perception of ICT with type of school (Mann-Whitney U= 855, P= 0.02) where primary school scored higher median (2.33) and mean rank (59.89) as compared to the secondary school with median (2.20) and mean rank (45.86). Hence, the null hypothesis is rejected and alternative hypothesis is accepted.

H02 - There is no significance difference between the effectiveness of ICT integration for students in learning with the school area (City & Rural)

Table 6. Mann-Whitney U-test between The Effectiveness of ICT Integration for Students in Learning with School Area

	School Area	N	Median	Range	Mean Rank	Mann-Whitney U	P
Score_C	City	79	1.60	1.40-2.00	46.92	547.00	0.01**
	Rural	22	2.00	1.60-2.35	65.64		

** Significant $P < 0.05$

From the result, it shows that there is significance difference between the effectiveness of ICT integration for students in learning with school area (Mann-Whitney U= 547, P= 0.01) where school in rural area scored higher median (2.00) and mean rank (65.64) as compared to the school in city area with median (1.60) and mean rank (46.92). Hence, the null hypothesis is rejected and alternative hypothesis is accepted.

DISCUSSION & CONCLUSION

The results of this study show that technology-based teaching and learning is more effective in compare to traditional classroom. This is because, using ICT tools and equipment will prepare an active learning environment that is more interesting and effective for both teachers and students. The results are in line with a research findings by Macho (2005) that proved using ICT in education would enhance students' learning. However, most of teachers in this study agree that ICT helps to improve classroom management as students are well-behaved and more focused. Moreover, this study proved that students learn more effectively with the use of ICT as lesson designed are more engaging and interesting. Accordingly, the participants agreed that integrating ICT can foster students' learning.

Results of a study by Zhang (2013) show that the Internet Use in EFL Teaching and Learning in Northwest China and the findings indicated that teachers have positive attitude regarding the use of Internet in teaching and learning; teachers have some knowledge about Internet use in teaching and learning; they have not well integrated Internet into teaching and learning so far; teachers' knowledge about ICT and network technology is very limited. Likewise, the first two points were similar to the findings of this research, which most of teachers think ICT integration for students in learning is effective. Because students can develop the confidence to have better communication and able to express their thoughts and ideas; ICT helps students to be more creative and imaginative as their knowledge paradigm expend; and ICT helps students to possess all four skills in learning when they are able to acquire necessary information and knowledge. However, this study finds that public school teachers in Kuala Lumpur, Malaysia are not given enough time to learn and be comfortable with ICT.

In compare to a study conducted by Tazci (2011) that shows most of pre-service teachers indicated that they only implicate elementary ICT tools for educational use , this study found that most teachers think ICT integration is effective, but ICT tools provided in school are not enough nor in good condition; training and professional development are not adequately provided for teachers; technical supports are somehow provided but can be improved from time to time; and not very good condition of computer lab in school with well-functioning tools and facilities.

In conclusion, the very first stage of ICT implementation must be effective to make sure that, teachers and students are able to make the best use of it. Thus, preparations of a technology-based teaching and learning begin with proper implementation and supports by the school top management. If the implementation process of technology integration in schools take place appropriately from the very beginning stage and the continuous maintenance are adequately provided, ICT integration in schools will result in a huge success and benefits for both teachers and students. The use of ICT especially in teaching and learning is more about practicality as compared to theories and that is why teachers must be given time to learn and explore it, face the "trial-and-error" phase before they are completely comfortable with its usage and able to make use of it for teaching and learning.

Finally, the integration of ICT in classroom needs serious consideration in order to increase the competency of the country's education system. This will help in increasing the world ranking of the national education and produce the better future work force. In order to enhance the use of ICT in classroom, the government needs to improve and change the teachers' belief about the integration of ICT in classroom. As the teachers' role is the key role in making any of the new policy to be implemented efficiently and successfully. The changes that is taking place is driven by advanced technology and communication devices that should be available to students wherever they are either at school or home. In addition , the needs for teachers to be literate and have good skills and knowledge in using ICT to improve their teaching methods and approach is desired to promote effective learning as well as to meet the demand of the 21st century teaching skills .

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IMPACT OF ENCRYPTED MULTIPLE CHOICE EXAM ON STUDENT SUCCESS

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ABSTRACT: Due to the rapid advancement of technology, the science of cryptography increasingly gained importance. Basically, the encryption algorithms used to encrypt the message or data. This work is motivated from *ÖSYM* (National University Entrance Exam of Turkey in 2011). The main aim of this study is to analyse the impact of encrypted multiple choice exam on students' success in Computer I course which is offered to Faculty of Law at Cyprus International University. Therefore, the study uses the results of an encrypted and non-encrypted multiple choice exam used in Computer I course. Encrypted multiple choice exam involves individual question sheets for each student having their own answer keys. For this reason, the original exam questions were arranged differently for each student. Thus, a separate answer key is created for each one of the students. While there were 150 students who took the course in fall 2011-2012, there was no assigned priority to any of the questions. In the implementation, the generated one-time pads (keys) are permutations of *n* numbers where *n* was the number of questions. This paper aims to compare effect of encrypted exam with non-encrypted exam results on different groups of students' success, using descriptive and inferential statistics. It is aimed to measure whether or not there is a correlation between the encrypted and non-encrypted exam results.

Key words: cryptography in education, encrypted exams, assessment in education, assessment methods to measure student success

INTRODUCTION

There are several studies searching the effect of examination types on students' success such as effect of assement techniques on programming courses are analyzed in (Yurtkan, K. Kaziımoglu C. Tekguc, U., 2014) and (Kaziımoglu, C. Tekguc, U. Yurtkan, K., 2014).

Multiple choice questions are generally generated from a list of questions. To prevent cheating, several booklets are prepared by shuffling the questions. There are some tools that generates tests from a databank of static questions (Fong, A.T. Siew, H.H. Yee, P.L. Sun, L.C., 2007). This online assesment system adaptively selects question indices. Another type of automatic question generation is based on estimating students' profile. Both of above systems require authoring and storing huge number of questions. Uğurdağ et. al. (Ugurdag, H. F. Argalı, E. Eker, O. E. Basaran, A. Gören, S. Ozcan, H., 2009) developed a tool that dynamically generates questions based on some parameters to have myriad number of question versions. This system also works online.

This study is motivated from the national university entrance exam of Turkey in 2011 (*ÖSYM*). Same questions were used for all students' booklets having different answer keys. The examination was a written exam and it was performed in classrooms. Similarly, the encrypted multiple choice exam also uses same questions and individual answer keys are generated for all booklets.

Students' results of encrypted and non-encrypted multiple choice examinations are compared and analyzed using descriptive and inferential statistics.

CRYPTOLOGY

Cryptography and cryptanalysis are two main fields of cryptology. Cryptography deals with the encryption of messages and data. Encryption algorithms are classified as symmetric and asymmetric encryption methods (Kodaz, H. Botsallı, F.M., 2010). Symmetric encryption uses single key and asymmetric encryption method uses two keys, general key and special key, for encryption and decryption. Cryptanalysis is the study of decryption or analysis of encrypted message. The first crypto system was used by Julius Caesar (Şahin, M. Ekin, A.B., 2011). Caesar encryption is one of the basic encryption method which based on the modular arithmetic. The process of encrypting a message in Caesar encryption can be performed by shifting the letters of an alphabet. An encryption of a letter *x* with key *k* is performed with encryption function (1) and the decryption of same letter is performed with decryption function (2).

$$E_k(x) = (x+k) \bmod 26 \qquad (1).$$
$$D_k(x) = (x-k) \bmod 26 \qquad (2).$$

For example, a message "CAN" is encrypted with function (1) and key k=3. The result of encryption is "FDQ" with Caesar encryption algorithm. The same key is used to decrypt the encrypted message to obtain the original one. Although Caesar algorithm is easy to use, it can be easily broken (Şahin, M. Ekin, A.B., 2011).

Vernam method is another symmetric encryption which also known as one-time pad encryption. One-time pad encryption firstly discovered in 1882 by Frank Miller (Markoff, 2011). The same method was reinvented in 1917 by Gilbert Stanford Vernam and Joseph Mauborgne without be aware of its first invention (Markoff, 2011). This encryption method based on a random key for each message which has the key length of original message length. One-time pad encryption is the only method which is theoretically proven as unbreakable (Shannon, 1949). However, this encryption method is not preferred in practice because of its implementation difficulty.

Implementation of Encrypted Multiple Choice

Symmetric key encryption methods encrypt and decrypt messages using the same key. Original message is called plain text and encrypted message is called as cipher text. In Vernam encryption, a message m having j number of characters (m_1, m_2,..., m_j) is encrypted using function (3), and a cipher text c (c_1, c_2, ..., c_j) with key k (k_1, k_2, ..., k_j) is decrypted using function (4).

$$E(m_j, k_j) = c_j \qquad (3).$$
$$D(c_j, k_j) = m_j \qquad (4).$$

Table 1. Multiple Choice Question Encryption

Student IDs	Randomly generated key for each student (k_j), $1 \leq j \leq N$, j is an integer	Encrypted answer keys for each student
546875	5, 9, 15, n, … , 20	a, c, a, b, …, d
…	…	…
153467	12, n, 3, 9, … , 17	c, b, a, b, …, a

In this study, modified Vernam encryption method is used to implement encrypted multiple choice exam. The difference comes from the nature of the problem. Instead of truly random keys, one-time pads are generated from a set of original question indices. The original exam questions are randomly ordered for each student. Thus, a separate answer key is created for each one. Each answer key is a sequence of length n. The possible number of randomly generated keys are permutations of n numbers where n is number of questions.

The student numbers are assumed to be eight digit positive integer M_i (i=1,...,N, N is the number of students). Students' questions and their corresponding encrypted correct answers are summarized in Table I.

In this application, the encrypted students' answer keys are calculated by the encryption function (5).

$$E(m_j, k_j) = (m_j + k_j) \bmod 4 \qquad (5).$$

In modular arithmetic operation, the second operand must be the number of choices. The result of mod operation is coded to "*a*, *b*, *c*, and *d*" respectively as correct answer choices. The encryption process produces answer keys for each student with the length of number of questions.

The number of possible keys is $1.55x10^{25}$ for 25 questions. Even if the same key is randomly generated for more than one student, different answer keys are created. This is because, unique student numbers are used in encryption process. If any of the students in the exam tries to decrypt the corresponding answer key, s/he needs to guess the original question index in their questions. The probability to find the possible key is 1/(25!). The student's encrypted multiple choice exam preparation process is shown in Figure 1.

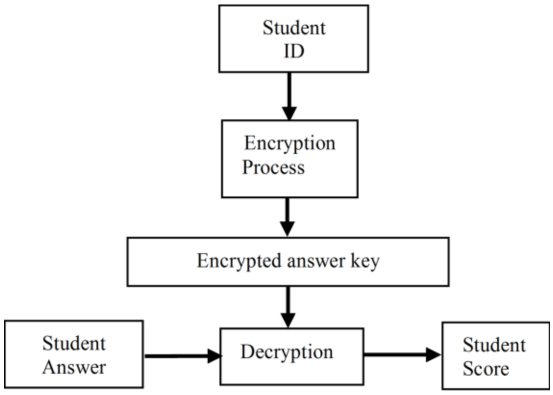

Figure 1. Encryption And Decryption Processes For Individual Student's Question Booklet.

The decryption process of the implementation is performed by comparing the student answers with the corresponding answer keys. Student scores are calculated as the result of decryption. The implementation details of encrypted multiple choice exam can be found in (Ulukok, M.K. Sensoy, Z.B., 2012).

EXPERIMENTAL STUDY

A total of 150 comparable valid results from non-encrypted and encrypted exams were gathered and entered into IBM software package used for statistical analysis (SPSS). The results of the exams were gathered randomly without considering whether or not students have prior knowledge in the subject. The encrypted and non-encrypted exam results are used as raw data to investigate the following research question:

Research Question	Null Hypothesis (H_o1)	Alternative Hypothesis (H_a1)
Is there a significant correlation between student's encrypted and non-encrypted exam results?	There is no significant correlation between students' encrypted and non-encrypted exam results.	Students' encrypted and non-encrypted exam results are significantly and strongly correlated with each other.

In order to examine the results accurately in the context of the above research question, it was important to identify the correct method for an inferential statistical analysis. As the experimental structure is based on investigating the correlations in a sample group, it was essential to investigate the distribution of data before evaluating the correlations. Therefore, a procedure for carrying out either a Pearson's product-moment correlation coefficient or a Spearman's rank-order correlation could be performed. A Pearson's r was to be selected should the data captured comes from a normally distribution and similarly, Spearman's correlation was available if the data captured did not come from a normally distributed population.

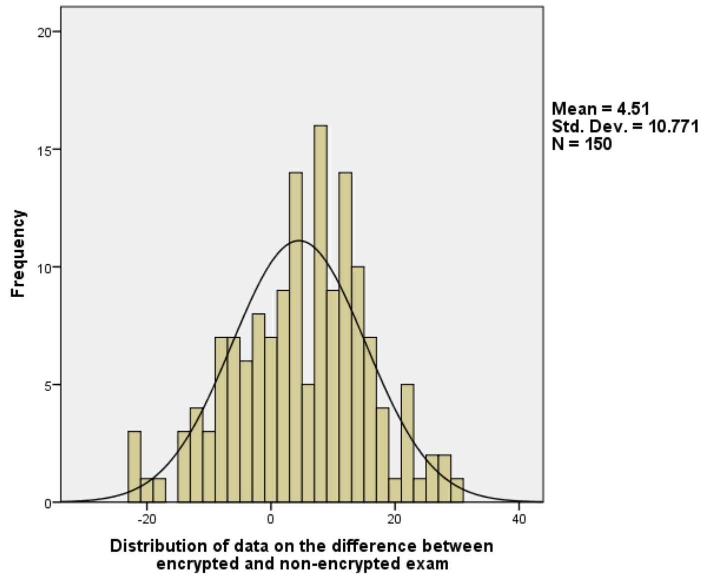

Figure 2. Shows The Histogram Distribution Of Data Based On The Difference Between Encrypted And Non-Encrypted Exam.

Figure 2 illustrates the histogram distribution of data collected from the difference of encrypted and non-encrypted exam results. As seen from the figure, the histogram indicates the distribution of data as skewed to the right. Additionally, the difference between encrypted and non-encrypted exams was found to be positive. Based on the distribution of data, there are skewness issues on the data distribution as considerable number of responses are on the right side of the histogram. Although the distribution of data on the histogram provides an initial overview for the normal data distribution, the histogram itself is arguable tool to determine whether or not data came from a normally distributed population. To investigate the distribution of data distribution further, it was essential to analyse the Normal Q-Q Plot of distribution.

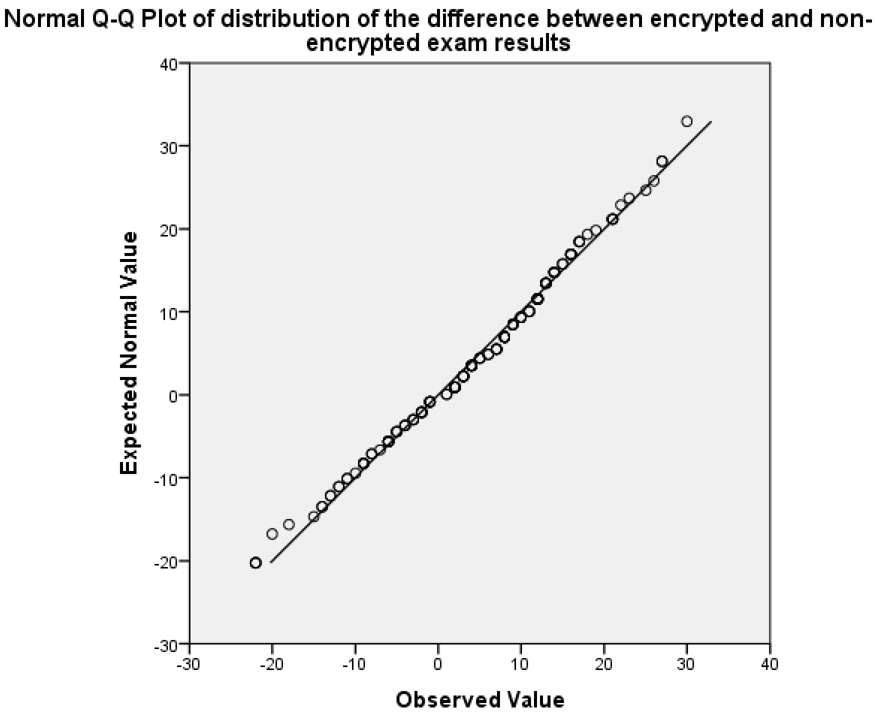

Figure 3. Normal Q-Q Plot Of Distribution Of Data On The Difference Between Encrypted And Non-Encrypted Exam Results.

Figure 3 illustrates the distribution of data collected from the difference between the encrypted and non-encrypted exam. As histogram is not a very reliable tool for measuring whether or not data came from a normally distributed popular, it was essential to look into Normal Q-Q plots and the results of a normality test (specifically *Shapiro-Wilk test* since the population number is not high). The linear line on the above figure represents a perfect normal distribution on data set. The Circles on the Q-Q plots are the observation nodes which represents the difference of encrypted and non-encrypted exams. As it can be seen from the above figure, majority of data nodes embrace the linear line whereas those nodes at the edges are not on the line. Additionally, the expected normal values (i.e. the difference between the exams) go up to 40 whereas the same value only goes down to -30. Hence, the Q-Q plot supports the findings of the histogram and indicates that the data distribution is indeed skewed to the right. However, as majority of the nodes embrace the linear line, the Q-Q plot provides strong evidence that the data came from a normally distributed population.

Table 2. Shapiro-Wilk Normality Test

	Shapiro-Wilk		
	Statistic	df	Sig.
exam with encryption – exam without encryption	.989	150	**.282**

To validate the findings of Q-Q plot, a normality test (i.e. Shapiro-Wilk) was conducted to ensure whether or not the data came from a normally distributed population. Table 2 illustrates the findings of the Shapiro-Wilk normality test which is a normality test used especially when the sample size is not very large. If the Sig. value (P) of the Shapiro-Wilk Test is greater than 0.05 ($P>0.05$), this indicates that the data comes from a normally distributed population. On the other hand, if the Sig. value is below 0.05 ($P<0.05$), the data significantly diverge from a normal distribution. As it can be observed from the table, the Sig. value is greater that 0.05 ($P=0.282$), which provides strong evidence that the data came from a normally distributed population.

Table 3. Pearson Product-Moment Correlation Coefficient Showing Relationship Between Exams Without Encryption And Exams With Encryption

		Exam without Encryption	Exam with Encryption
Exam without Encryption	Pearson Correlation	1	**.387****
	Sig. (2-tailed)		.000
	N	150	150
Exam with Encryption	Pearson Correlation	**.387****	1
	Sig. (2-tailed)	.000	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

A *Pearson's r* was computed to assess the relationships among the exams (i.e. encrypted and non-encrypted) since the Normal Q-Q plots and the Shapiro Wilk normality test provided strong evidence that data came from a normally distributed population. Although there are only crude estimates available for interpreting the strength of a correlation, a strong positive correlation between two or more variables is identified when *Pearson's r* is equal or greater than +0.7. Correspondingly, a modest strong correlation ranges from +0.49 to +0.69 and a weak relation is recognized to be between +0.2 and +0.39. Any correlation that ranges between +0.01 and +0.019 is often accepted as negligible. In addition to these, the negative correlations follow the same guidelines but with a negative value rather than positive.

As shown in Table 2, the correlations between the encrypted and non-encrypted exams are in positive direction, significant but weak. According to the results of the Pearson's correlation, there is a positive, significant but a weak association in between encrypted and non-encrypted exams ($r=0.387$, $n=150$, $p=0.001$). This means that the Pearson's coefficient provides strong evidence that the association between the encrypted and non-encrypted exams is feeble ($r^2=0.149$, 15%).

CONCLUSION

Based on the analysis of data, two different conclusions can be drawn from the Pearson's correlation result. Firstly, those students who did well in their non-encrypted exams also did reasonably well in their encrypted exams as the difference between the coefficient numbers is small. Secondly, there is a significant but a very weak relationship between the difference of students' encrypted and non-encrypted exam results (r^2=0.14). The correlation percentage between the two exam results was found to be 14% which is low. This provides strong reasons to believe that those students who did well in their non-encrypted exams also did well in their encrypted exams. In other words, there is strong evidence from the Pearson's correlation test that proves preparing an exam encrypted or non-encrypted has negligible effect on students' exam results. There is another sample of size 220 (students' results in fall 2012-2013), which will be analyzed in future work.

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E-LEARNING TOOLS: CONCEPTUALISATION OF DOMAIN KNOWLEDGE FOR FUTURE USE IN E-LEARNING CONTEXT

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ABSTRACT: Semantic Web is a Web of new generation. The main difference from the Web of the first generation is that information presented is understandable not only for humans, but also for software agents or other software modules. Ontologies are most often defined as basic component in Semantic Web infrastructure. Domain ontologies provide shared and common understanding of a specific domain. They, as engineering artefacts, are used in different fields, including e-learning. In this paper, we present the development of domain ontology for future use in e-learning context. Domain of "E-learning tools" was chosen for implementation. The distance learning course "E-learning technologies" (3 credits) is elective and oriented not only for students with strong background of information technologies. Among others, the expected ability of the study module is formulated as follows: students will be able to analyse, compare and in the real context to choose the most suitable tools for development of study materials, delivering distance learning course or making other decision in e-learning context. Our domain consists of three large parts: tools (software products), technologies in a wider sense of this word and didactics. The obstacle of our solution is that the domain is evolving quickly. But since we agree that "there is no single correct ontology for any domain" (Noy, 2001), we can freely experiment and foresee further use of developed ontology in e-learning.

Key words: domain ontology, ontology development, e-learning, e-learning tools

INTRODUCTION

Ontology is an emerging instrument for knowledge representation, share, reuse and interoperability. Some of the definitions of ontology, used in computer science field, are presented in (Guizzardi, 2005), and they are summarised below:

- "Ontology is a representation of a conceptual system that is characterized by specific logical properties". This definition accentuates the collection of statements or other semantic definitions for a domain.
- "Ontology is a synonym of conceptualization". This definition emphasizes, that we deal with an abstract, simplified view of the part of the world.
- "Ontology is a special kind of knowledge bases". This definition emphasizes, that ontology is engineering artefact.

Ontologies are most often defined as basic component in Semantic Web infrastructure. Semantic web technologies can enhance possibilities and functionality of traditional Web. For example, Davis (2007) characterises the business value of semantic technologies in five critical areas:

- Development. In this aspect, some automation in different steps of development of information system becomes possible. Semantic Web technologies allow to manage better software system's complexity, to fit better in project's time period, to reduce risk.
- Infrastructure. Modern information systems are net-centric, distributed, rapidly evolving. Semantic technologies provide possibility to orchestrate core computing processes.
- Information. We deal with information overload and semantic inconsistency. Semantic technologies strive for semantic interoperability of information and applications in real context.
- Knowledge. Semantic Web technologies provide possibilities to knowledge work automation and supporting knowledge workers.
- Behaviour. The final aim is a situation, where "systems know what they are doing". It is achievable over implementing of adaptivity, machine learning, and automatic reasoning mechanisms.

Ontologies, as engineering artefacts, are used in different fields, including e-learning. The aim of this presentation is to analyse the types of domain ontologies and to present our practical work in the field of development of ontology. Domain of "E-learning tools" was chosen for implementation.

DIFFERENT TYPES OF ONTOLOGIES

Literature review shows that there are different classifications of ontologies. Some of them concern different aspects, e.g. generality level, richness; some of them are alternatives of some kind. Different classifications are comprehensively analysed in (Ruiz, 2006). Here we highlight more important in our viewpoint classifications, which enforce us to choose one alternative, and briefly summarise the other classifications.

There can be two types of ontologies, depending upon a language used for formalisation and the purpose of ontology: lightweight and heavyweight. Lightweight ontologies include concepts with properties and taxonomies, but do not include axioms. Heavyweight ontologies are richer in expressiveness, but they are harder to manage. Since the lightweight ontologies are less restrictive, they are usually wider acceptable, which is very important for knowledge sharing and reuse. We are planning to find balance between expressiveness and decidability. The less expressiveness the language provides, the better reasoning mechanisms are implemented. This is very important in the context of immediate feedback generation and increasing efficiency of system in common and simple tasks.

Other classification of ontology as schema-ontology and topic-ontology is introduced in (Kiryakov, 2006). Concepts with intuitive relations, for example Africa and Nile, can be related in topic-based ontologies. However, if we want to implement effective reasoning algoritms, we should use schema-based ontologies. Also the author accentuates the possibility to formalise the domain while using set-theoretical model and set theoretical operations.
Several other classifications of ontologies are summarised in Table 1.

Table 1. Classifications of Ontologies

Aspect	Proposed by	Types mentioned
Generality level	Guarino (1998)	▪ High–level ontologies ▪ Domain ontologies ▪ Task ontologies ▪ Application ontologies
	Fensel (2003)	▪ Generic or common-sense ontologies ▪ Representational ontologies ▪ Domain ontologies ▪ Method and task ontologies
Type of conceptualisation structure	Van Heist (1997)	▪ Terminological ontologies specify the terms that are used to represent knowledge in the domain. ▪ Information ontologies specify the record structure of databases. ▪ Knowledge modeling ontologies specify conceptualizations of the knowledge.
Richness of internal structure	Lassila (2001)	▪ Controlled vocabulary - a finite list of terms. ▪ Glossary - a list of terms and meanings. ▪ Thesauri - provides some additional semantics. ▪ Term hierarchies (or informal hierarchies) - provides generalisation and specialization. ▪ Strict subclass hierarchies (or formal hierarchies). ▪ Frames – includes property information. ▪ Ontology with value restrictions. ▪ Ontology with logical constraints.
Formality	Uschold (1996)	▪ Formal, e.g., expressed in first-order logic. ▪ Informal, e.g., expressed in natural language. ▪ Semi-formal, e.g., expressed in UML.

We choose lightweight, schema-based, semi-formal domain ontology for capturing subject domain knowledge, because:

1) It better corresponds with our understanding of the concept of ontology;

2) It deals with formal or semiformal representation;

3) It represents a top-down systematic approach;

4) It better fits in our instructor-led e-Learning context.

MANUAL AND AUTOMATIC ONTOLOGY DEVELOPMENT

Two main types of ontology development are distinguished:

1) Manual ontology development. The main design and development processes are done by humans. We argue for the manual ontology development because of the following reason: despite of the fact, that there are still much heuristics in the development of domain ontology manually, it remains still the best approach to the development of ontology of high quality. The main problem while using this approach is that such task is very time consuming.
2) Automatic or semi-automatic ontology development. In the future we have plans to experiment with semi-automatic methods for ontology (starting from its structural base - taxonomy) development, in order to find easier ways to build the main corpus of knowledge from particular domain. But at this moment there are no suitable tools for automatic ontology development, especially if we suppose that our concepts and relations must be expressed in Lithuania.

The main characteristics of manual ontology development are presented in Table 2.

Table 2. Characteristics of Manual Ontology Development

Characteristics	Description
Typical processes	The consensus of different methodologies is the following list (Uschold, 1996; Fernández-López et al., 2004; Grobelnik, 2006): 1) Pre-development (domain and data understanding, purpose and scope definition). 2) Development (practical dealing with concepts, relationships, instances). 3) Post-development (evaluation, evolution).
Main advantages	• Better quality can be reached. • Reliability. • Top-down approach can be used, what implies better systematisation.
Main shortcomings	• A great amount of time from both domain experts and knowledge engineers is required. • Cost (human resources).
Involvement of the humans	In all processes.
Support provided by tools	• Ontology editors; • Ontology visualisers (useful in evaluation of domain ontology of domain experts); • Reasoners (useful in finding contradictions).

CASE STUDY: CONCEPTUALISATION OF E-LEARNING TOOLS DOMAIN

Domain ***E-learning tools*** was chosen for implementation. Ontology is intended to be used in the distance study course “E-learning technologies”. The course is implemented using MOODLE: a free, open source course management system. Therefore, we already have learning material, which can be linked to the concepts from domain ontology.

Among others, the expected ability of this course is formulated as follows: students will be able to analyse, compare and in the real context to choose the most suitable tools for development of study materials, delivering distance learning course or making other decision in e-learning context.

The main general concepts in our domain are: *SoftwareProduct*, *Manufacturer*, *Purpose*, *CurriculumLevel*, *Learning Activity*, *Task*, *User Role*. We employ a whole-part relationship in order to represent aggregation (see Figure 1).

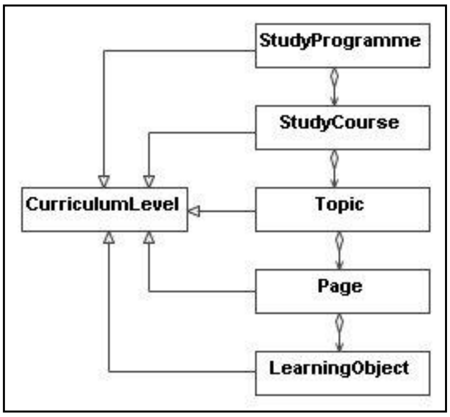

Figure 1. Example of Whole-Part Relationship

Also, other different types of functional relationships are employed, for example, *provides*, *isProvided*, *isSuitableFor*, *canBeAchievedWith*. They link general concepts. The largest part of ontology is represented as taxonomical hierarchies. The bigest taxonomical hierarchy starts from the concept *SoftwareProduct.* The part of this hierarchy is presented in Figure 2.

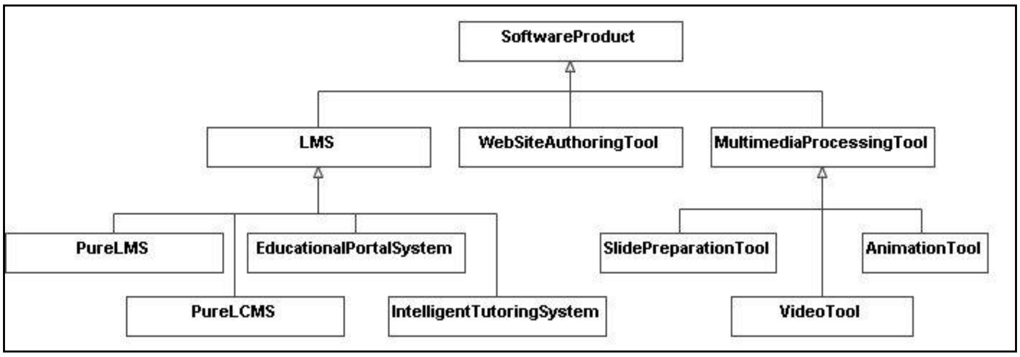

Figure 2. The Part of Taxonomical Structure

Concrete tools, discussed in the course and treated as instances from ontology-based view, are selected from the variety of tools from basically two types: 1) Best, industry leading tools in the field; 2) Free tools. The lists of important properties are defined considering, what type of information is useful when we want to choose a tool for some job in eLearning field. One of the special properties, usually not mentioned in web sites with tools' ratings, is possibility to translate captions of user interface elements into Lithuanian.

CONCLUSION

In different cases different ontology development methods are applicable: manual ontology development, reusing existing ontologies, semi-automatic development of domain ontology. Despite of the methodologies for the manual development of ontology are underdeveloped, and there are still much heuristics in the development process, it is the way in which at the moment higher quality ontologies can be made.

Lightweight, schema-based, semi-formal domain ontology for capturing subject domain knowledge should be used, because it 1) better fits in instructor-led e-Learning context; 2) is more suitable for further reasoning over it.

Instances (the A-Box of ontology) are evolving very rapidly. It requires some semi-automatic processes for further renewing domain ontology.

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AN INVESTIGATION INTO EFFECTS OF DYNAMIC GEOMETRY SOFTWARE (DGS) ON STUDENTS' THINKING PREFERENCES: SOLVING GEOMETRY PROBLEMS WITH AND WITHOUT DGS

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ABSTRACT: Researchers suggest that students have preferences (visual and non-visual) when solving mathematics problems. Many times students have difficulties in solving problems because of one-sided thinking and weakly associating other representations. Reform efforts support connecting visual representations with non-visual representations in order to develop deeper understanding. This study investigates how prospective teachers with different preferences for visual, non-visual, and harmonic thinking solve geometry problems with and without using DGS. The study aims to explore whether students' use of DGS when solving geometry problems is related to their preferences. Suwarsono's mathematical processing instrument (MPI) was administered to determine their preferences for visual and non-visual thinking. Based on MPI instrument's results and their performances of geometry problems solved with and without DGS, three students were selected to be interviewed. Multiple case studies were conducted to conduct a deeper analysis. The reason for selecting three students was to take at least one person from each group based on their thinking preferences so that different cases can be compared and contrasted. The results reveal that regardless of students' preferences preservice teachers preferred to use visual solutions when they are asked to use DGS. When their solutions of DGS and paper-and-pencil were compared, students' solutions with DGS demonstrated more conceptual understanding of the task than paper-and-pencil.

Keywords: dynamic geometry environment, prospective teachers, geometry.

INTRODUCTION

In the last two decades, the use of technology in mathematics education had a great growth in teaching and learning mathematics. Researchers suggest that technology has an essential role in students' understanding of mathematics with the dragging facilities of dynamic geometry environments (Hollebrands, 2003; Leung, 2008; Hölzl, 2001). There have been many studies that investigated the role of dynamic geometry software (DGS) in understanding geometric constructions, proofs, and measurement (Healy and Hoyles, 2002; Jones, 2000; Mariotti, 2002). These studies showed that dragging is an essential feature of DGS that supports conjecturing, proving, and searching for common properties of geometric shapes.

The effectiveness of using technology depends on the teacher. Teachers have an essential role to increase learning opportunities by using the graphing, visualizing, and computing features of technology. However, many times teachers prefer to use only textbooks and other instructional problems to teach geometry rather than integrating dynamic software into their lessons (Hanna and DeVillers, 2012). One of the reasons of this is that DGS requires teachers to analyze different answers' of students and create different dynamic activities where students can explore mathematical relationships (Healy and Lagrange, 2010).

Studies show that integration of technology into prospective teacher courses enhanced their understanding of mathematical ideas and their instruction (Habre & Grunmeier, 2011). Especially, prospective teachers explored essential advantages of using dynamic geometry in proof problems since they could make conjectures with the help of the software (Christou, 2004; Pandiscio, 2010). Additionally, many prospective teachers stated that using dynamic software helped them gain a broader perspective in solving geometric problems and make geometric conjectures (Pandiscio, 2010). However, the studies also discussed the limitations that might arise from using dynamic software (Habre, 2009). The important point emphasized in these studies is that the properties of the dynamic software program should match with the aim of the problem and the teacher has an essential role in development of approaches in the solution of the problem by using technology. Thus, the teachers' use of a technological tool is an important component of mathematical learning.

Students' thinking preferences also have an important role in their use of tools. Even though there are some studies that focus on the effect of using technology on students' problem solving strategies (Coskun, 2011; Harskamp, Suhre & Van Streun, 2000; Iranzo-Domenech, 2009; Yerushalmy, 2006), there are not many studies that investigate how students' thinking preferences affect their use of technology.

According to Kruteskii (1976), students thinking preferences can be categorized as analytic (non-visual), geometric (visual), and harmonic (mixed) thinkers. He defined these categories by comparing students' verbal-logical and visual-pictorial components of mathematical abilities. While analytic thinkers generally solve problems using logical reasoning, geometric thinkers utilize mostly visual-pictorial means. Harmonic thinkers, on the other hand, have a relative equilibrium between the two categories. Despite the importance of these thinking preferences, whether they affect the use of dynamic software is an under-explored question.

Koehler and Mishra (2005) define the knowledge the teacher needs to have in order to use technology effectively as the technological pedagogical and content knowledge (TPACK). According to this framework, knowing technology is not enough for teachers to use them effectively. They also need to know how using technology helps students to understand mathematics, how students think about the solutions of problems by using technology, what kind of materials to use in order to integrate technology, and what are the different representations and instructional strategies in learning mathematics with technology. Research shows that prospective teachers as well as secondary mathematics teachers have difficulties changing their practice from direct teaching to guidance where students can explore mathematical relationships using software tool and making deductive reasoning (Christou et al., 2004). They also have difficulties in guiding students to investigate problems without giving answers, reacting "trial and error" methods, and making sense of different unexpected answers (Hahkioniemi and Leppaaho, 2012). Thus, it is important to understand how teachers use technology and provide training to help them overcome their difficulties that might stem from their lack of knowledge (Kokol-Volj, 2007).

In this study, three prospective teachers were taken as cases and their thinking preferences were identified by using Suwarsono (1982)'s mathematical processing instrument (MPI). Then their use of a DGS tool during the solution of several problems were analyzed. In the analysis, the instrumental genesis framework (Trouche, 2004), which defines the interaction between a technological tool and a user, is adopted to understand the nature of their interaction with the tool. The results indicate that regardless of students' preferences, preservice teachers preferred to use visual solutions when they are asked to use DGS. When their solutions of DGS and paper-and-pencil were compared, students' solutions with DGS demonstrated more conceptual understanding of the task than paper-and-pencil.

METHODS

Theoretical Framework

One of the ways to support students' learning of mathematics is the use of tools. While students make use of tools, they facilitate their mathematical activities. Even though these tools are technical, they become internalized and affect the psychology and the learning process of the user (Vygotsky, 1978). In analyzing the interaction between a tool and the user, a commonly used framework is called *instrumental genesis*.

Instrumental genesis is based on the interactions between the tool and the learner. It has two important components: *instrumentation* and *instrumentalization*. While the first one refers to how a tool affects and shapes the thinking of a user, the second one pertains to how the user shapes the tool. According to this framework learners develop conceptual understanding and techniques for using a tool for a specific type of task in time resulting in mutual relationship between the user and the tool (Trouche, 2004). Instrumentation is more related to mental schemes since it is shaped as the user executes the task. On the other side, instrumentalization is a psychological process since organization of the use-schemes is also developed in this process and the user internalizes the use of artifact (Guin & Trouche, 2002).

Another important concept used in the framework is *hotspots* that define the dynamic points in the dynamic software environment. A hotspot is different than a regular point since as the user drags the point the figure is dynamically reconstructed. Thus, a hotspot is the key element between the software environment and the user. As the users move hotspots, they can make conjectures and based on their knowledge they can react the use by moving these points. Thus, hotspots are not owned by users, but they are infrastructural pieces of the environment which give feedback to users. Here it is important to note that when a hotspot is moved, the resulting construction is built by the environment, not by the user, and this provides an important feedback to the user (Hegedus, 2004). In the analysis, the concept of hotspot is also used in interpreting the prospective teachers' interactions with the tool with instrumental genesis.

Data Collection

This study was conducted in a large public university in Ankara, Turkey. The data was collected from the preservice teachers who took an elective course. The aim of this course was teaching students how geometry can be taught using technology and in particular with DGS. Three plane geometry problems were given to 25 prospective teachers who took “exploring geometry with dynamic geometry software (DGS)” course and they were asked to solve the problems with and without DGS. Additionally, Suwarsono’s mathematical processing instrument (MPI) was administered to determine their preferences for visual and non-visual thinking. Based on MPI instrument’ results and their performances of geometry problems solved with and without DGS, three students were selected to be interviewed. Multiple case studies were conducted to gain a deeper understanding. The reason for selecting three students was to take at least one person from each group based on their thinking preferences (visual, non-visual, harmonic) in order to compare and contrast the cases. The method of selection of these students was purposeful sampling in order to get rich information to answer the research question.

After these three students were selected, the researcher conducted interviews with each of them individually. The interviews lasted about one hour. They were asked to solve six geometry problems during the interview. These problems were selected from Johnston-Wilder and Mason (2005). The selected problems were open-ended with multiple solutions. Students were asked to solve the problems with and without DGS. The choice of which environment to start with was up to the students. In this paper only two questions’ data are shared for brevity.

Analysis

Multiple case study was used in this study. In a multiple case study two or more cases are analyzed. Merriam (1998) emphasizes that using more cases in a study results in more compelling interpretation. In this study, the three cases were selected based on their different thinking preferences. The first case was identified as a non-visual thinker, the second case was identified as a visual thinker, and the third one was identified as a harmonic thinker according to the mathematical processing instrument (MPI) developed by Suwarsono (1982).

Suwarsono’s MPI test includes two parts with 15 items in each part. The first part contains the questions that the student is required to solve on the paper. The second part contains the possible solution strategies for each question in the first part. Here, the student is expected to choose the solution strategy that he or she followed in the first part. The entire process is repeated for a new set of 15 questions to ensure consistency. MPI included 30 word problems. For each visual solution, a score of 1 was given and for each nonvisual solution a score of 0 was given. Students, whose scores were lower than 15, were considered as nonvisual thinkers. Students, whose scores were higher than 15,were considered as visual thinkers. Students who scored around the cutoff point 15 were considered as harmonic thinkers. S1 scored 10, S2 scored 15 and S3 out of 24 on the MPI. Based on these answers, the thinking preferences of the students were classified as non-visual, harmonic, and visual.

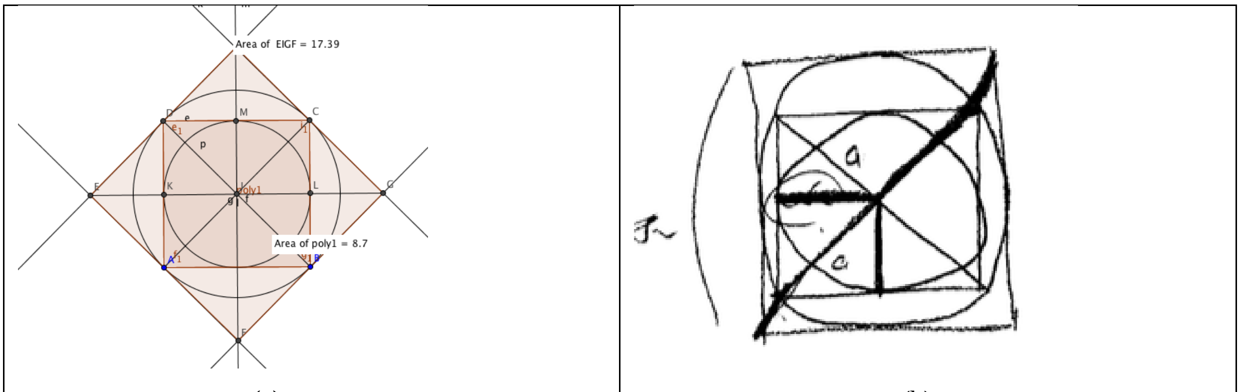
In addition to this instrument, students solutions of problems with and without DGS during the classroom were used to cross-check their thinking preferences. This data was found to be congruent with the MPI results. During the interview the students were asked six questions, two of which are discussed here for brevity. One of the questions was Q1: “Draw a circle with one square inside and one square outside. Calculate the ratio of two squares. Draw a circle inside the small square. Find the ratio of two circles”. The other question was Q2: “Suppose you have a chord AB of a circle. Find the triangle inscribed with AB as a side, which has the largest area”. Use this result to solve: In a circle with Radius 1, what inscribed triangle has the largest area?”

RESULTS AND FINDINGS

Case One: S1’s solution strategies (non-visual)

S1 was found to be the highest scoring non-visual thinker according to Suwarsono’s instrument as well as the analysis of problems solved in the classroom. During her solution of Q1, she first tried to construct the file with Geogebra (GGB) without solving it on the paper.

I: How would you solve this problem?
S1: I would use GGB to see the solution. First, I will construct the problem and then I will try to find out the answer (she creates the construction in Figure (1a)).



(a) (b)

Figure 1: S1's Solution Of First Problem With And Without GGB

S1: Without using the area tool of GGB, I can say the answer.
I: How did you see the relationship?
S1: It is half of it.
I: Why?
S1: Because, I look at the big square. It includes four small triangles. And then I look at the inside square. It includes four triangles. If we combine two of the triangles, it makes one small square. So inside square includes two small squares. Outside the square included four small squares (She moves the hotpoint and states that the result does not change).

She checks the result with the area tool of GGB. Next, she was asked to solve this problem on the paper. She did the similar method on the paper. She stated that she would create small triangles and then combine them to make a square. Additionally, she stated that she would use similarity. However, she had difficulty in drawing the problem on the paper. She stated that if she said *a* to half of the diagonal of the inside square, then one side of the square would be $a\sqrt{2}$ and one side of the outside square would be $2a$. The ratio would be 2.

However, even though she assigned a variable to the side of squares, she did this using the GGB file. She stated that she could not see any relationship on the paper since her shape did not look right. Thus, even in her algebraic solution she used the shape on the GGB.

I: What about the second part of the question?
S1: The half of the outside square's side is equal to the radius of outside circle and the half of the inside square's side is equal to the radius of inside square. Since the side's ratio of circles were 2, the ratio of radius's would be 2 and the ratio of areas would be 4 because of the area formula which is $pi*r^2$*. However, I could not tell this by looking at my drawing on the paper. I am lucky that I can use Geogebra. Otherwise it is important to be able to draw the shape beautifully in order to answer these questions.*

Even though, she was asked to solve by using paper-pencil, she stated that from her drawing she could not see the relationship. Thus it would be more useful for her to look at the GGB file while she was trying to explain the relationship. She tried to do the solution on the paper but because of difficulty in drawing, she did not use it in her explanation (see Figure 1(b)).

In the solution of this problem, S1 found the ratio of two squares by using the dynamic features of DGS. She also stated that it was very useful for her to create the activity itself since they need to know what constitutes the center of the inscribed circle as well as the circumscribed circle. During the creation of the activity she had to use bisectors and perpendicular lines. Construction of the shapes helped her to understand mathematical relationship between the circle and the square. Using hotspots was essential to generalize the problem and make conjectures. As the user executed the tasks on DGS, the environment gave feedback to reflect on. This was essential to support instrumental genesis as the co-action emerged and shaped the sustainable bi-directional process that support developing mathematical concepts.

Next she was asked about the second question, Q2:

S1: (She starts with GGB, draws a circle and then a triangle inside of it). I think the area would not change. Would it? But, it changes. Perhaps when the midpoint of AB passes through the center...Mmm..I do not know.
I: Try to think about it.
S1: I think, it would be the greatest area when it is equilateral triangle (she uses hotspots on Figure 2(a)).
I: Why?

S1: When three sides are equal than it looks like the area becomes the biggest (she finds this by using the area tool of GGB, area of BDC in Figure 2(a)). But I do not know why.
I: Do you think the triangle you show is equilateral?
S1: (She checks the length of sides by using GGB). Yes. And then she draws the same Radius circle (5 cm) and a equilateral triangle inside of it by using rotation (Figure 2(b)). I think the area of circle is two times bigger than the area of triangle (she checks with area tool). No it is not like that.
I: Why do you think it is equilateral triangle?
S1: I do not know. But I can try it on other circle. I will create a slider. I can rotate the points by γ angle and then create the triangle. I can find the area of triangle. I can see that when slider is 120 degrees it has the maximum area. But I do not know why it works.

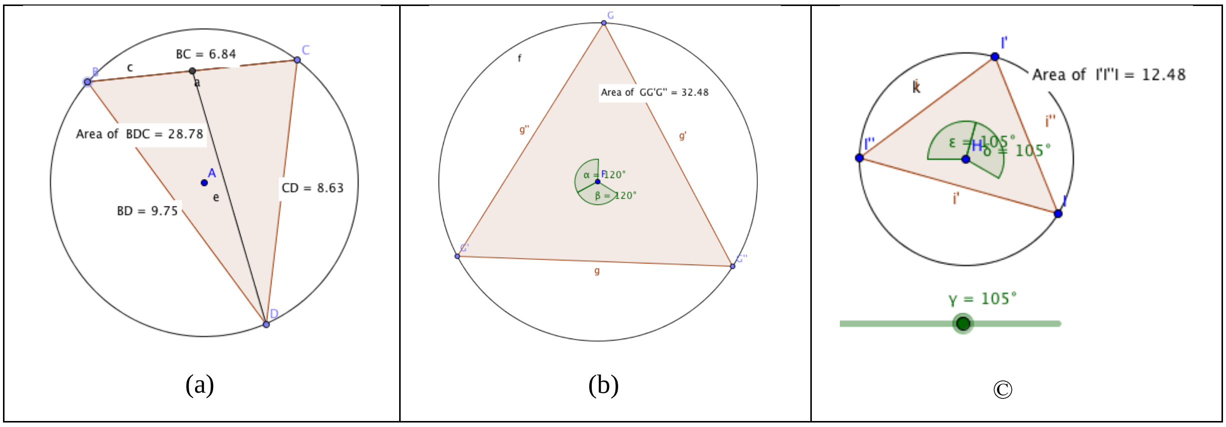


Figure 2: S1's Second Problem's Solution

S1: Angles would be the same. The side of the triangle is a and a is the chord. So we need to find the maximum value of multiplication of side and height. Actually, I first thought when the base is diameter it should be maximum. However, the result did not come out like that when I checked it with GGB. When we make it equilateral the base decreases but height increases. If r is equal to 2a√3 then the height is 4a (she writes on the paper). When it is 90 degrees the side is 2a and the height is 4a.

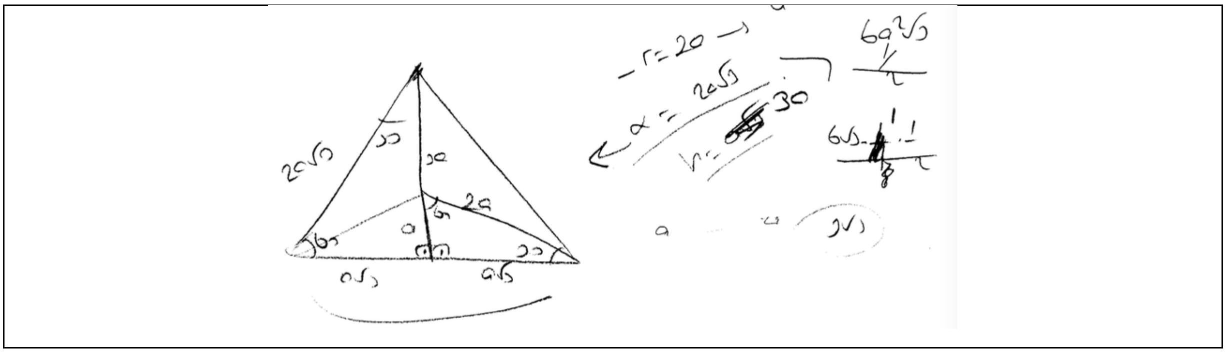


Figure 3. S1' S Solution Of Second Problem On The Paper

Since S1 was very comfortable using the tool, the features of the tool allowed her to find different solutions than the paper-pencil methods. The instrumentation level was very high as the tool had important role shaping her solution strategies. Especially, for the first solution, she used the dynamic feature of the software program and without that she might not have been able to make the conclusion that the ratio of the outer square to the inner one is 2. In the second question, she also found the equilateral triangle by using the hotspot on the software. By using the dynamic feature of the software she calculated both areas and generalized it by dragging the hotpoint. In her second solution, she used different properties of the tool such as making rotation of the given shapes by creating sliders. It can be seen from the solution strategies that instrumentation and instrumentalization was intertwined. For example, in the second solution she could find the strategy of using rotation thanks to the tool since it is easy to make transformations with the DGS. Her mathematical knowledge was also essential to find this solution strategy by using the tool. In her last solution she used the hotspot in order to make a conjecture. She preferred to use sliders instead of dragging from the hotpoint; both of which allow dynamic variation. Here it is important to note that even though she moved the sliders to change the figure dynamically, the resulting construction was developed automatically by the environment. As Hegedus (2005) emphasizes, "the artificial realities of the diagram obey the rules of geometry that are preserved in the elements of diagram". This feature of the tool is critical in supporting both instrumentation and instrumentalization.

Case Two: S2's solution strategies (harmonic)

When S2 was asked about the first question, before trying the solution on the paper, she opened Geogebra and first created the problem on it. However she did not use the file created on the GGB in order to find the answer. Instead, she used a paper solution to give the answer.

S2: If I say √2 to half of the diagonal, the diagonal is equal to 2√2. And one side would be 2. Then outside square area would be 4. The ratio would be 2 (Figure 3(b)). We can use GGB to check our result. We can compare poly1 and poly2 and see that the ratio is 2. I use numbers since it is ratio, it does not matter to use variable.
I: How would you use GGB to solve this problem?
S2: I would use in the same way. I can create a segment between center and midpoint of the outside square's side. I would say r to that segment. I would find out the lengths by using the GGB tool. I can divide the big square's side to the small square's and find out the ratio (1/2). Even though I move the square dynamically, the ratio would not change (Figure 3(a)). I can also see the ratios from the triangle.

After this she was asked to solve the second part of the question.

S2: They would be also 2. One of them would be pi(r√2)^2 and the other would be pi*r^2 (Figure 3(b)). And then I would use the GGB to check the result.*

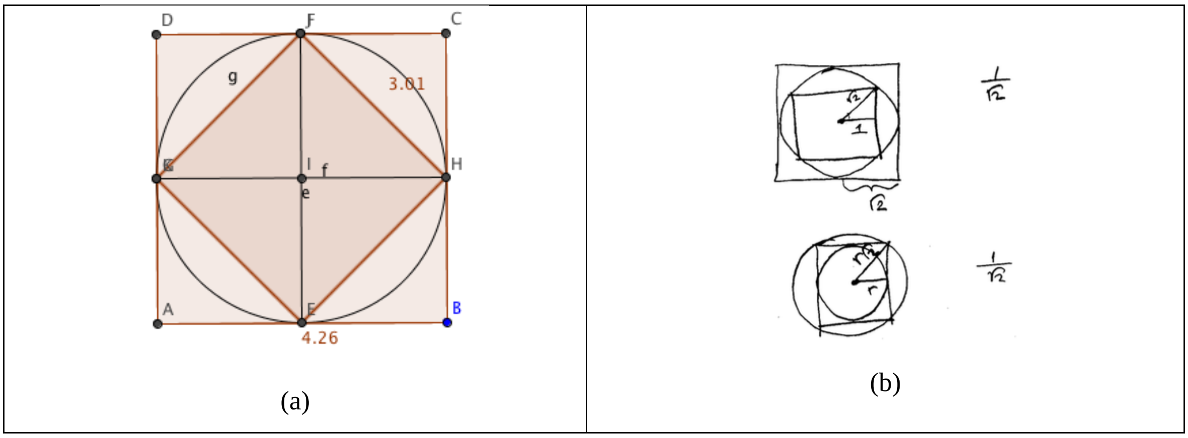


Figure 3. S2'solution Of First Question With And Without DGS

S2 used the dynamic software as a checking tool in the first question. First, she created the figure of a square, she found the length of inside and outside squares. Next, she calculated the ratio of inside square's side to the outside square's side. The tool helped her to construct the shape precisely and show the lengths in the question. She checked the area of polygons from the algebra view. Next, she made an explanation based on the triangles inside the squares. She moved the hotpoint and showed the results do not change even though squares size change. Her instrumentalization level was high. She could use the tool effectively. Once she finished solving the first problem, she was asked to solve the second one. In this question she started to solve the problem by using paper and pencil.

S2: AB chord is constant. I am trying to find out the maximum height. I need to draw a perpendicular line that passes through the center. The intersection of the line and circle would be my third point. This triangle would be an isosceles triangle (Figure 4(a)).
I: What about the second part of the problem?
S2: Before I start I thought regular shapes cover more area. But how can I show it on paper? I can use derivative.
S2: If I say 1 to the radius, then this length would be √1-x^2. And the height would be 1+x. I want the area to be maximum. So I would find out the derivative of this function and make it equal to zero . There are two numbers that make it zero but since I want the length, I take the positive one (Figure 4(b)). I got the x value as ½. Now, I need to find out what kind of triangle is when x =1/2. I will find the arctan which is √3. That angle is 60^0. Since it is isosceles triangle, it would be equilateral triangle.

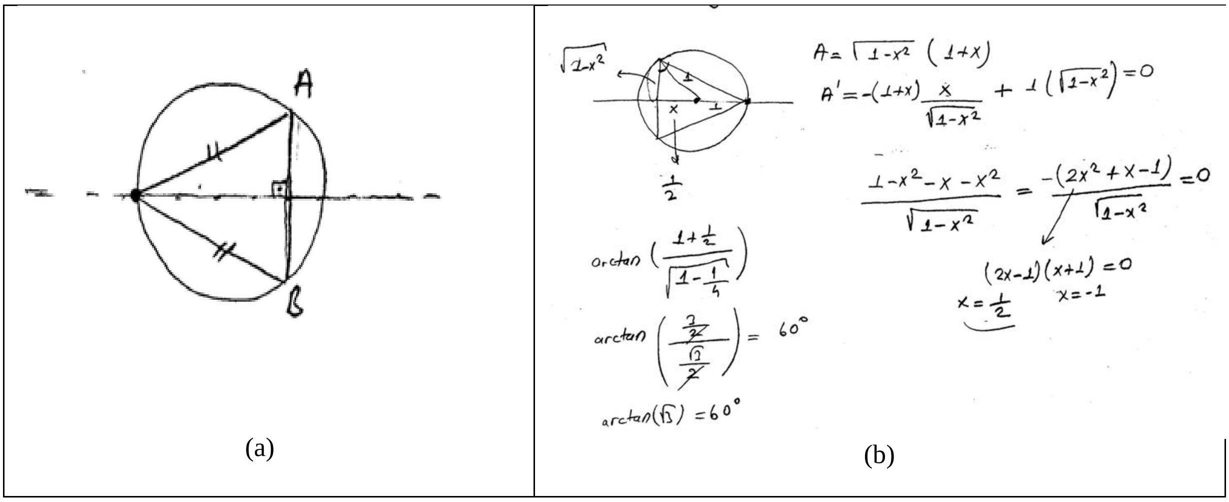


Figure 4. S2's Solution Of Second Problem On The Paper

In this question, she preferred to start from the paper solution similar to the previous one. She could solve the problem mathematically on the paper by using her content knowledge. After this solution, she was asked to solve it on GGB and she did the solution below:

I: How would you solve it with GGB?
S2: I can draw a unit circle on the axis where the center is origin. I take the point C and draw a perpendicular line from the point c. Find out the intersection of it with circle, which is D. I also take the E point, which is the height of the triangle. Next, I can find the area of the triangle, which is poly1. Then I took the point F. The coordinate of F can be (x(C), poly1). This way I can see when the x of point C gives the maximum area (Figure 5(a)). When I turn on trace on tool, I can see that F is maximum when the length are equal.
I: How can you show it on GGB?

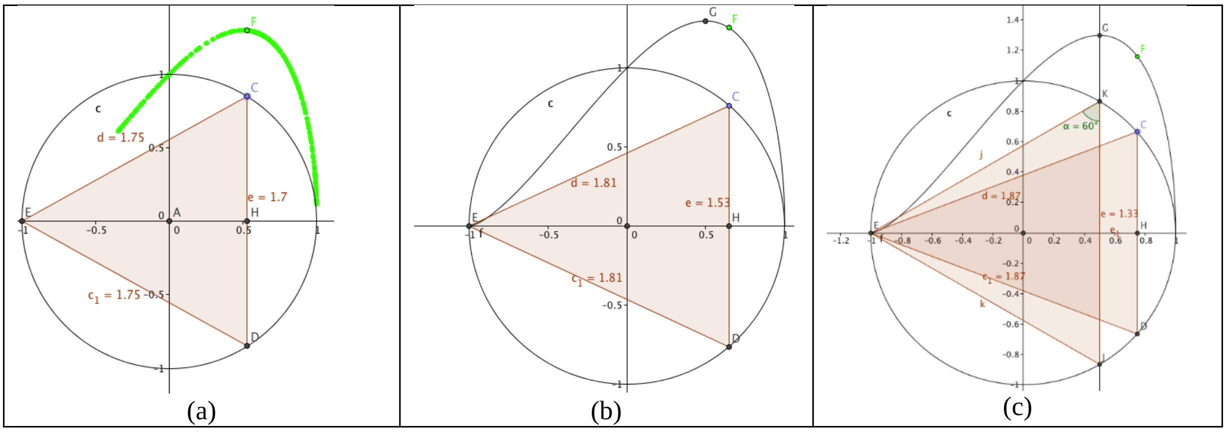


Figure 5. S2's Solution Of Second Problem With DGS

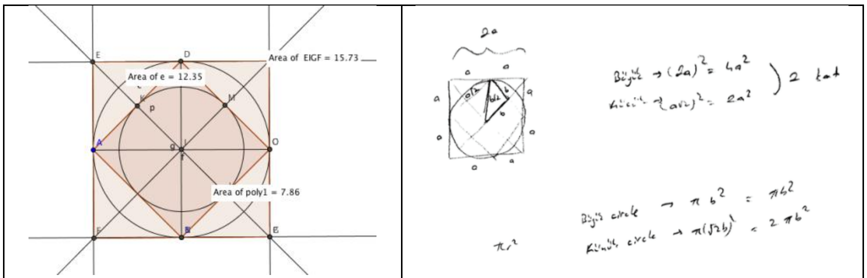
S2: I can draw the function which is $(x+1)\sqrt{1-x^2}$, since we used this function in order to find the critical points (Figure 5(b)). And then I can find the maximum point of f(x) function which is point G. Actually F is also the maximum when we move it on G.
I: How can you show the triangle is equilateral when the point is on G?
S2: I can draw a perpendicular from G to circle and get the intersection points (K and J). If I create the triangle KEJ, that triangle is equilateral. I can show each angle is 60^0 (Figure 5(c)).

From her solution, we can see that she could visualize the solution. In this question, it was more obvious that she could use the tool effectively. Thus, the type of questions were important to understand instrumental genesis. By using GGB, she could prove why the equilateral triangle has the largest area. Her GGB showed that her instrumentalization was very high. She is a harmonic thinker and similar to other students she preferred to use Geogebra to visualize the problem. Her Geogebra solution was more conceptual than her paper solution. Here it is important to say that her content knowledge was also very high. This helped her to use the tool effectively.

Case 3: S3's solution strategies (visual)

When S3 was asked by the first question she did it very similar to S1. She first drew the squares and then she created triangles inside of the square.

S3: There are four squares inside of the outside square and there are two small squares inside of the square. So the ratio is 2.
I: How would you solve it on the paper?
S3: I would give variables. One side of the outside square is 2a and one side of the inside square would be a√2. So the ratio would be 2.
I: What about the circles if we compare?
S3. (She draws on GGB and finds the area of circles by using area tool). I think there is the same ratio between the radius' of two circles. We can calculate it on the paper. The outside circle's radius is b and inside circle's radius is √2b. So the ratio would be 2.

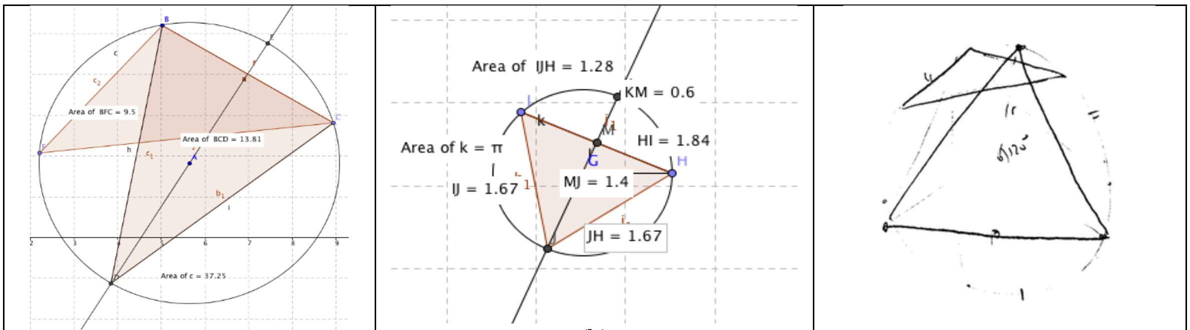


(a) (b)

Figure 5. S3's Solution Of First Problem With And Without DGS

As it might be seen from the solutions of S3, she used the dynamic software environment in order to create dynamic constructions. In her solution strategies, by dragging hotspots on the object she had a chance to test several iterations of the geometrical constructions (Figure 5(a)). The figures above show the dynamism of the figures with different values. During her solution, she dragged the blue points which are hotspots in order to enlarge or minimize the figures to illustrate the mathematical ratio is conserved for many points. Dragging hotspots illustrated Euclidean construction of squares could be created in DGS environment and the relationship between interior and outer squares can be observed. Using hotspots were essential to give feedback to users as S3 moved those points they inquired the mathematical reasoning behind the construction that conserve the geometric relationship. Next, she was asked to solve the second question. She drew a circle and then created the chord BC.

S3: In order to have the largest triangle I need the maximum height. I will find the perpendicular line to the chord. Then I will take the intersection of the line and the circle to find the vertex of the triangle. Then I can create the triangle. This triangle has the maximum area. I can check it with GGB (up to this part it was similar to S2's solution). I can take a random point on the circle and create a triangle. Then compare the area of the first and second triangle (she moved point F in order to test (Figure 6(a)).
I: Is this a special triangle?
S3: It is an isosceles triangle since I drew the height from the midpoint of the chord. I can also see that the sides are equal by using the length tool.



(a) (b) (c)

Figure 6. S3's Solution Of Second Problem With And Without DGS

I: What about the second part of the question?
S3: (She draws a circle which has radius 1 and tries to find the triangle that has the maximum area). If I look at the area of circle it is 3,14. This question is totally different from the other one. Here we can change the base. (She moves the triangle dynamically and sees that it has maximum area around the 1.3 value.) There might be a ratio between KM and MJ. I need to think again. I can find out the sides. All sides are equal.
I: Why?
S3: The height and base's values are closest when the triangle is equilateral. But I am not sure why it works. This one is also equilateral, but I cannot relate it with the other question. Because in the other question it asks me to take a chord and do not ask to find a maximum area in a given random triangle.
I: Okay, how can you explain it?
S3: Logically, when I change these points, the side becomes bigger but height gets smaller. But when they are equal we spread the circle equally. I am trying to explain mathematically, but I am not sure how to do this.

She continued by drawing triangles on the paper and stated that the triangle becomes bigger when we increase the length of the side but from one point, it starts to increase since the height becomes smaller (Figure 6(c)). For this problem, the instrumentation level was very high as the tool had an important role shaping her solution strategies. However, here it is important to note that it is difficult to separate instrumentation and instrumentalization since both affect each other continuously. These two concepts are interwoven and interdependent as was stated before. For example, in the second solution, S3 knew that the height of the triangle is passing through the midpoint of the BC chord. Without this knowledge, she would not have been able to create the correct construction given in the problem. So her knowledge allowed her to shape the use of the tool. Once she created the triangle that she thought has the largest area, she created another triangle and compared the area of the triangle with the one she created first by using hotspots.

CONCLUSION and RECOMMENDATION

Many researchers emphasize the importance of using tools in teaching and learning mathematics (Drijvers, Doorman, Boon, Reed, & Gravemeijer, 2010; Lagrange et al., 2003). However, they also state teachers have an essential role in using tools in order to help students understand mathematical concepts (Hoyles and Lagrange, 2008).

This study shows how the use of the same tool can change from one prospective teacher to another. The first and third cases, S1 and S3 (non-visual and visual thinker), used the dynamic software program as a tool to solve the problem. They constructed geometrical solution strategies by using the DGS environment. They used the hotspot effectively in making conjecture and generalization. Using hotspots was critical in supporting instrumentation as they received feedback from the tool while using the DGS. The use of the tool helped them to shape their mathematical knowledge and with the feedback taken from the tool, they developed new mathematical ideas and applied them again by using the tool. The interaction between the instrumentation and instrumentalization was highly effective in their solutions.

The second student (harmonic thinker) also used many dynamic features of the program in the second question; while she preferred to use the program to show the results that she did on paper for the second question. One of the reasons that she didn't use the program effectively in the first question might be related to the type of the problem. Even though, the problem could be solved more dynamically with DGS, it was possible to find a solution without using the software program. Thus, one of the important points in teaching with technology is the selection of suitable tasks. Another important point that is related to the instrumental genesis was using the technology in different solution strategies of the problem. It is important to facilitate instrumental genesis by making connections between DGS and the paper-pencil environment (Bretscher, 2009). When we compare the solution of the first question, using the triangles to compare the area of inside and outside squares was more conceptual than just using formulas. Especially for the second question, two students (S1 and S3) could not even interpret what question means without DGS. By using DGS they made conjecture about the type of triangle. Even though S2's solution on the paper was non-visual, she preferred to use visual method with DGS. She used different representations during the solution of the second problem. She wrote the function for which she wanted to find the critical points. Next, she drew this function and took a point on it. Also she created the triangle. Thus, her solution included three types of representation, algebraic, geometric, and numeric. This also revealed that the use of DGS facilitated students' use of representations (Huntley et al., 2000). Thus, the use of DGS might be important in supporting students' conceptual understanding.

In other words, students tended to solve the problems algebraically on paper, while they solved the problems geometrically on DGS environment. Regardless of students' thinking preferences, they used more visual methods when they solved problems by using the DGS environment. This result is also compatible with Harskamp et al. (2000)'s study. According to this study, the tools of Geogebra, which help to create lines and graphs automatically are important factors to have these results. Similarly Yerushalmy (2006) also stated the differences between the solution of the problem based on the environment. DGS environment helped students to make conjectures and check their answers. However, as it was seen in the second question, even though three students guessed the answer of the problem from the tool, they could not explain the answer mathematically. This shows the importance of content knowledge in supporting instrumental genesis. These results are consistent with Drijvers and Gravemeijer (2005), as they also emphasize the importance of interrelation between the tool and students' conceptual background in instrumental genesis.

Even though there have been some studies that compare the different strategies of students on DGS who have different preferences (Yerushalmy, 2006; Coskun, 2011), the importance of thinking preferences on supporting instrumental genesis has not been investigated up to know.

Since the use of DGS support using different type of representations, effective use of DGS might contribute to an in depth understanding of mathematics (de Jong & van Joolingen, 1998). In order to support instrumental genesis, teachers can determine students' thinking preferences from how they use the virtual manipulatives and how they use them to solve problems. Once they identify students' difficulties in their use of visual or non-visual representations, they can focus on the problems where they can connect visual representations with non-visual aspect of the problem. They can use DGS to solve the problem with different representations. This might support instrumental genesis. This way, regardless of students' thinking preferences, students can use DGS effectively.

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SCIENCE EDUCATION: BEYOND A LIMINAL UNDERSTANDING OF KNOWLEDGE PRODUCTION/DISSEMINATION

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ABSTRACT: The present paper is based on a first year BA Education Studies module that explores a number of important questions about the relationship between technology, knowledge and society and begins to think about how our ideas about each of these contribute to an understanding of what education means. Following a Foucauldian perspective on discourse, truth and power, we look with our students at science – and science education – to explore the production of knowledge in a context where many initiatives promote scientific literacy for children and young people. The present paper argues that it is important to reflect with students on these forms of knowledge production and dissemination so as not to see – and teach – science from a consumerist perspective but rather to embrace the idea of science education as a discourse that shapes our understanding of the world and ourselves.

Key words: science education, knowledge production, discourse, power, foucault

INTRODUCTION: SCIENCE AND SCIENCE EDUCATION

Science, in one form or another, has been “a subject” at school level in many countries for centuries. However, in recent years, science education for children and young people has become increasingly important, with the subject being an essential part of school curricula and as a result new guidance has been developed. For example, in England a revision of the subject has led to developments in the National Curriculum – which come into effect for all Key Stage 1 and Key Stage 2 pupils from September 2015 – and for pupils in Year 11 from September 2016 (Department for Education, July 2013). This means, from September 2015, all Key Stage 1 and 2 pupils will study the new National Curriculum science programmes of study – which is issued to schools by law and therefore must be taught by all local-authority-maintained schools in England.

The new ‘National curriculum in England: Science programmes of study’ states that ‘...all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science‘ (Department for Education, December 2014). This means, pupils should learn to understand the world through the specific disciplines of biology, chemistry and physics. ‘They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes’ (Department for Education, December 2014). The aim is to ensure that all pupils:

- ‘develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics;
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them;
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future’ (Department for Education, December 2014).

For children in Key Stage 1 – the two years of schooling in maintained schools in England normally known as Year 1 and Year 2, when pupils are aged between 5 and 7 – this means to experience and observe phenomena by looking more closely at the natural and humanly constructed world around them. They are encouraged ‘to be curious and ask questions about what they notice’ (Department for Education, December 2014). Older children – upper Key Stage 2, Year 5 and 6 – are encouraged to develop a deeper understanding of scientific ideas. ‘...they should encounter more abstract ideas and begin to recognise how these ideas help them to understand and predict how the world operates’ (Department for Education, December 2014). In Key Stage 3 – the three years of schooling in maintained schools in England normally known as Year 7, Year 8 and Year 9, when pupils are aged between 11 and 14 – pupils are encouraged ‘to relate scientific explanations to phenomena in the world around them and start to use modelling and abstract ideas to develop and evaluate explanations’ (Department for Education, December 2014). They should learn to pay attention to objectivity and develop concern for accuracy, precision, repeatability and reproducibility.

Although the Government – with the new curriculum – envisages schools and teachers to take greater control over what is taught in schools and how it is taught, using their professional skills and experience to provide the best educational experience for all their pupils, the new 'National curriculum in England: Science programmes of study' provides quite detailed guidance on the topics to be covered by schools. For example, in the Year 1 programme of study children should learn to:

- 'identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals;
- identify and name a variety of common animals that are carnivores, herbivores and omnivores;
- describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals including pets)' (Department for Education, December 2014).

Hence, many feel that with the new science curriculum there is 'a shift towards hard facts and "scientific knowledge"' (BBC News, September 2014). Others argue that the new science curriculum is 'a "two-tier curriculum" favouring the core subjects of English and maths at the expense of the arts and humanities' (The Independent, September 2013).

However, in general it seems as if the new curriculum follows what Hodson (1993) has pointed out as the three main purposes of science education, that is, to come 'to understand the major achievements of science', the concepts, the models and the theories, 'to learn about science', to develop an understanding of the nature and methods of science, and 'to learn to do science', involving modelling and model testing – although some argue that the main purpose of science education in schools should be 'to increase the flow of specialist scientists, technologists and engineers' (The Association for Science Education, The Economic & Social Research Council & The Teaching and Learning Research Programme, 2006); a sort of sensitization and pre-professional training.

The purpose of this paper is to critically reflect on current science education with the help of a case study example in order to develop a more critical understanding of what science education might mean for "future educators". The paper argues that – in the light of the new English National Curriculum – the teaching of scientific knowledge should be more than the presentation of facts and figures, in the sense of Millar and Osborne (1999, para 4.2), who argue that 'The science curriculum from 5 to 16 [years] should be seen primarily as a course to enhance general "scientific literacy"'. This means that educators need to be able not only to teach scientific facts and figures, but also to raise questions of truth, power and the subject itself in order for their pupils to recognise that scientific ideas change and develop over time. We use the Foucauldian theoretical positions of discourse and its power to produce "truths" as heuristic tools that future educators can use to diversify the teaching, learning and public understanding of scientific knowledges. We argue that it is therefore important to introduce prospective educators not only to science as subject, but also to make them aware of the importance of discourse in shaping our understanding of the world and ourselves – in the sense of Foucault, who pointed out that our society is being shaped (or constructed) by discourse, and in modern societies scientific discourse is highly valued and authoritative, which in turn reflects existing power relations – so they are able to provide a high-quality science education.

FOUCAULT: DISCOURSE, TRUTH AND POWER

With reference to discourse, in this paper we follow a Foucauldian perspective because of the implicit power the creation of discourse carries. Foucault (1981, p. 52) argues that:

> 'In every society the production of discourse is at once controlled, selected, organised and redistributed by a certain numbers of procedures whose role is to ward off its powers and dangers, to gain mastery over its chance events, to evade its ponderous, awesome materiality'.

Poignantly, science as discourse is one of the angles which we use in our module in order to re-pose questions about science education with students. Discourse, as argued by Foucault, transcends desire and institutions. Desire in relation to discourse is then understood as that subjective (circumstantial and often contextualised) position that we might find ourselves in; in any given moment we are juxtaposed with discourse(s). The institution, as Foucault (1981, p. 52) points out, is ontologically dependent on the production of a particular discourse; it replies to the individual by saying:

> 'You should not be afraid of beginnings, we are all here in order to show you that discourse belongs to the order of laws, that we have long been looking after its appearances; that a place has been made ready for it … and that if discourse may sometimes have power … it is from us and us alone that it gets it'.

In this way, the institution tries to control discourse, and its production and distribution (or dissemination), yet, discourse has a more subversive and insidious power, which permeates desire (subjectivity) and institution (objectivity). Discourse in itself could then be understood as symbolically, representationally, semantically and concretely forming and constructing the objects of which it speaks and in doing so it finds itself outside subjective and objective positions. The study of discourse as explored by Foucault is strung to the historical institutions that embrace it, give it a voice, silence it or disregard it; discourse then forms not only the objects of a particular reality, but also determines how that reality is formed. Discourse creates knowledges and "truth"; it creates "a world" that is both palpable but also transformative.

For instance, if we take Foucault's example of the historical opposition between reason and madness as represented by the 'madman' and his speech, we can appreciate how the scientific knowledges of psychiatry and psychoanalysis have emerged as a result of the continuous decoding of the evolving discourses around madness. But in these decoding there is still a very definite oppositional production of the conditions and characteristics associated with states of reason and madness. Foucault (1981, p.53) points to how:

> 'Since the depths of the Middle Ages the madman has been one whose discourse cannot have the same currency as others. His word may be considered null and void, having neither truth nor importance … It was through his words that his madness was recognised, they were the place where the division between reason and madness was exercised, but they were never recorded or listened to. No doctor before the end of the eighteenth had ever thought of finding out what was said, or how and why it was said … He [the madman] was only symbolically allowed to speak, in the theatre, because there he played the role of truth in a mask'.

This extract is pointing to how although the madman's speech was discredited it still held a credited position within the institution of the theatre, there on the stage, was the madman's place of worth, where his madness became mysticism and curse but still in its most rational form. Yet, it could be argued that this discourse is understood and decoded very differently now that the madman's speech is no longer sitting easily on one side of the divide between reason and madness. This is because this discourse is now decoded by other modern knowledge-institutions which no longer appraise his speech as immediately discredited, but rather '...that it puts us on the alert; that we now look for a meaning in it...' (Foucault, 1981, p. 53). Further referring to the development of a whole system of knowledge, knowledge-institutions and knowing-subjects (individuals) who are now responsible not only for articulating, the 'madman's speech' but also for diagnosing and treating it. Of these knowledge frameworks we only need to think '...of the whole network of institutions which permit someone – a doctor or a psychoanalyst – to listen to it, and which at the same time permit the patient to bring along his poor words or, in desperation, to withhold them' (Foucault, 1981, p. 53).

As part of this paper – and with reference to our case study – we use this Foucauldian understanding of discourse to critically analyse and re-pose questions about specific parts of scientific knowledge, and what the acquisition of these knowledges have allowed us to make of ourselves as part of a changing society, underpinned by varying and changing discourses. The problem that we present to students is not to do with drawing the line between truth and something else; in fact, the notion of discourse is pointing beyond this long-standing true-false opposition. Foucault (1994, p. 119) asserts that:

> '...the problem does not consist in drawing the line between that which, in a discourse, falls under the category or scientificity or truth, and that which comes under some other category; rather it consists in seeing historically how effects of truth are produced within discourses that, in themselves, are neither true nor false'.

Within this understanding we can open up possibilities to discuss scientific knowledge as discourse that is – amongst other things – pervaded by power relations. We, the authors of this paper, believe that discourse and power relations are important theoretical tools for students to understand how we are in a state of flux – societally and culturally – and that the examining of discourses is a powerful indication as to how societal and cultural change is created and effected. Therefore, in the module 'Culture, Curriculum and Technics', we are moving students beyond what is normally covered in a first year undergraduate course by introducing them to evaluative, theoretical tools that help them understand that all systems of knowledge are subject to debate. They are, as Foucault (1994, p.131) states, neither outside of power nor 'lacking in power'. Following this view, we argue that systems of knowledge are systems of power because of the types of discourses that they are formed by; implicitly exerting exclusion over others. Consequently, science education needs to have a strong and discernible criticality looking at the very

> '…mechanisms and instances that enable one to distinguish true and false statements; the means by which each is sanctioned; the techniques and procedures accorded value in the acquisition of truth; and the status of those who are charged with saying what counts as true (Foucault, 1994, p. 131).

Science education is a particular discourse of science and its truths, but ultimately, and following a Foucauldian perspective, is neither true nor static; it is incited by economic, political, social and ideological traits of our time.

CASE STUDY: EDUCATION STUDIES

We, the authors of this paper, both teach on the BA Hons Education Studies at London Metropolitan University (UK). The BA Hons Education Studies takes education as a study object. This means, the course tackles big questions concerning the place of education in the modern world as well as the detail of everyday professional practice in schools and other educational institutions. Hence, it addresses philosophical, sociological, epistemological and historical aspects of learning and teaching against the backdrop of education as part of changing societies. Through that, it prepares students for a range of socially responsible professional roles in a variety of settings – including primary, secondary and adult education; youth and community work; and health and social care.

Students on the course traditionally come from a broad range of backgrounds, with many students choosing the course as a second pathway into professional teaching. As Blagburn and Cloutterbuck (April 2011) point out, London Metropolitan University (UK) is made up of almost 50 per cent of non-traditional students. This is confirmed by internal statistics that show that the majority of students on the course come from a working-class and/or ethnic minority background. This means, students on the course have mixed abilities and interests – with many being unfamiliar with the theoretical frameworks used in academia – and science. They are 'outsiders' compared to 'those who know how the system works' (Pratt-Adams et al., 2010). Despite this, we have very high expectations of our students – and like to challenge and develop their personal learning and understanding.

One of the first modules student on the course need to undertake is 'Culture, Curriculum and Technics' – a 30 Credit Level 4 core module that runs over 30 weeks, from September until May. The module was introduced in 2012 as part of a broader restructuring of the BA Hons Education Studies. The aim of the module is to present a range of theoretical perspectives and tools, to students, which they can use to describe and analyse a curriculum as socio-cultural construction – and which also enable them to identify ways in which knowledge is produced, reproduced and transmitted. It is hoped that this enables students to move beyond a simplistic understanding of a curriculum as a set of subjects that need to be covered in a certain period of time towards a critical appreciation of knowledge and knowledge production in educational settings – including schools.

The module content is organised in blocks, six in total, which all address a specific question. These blocks are as follows:

- Block 1: What do we mean by culture?
- Block 2: What counts as knowledge and why do we educate?
- Block 3: How does representation construct knowledge?
- Block 4: How will new media technologies transform knowledge and education?
- Block 5: workshop project (Wiki workshop)
- Block 6: Does the Anthropocene have a future?

This means, the module does not introduce students to educational subjects, but rather encourages students to critically think about records and information; objects, evidence and interpretation; and stories, narratives and meaning. Students – in the sense of Vivianne Burr (2003) – are encouraged to 'take a critical stance toward our taken-for-granted ways of understanding the world, including ourselves'. This means, students are encouraged to see science as a 'set of practices' – following Stuart Hall's (1997) approach to culture. As Hall (1997, p.2) in relation to culture states: 'Primarily, culture is concerned with the production and exchange of meanings - the "giving and taking of meaning" – between the members of a society or group'. Equally science – and science education – could be seen as driving force for the creation and representation of our knowledge about the world we live in and ourselves.

It is in this context that students are introduced to the notion of discourse, which we define in a Foucauldian sense as '…a group of statements which provide the language for talking a way representing the knowledge about – a particular topic at a particular historical moment ...*'* (Hall 1992 cited in Hall 2004, p.72). This leads to the argument that knowledge might not be absolute but rather provisional and that what is presented in a curriculum represents selections from the knowledge available in any particular culture at a given point in time.

The module therefore moves beyond seeing science as a pure subject to be mastered by prospective students and educators; rather, that the subject itself opens up questions to think more holistically about knowledge creation and dissemination. Crucially, this approach envisages science education as needing to be creative and innovative – and challenging current perceptions and approaches by students as well as teachers.

CONCLUSION AND RECOMMENDATIONS

In this paper by looking at science and education in the context of an Education Studies module we, the authors of this paper, have evaluated practically, the objectives and some of the new developments in science education curricula and theoretically explored, the possible contributions of using the concept of discourse to approach the emergence and prevalence of scientific systems of knowledge. Similarly, we have argued that these scientific knowledge-systems are producers of reality and do not occur disentangled from power relations. Following a Foucauldian perspective we have also alluded to how these discourse-based producers of reality are not inherently producing truths, but rather, effects of truths. As a result of these explorations we argued that the education of prospective educators needs to move beyond fact-bounded pedagogy and approximate towards a more constructivist understanding of the subject.

In practice this means, to encourage students to de-essentialise curricula in order to become holistic pedagogues; to 'provisionalise' knowledge in order to be critically aware of its effects; and to understand the changeable, shifting, fluctuating and dynamic nature of societies. These myriad effects, changes and moves – within the module have been discussed – as occurring as part of a wider culturally, technologically and ideologically changing paradigm. The approach we have taken with our students is to critically question traditional concepts and pedagogies, by presenting to them conceptual tools, such as, discourse, power relations and constructivism that afford them the opportunity to flowingly reflect on these macro and micro level topics.

Consequently, as Wellington (2005, p. 107) states: 'The essential bridge that needs to be built [is] between the world of experiences (the phenomenal) and the world of explanation (the conceptual or theoretical)…'. We propose that to bridge this suggested gap students need to be given the opportunity to deal with metaphor, theory and the abstract but similarly, they also need to deal with the concrete, experiential and practical but not in an atomised and disjointed manner but rather understanding them as all-inclusive, harnessed, inseparable and unfolding continuum.

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IMPROVING THE EFFECTIVENESS OF ELECTROMAGNETIC THEORY EDUCATION BY INCREASING THE LEARNING MOTIVATION

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ABSTRACT: Electromagnetic theory course is currently taught in many institutions and in many disciplines. However, this course usually has difficulties in capturing the glance of students especially for undergrads in disciplines which are not focused on concentrated mathematics education. The common reasons are that the course has mostly theoretical concepts, it needs a well mathematics background and it usually does not have any practical application. Since active and experimental education is usually more attractive to the undergrads in engineering, theoretical courses are difficult for them especially for biomedical engineering undergrads. For this reason an electromagnetic theory course with its laboratory and a project work is developed to increase the motivation of the students and it is planning to be taught for sophomores in Başkent University Biomedical Engineering Program.

In order to make the course more attractive firstly, a survey has been completed for different electromagnetic course taught worldwide and syllabus has been updated. Secondly, visual and practical teaching materials are searched for the electromagnetic concepts and they are classified. Thirdly, laboratory experiments are organized and test devices and materials are ordered. Finally, a plan for teaching electromagnetic theory is advised.

This paper explains the walkthrough to make the electromagnetic course more attractive to the students. In the paper the methodology for efficient and attractive learning and syllabus design are discussed.

Keywords: electromagnetic theory, learning motivation, electromagnetic laboratory, active learning.

INTRODUCTION

Circa 1870, extraordinary equations were formulated called Maxwell's Equations. They represent a fundamental unification of electric and magnetic fields. Engineers and scientists worldwide use these equations on their works or studies (Taflove, 2002).

In our department of biomedical engineering curriculum, we also give a place to this course because mainly the department has bioelectrical based lessons. Biomedical engineering involves human physiology and also electricity. Therefore we need to learn electromagnetic to combine these different fields.

It is generally admitted that electromagnetic theory (EM) is one of the most difficult courses to teach in engineering curriculums. Especially for our students unlike other courses such as physiology for engineers, microprocessors or linear system, EM requires a lot of mathematical tools. The course consists heavily vector mathematics and closed-form field solutions are only available for symmetric, idealized geometries. This inclines to make most students assume EM as too abstract when it is actually based on experimental results. Except for the ones who are mathematically tended, engineering undergraduates usually feel uncomfortable with EM and beware of it (Beker, Bailey, & Cokkinides, 1998).

The traditional way of introducing EM is to concentrate on theory and to omit even simple EM applications, but applications can be used as a vehicle to explain fundamental theoretical concepts. Due to this fact we are developing new course outline for Introduction to Electromagnetic Course for Başkent University, Biomedical Engineering Students.

We researched popular courses in the world, mostly EM courses supported with complex virtual experiments to capture the students' attraction, but it is required numerical calculation knowledge and also programming experience. On the other hand, lecture hours are not even enough to teach EM concepts. For this reason, in our course outline we prefer basic but real applications and some simple virtual experiments using MATLAB. We add some experiments in our syllabus and we aim learning electromagnetic theory while having fun for students because students tend to become best motivated to learn something when they can see its relevance (Durney, 1973; Belcher & Dori, 2005).

For capturing the glance of students we moved on step by step. In the first step, a research was completed for different electromagnetic course taught worldwide and our syllabus was updated. Then, laboratory experiments are organized and necessary devices and materials was obtained. Finally, some recommendations were given for teaching plan.

METHODS

Syllabus

According to researches, electromagnetism is taught in many universities worldwide in different departments. Generally, the lecture is given by faculty of physics or faculty of engineering. On the other hand, they have some differences in their syllabus. Although some of the courses have laboratory sessions, the others do not (Table 1). This table is obtained in order to compare the lecture and laboratory hours for different programs.

Table 1. Syllabuses of the Universities Investigated

University	Department	Course Name	Lectures	Laboratory	Credits
Başkent, Ankara, TURKEY	Biomedical Engineering	Electromagnetic Theory	3 sessions / week	1 session / week	3
MIT, MA, USA	Physics	Physics II: Electricity and Magnetism	4 sessions / week	1 session / week	12
Utah, UT, USA	Electrical and Computer Engineering	Introduction to Electromagnetics	3 sessions / week	3 sessions / 8 weeks	
Colorado, Boulder, CO,USA	Electrical, Computer, and Energy Engineering	Electromagnetic Fields and Waves	2 sessions / week	X	3
Houston, TX, USA	Electrical and Computer Engineering	Applied Electricity and Magnetism	2 sessions / week	X	3
California Santa Cruz, CA, USA	Electrical Engineering	Electromagnetic Fields and Waves	2 sessions / week	1 session (2 hours) / week	5+2 (LAB)
Lamar, TX, USA	Electrical Engineering	Electromagnetics I	3 sessions / week	X	3
Queen Mary, London, UK	School of Physics and Astronomy	Electric and Magnetic Fields	3 sessions / week	X	15
Penn State Harrisburg, PA, USA	Science, Engineering, and Technology	General Physics II: Electricity & Magnetism		1 session / week	
Michigan Tech, MI, USA	Physics	Physics II - Electricity & Magnetism	3 sessions / week	X	3

When the details of lecture plan is examined, in faculty of physics, the syllabus is mostly intended to fields and charges. However, electromagnetic waves are selected more in engineering faculties. The course contents were listed and compared (Table 2). Massachusetts Institute of Technology, University of Colorado, Lamar University, Penn State University and Michigan Technological University have courses which are included all topics in our syllabus. At these universities, electromagnetism courses are taught in department of physics and/or faculty of engineering.

Table 2. Course Contents of the Universities Investigated

Topics \ Universities	Başkent, Ankara, TURKEY	MIT, MA, USA	Utah, UT, USA	Colorado, Boulder, CO,USA	Houston, TX, USA	California Santa Cruz, TX, USA	Lamar, TX,USA	Queen Mary, London, UK	Penn State Harrisburg, PA,USA	Michigan Tech, MI, USA
Vector Calculation	□	□	X	□	□	□	□	□	□	□
Static Electric	□	□	□	□	□	□	□	X	□	□
Gauss' Law	□	□	X	□	□	X	□	□	□	□
Conductor, Capacitor	□	□	X	□	□	X	□	□	□	□
Magnetic Fields	□	□	□	□	□	□	□	□	□	□
Faraday's Law	□	□	X	□	X	X	□	□	□	□
Maxwell Equations	□	□	□	□	□	□	□	□	□	□
Electromagnetic Waves	X	□	□	□	X	□	□	□	□	□

In the laboratory sessions of these courses (Table 1), there are some visual and multimedia teaching methods. There is a method at the Massachusetts Institute of Technology (MIT). The Technology-Enabled Active Learning (TEAL) Project involves media-rich software for simulation and visualization in freshman physics carried out in a specially redesigned classroom to facilitate group interaction (Belcher & Dori, 2005).

There is also another multimedia method. The Computer Applications for Electromagnetic Education (CAEME) Center developed software books in electromagnetics, and produced CD ROMs for teaching and learning electromagnetics. Available CD ROMs include video clips, and extensive assets of innovative multimedia modules including virtual labs and instruments, simulation software, and virtual participation in practical applications. Several IEEE and non-IEEE societies participated in this effort including the IEEE Microwave Theory and Techniques Society, Electromagnetic Compatibility Society and the Applied Electromagnetic Society (ACES) (Iskander, 2014).

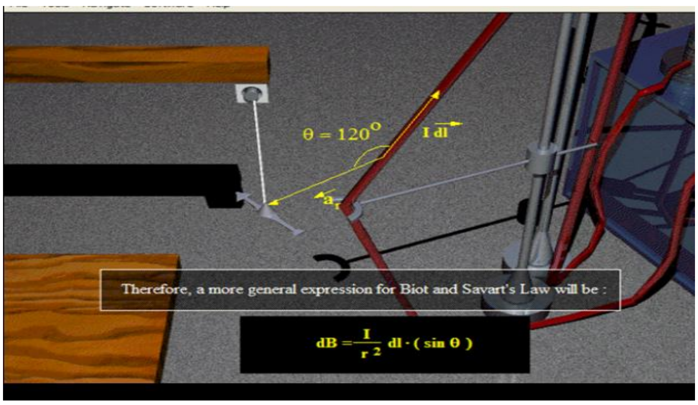

Figure 1. Virtual experiment illustrating Biot-Savart Law (Iskander, 2014).

Moreover, MATLAB is a choice to make electromagnetic simulations. MATLAB is an object oriented programming language. Signals, waves or some circuit combinations can be simulated with MATLAB. On the other hand, all of these methods require some programming skills and background information about these programs' toolboxes.

The last visual method is an application is called PhET Simulations. This application includes more simple examples and more understandable than the other methods to help students engage in science and mathematics through inquiry, PhET simulations are developed using the following design principles:

- Encourage scientific inquiry
- Provide interactivity
- Make the invisible visible
- Show visual mental models
- Include multiple representations (e.g., object motion, graphs, numbers, etc.)
- Use real-world connections
- Give users implicit guidance (e.g., by limiting controls) in productive exploration
- Create a simulation that can be flexibly used in many educational situations

We also incorporated this application into our experiments. If there is a match between our experiments and the PhET Simulations, after finishing the real experiments, the students check the test results by doing the simulations.

Experiments

In our electromagnetic theory course there are some real and visual applications in laboratory sessions. Although the sophomores do not have the knowledge about MATLAB, we counted a MATLAB simulation in our experiments. This application added to introduce MATLAB to students. Because, there will be many courses which are connected with MATLAB simulations on terms ahead.

Faraday Ice Pail experiment is done to show the electrification of the conductive materials. The mechanism was named "Faraday Ice Pail" by Michael Faraday, because he used an ice bucket as the conductive metal in the experiment. To perform this experiment, one metal bucket, one metal ball which is connected a plastic stick and one electroscope are used (Bueche, 1988).

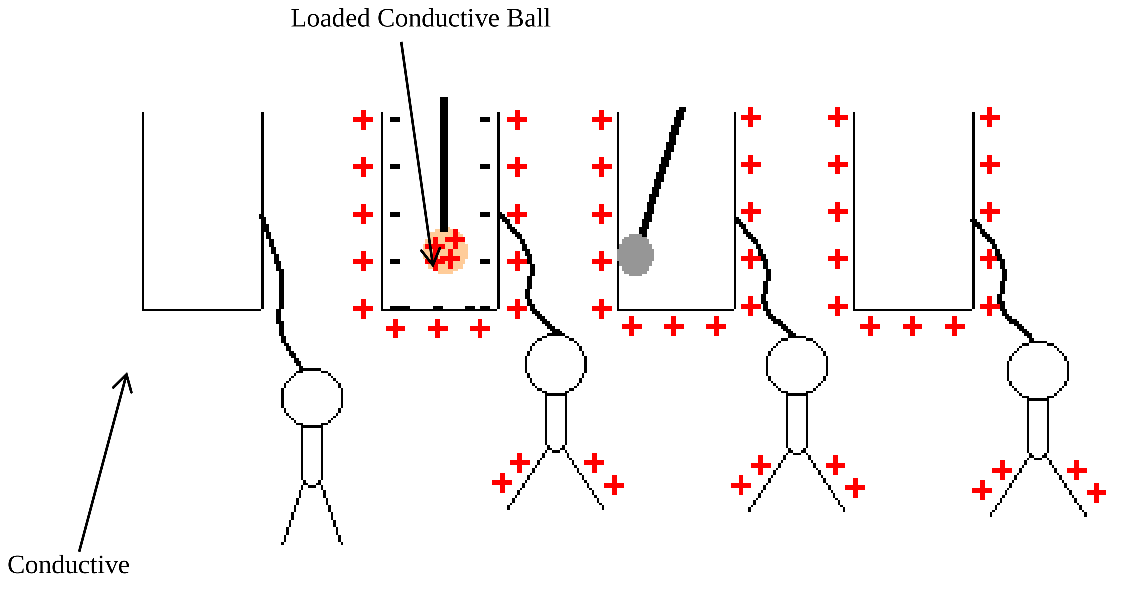

Figure 2. Faraday Ice Pail Experiment (Bueche, 1988)

Induction Experiments for Faraday is done to figure out the aim and applications of Faraday's Law. Also learn how make an electromagnet. One coil, one iron stick, one conducting wire, two bar magnet and one ampere meter are used for this experiment.

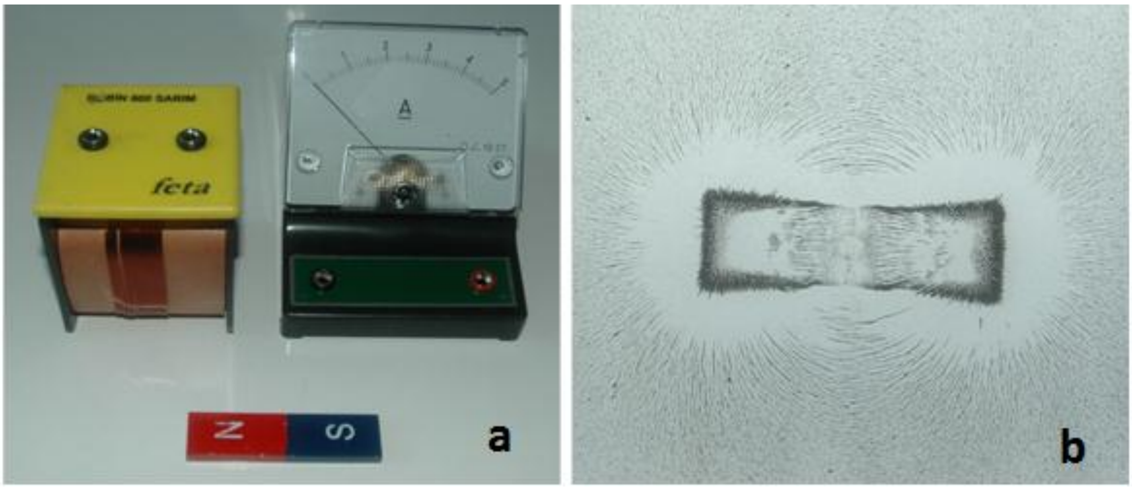

Figure 3 (a) Induction Experiments for Faraday (b) Magnetic Field Lines Experiment

Magnetic Field Lines is done to observe the magnetic field lines, the lines' behavior and direction. Required materials are one bar magnet, a white paper and iron fillings.

Magnetic Field in the Cause of Current experiment is performed to see the observation of the magnetic field created around the current-pass conductor and the moving of compass needles. Required materials are iron powder, circuit key, broadsheet-sized cardboard, batteries, wire, two compasses, magnet.

Besides the real experiments, we added a Matlab exercise to make students seem familiar about using Matlab and observe some electromagnetic fields in 2D and also 3D graphics (Arı & Özen, 2008).

Teaching Plan

In order to increasing the learning motivation, we advised some methods. First and foremost is laboratory session. In addition to experiments, assignments were planned for each topics and experiments. But above all, the first assignment is about TEAL. Afterwards, students have to research and observe each simulation on TEAL's website at the end of each topics. Furthermore, at the laboratory sessions, the matching simulations in PhET will be done and results will be compared with test results by students.

CONCLUSION & DISCUSSION

To sum up, to make the EMT more attractive, a progress was made. First of all, we updated our course contents and our schedule by doing a research about different electromagnetic course taught worldwide. Additionally, we included a laboratory session into our syllabus.

The electromagnetic course was just abstract before. However, after lecturing in this format, the students' results got better. Because now the lecture is more practical and it lets the students learn more clearly and easily. In that, students can visualize the abstract topics by doing experiments and simulations. Moreover, the experiments improve team working skills and active learning. Also, owing to projects, students have the chance to develop their presentation skills.

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A SHORT COURSE ON SPECTROSCOPY AND SPECTROPHOTOMETRY TRAINING FOR WORKERS IN INDUSTRY

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ABSTRACT: The use of spectrophotometers pass beyond academic research laboratories and become widely used in many industries including plastics, medical, chemical, textile, food, painting, paper, pharmaceutical etc. They are used for processing, quality control, testing and research purposes. Although they become more common as a tool in industry, mostly, industry workers do not have scientific knowledge and practical usage experience. These unexperienced workers cause misinterpreted results and loss of time and money. Due to this fact we offered a two days course for introduction to spectroscopy and practical usage of a common spectrophotometer.

The course includes lectures and experimental work. Contents are introduction to spectroscopy, safety usage requirements, sample preparation for testing, calibration of device for different references, two experiments and data processing of the results. This paper describes the need for the course, learning objectives of the course, the explanation of the course contents and used tools for experiments. Finally we report the results of the assessment in terms of trainee's responses and evaluations. The goal of this lifelong learning course is to help industry workers to study the fundamentals of spectroscopy, to use modern spectrophotometer instrumentation safely and correctly and to obtain accurate results. The results shows remarkable success in terms of course requirement and improvement of workers knowledge and expertise about spectrophotometry.

Key words: spectroscopy, spectrophotometer, lifelong learning, industry education

INTRODUCTION

Lifelong learning is now recognized as both a social right and economic necessity, there is a constant need to improve and update knowledge and skills (Anderson, 1999). Improving quality in products and services results high level of competence among companies. In many rapidly developing and already developed industries competence becomes obsolete especially technical competence. Due to this fact employees working in industries need continuous updating and upgrading. Implementing lifelong learning through Industry-University partnership is going to be a requirement in business life. (Otala, 1994)

We (SASAN, Ankara, Turkey) as a medical disposable producer company use spectrophotometer analysis for our process, quality control and research. We experienced that using a scientific equipment efficiently is not possible to just reading the manual or just by getting the application education provided by the supplier company. We also observed that misinterpreted results caused loss of time and money. So we asked for a collaboration to a training course to understand the details of spectrophotometry.

In order to satisfied similar needs of the industry we designed a course named "A short course on spectroscopy and spectrophotometry training for workers in industry" and we taught it as a trial to employees of SASAN. In this paper we described the details of the course design and trainees opinions before and after the course.

For designing the course we survey similar courses, mostly the similar example is laboratory experiments in applied science and engineering department of universities. Then the contents of the course is defined, experiments are organized and for the assessment, quiz examinations are prepared.
The final purpose of this lifelong learning course is to help industry workers to study the fundamentals of spectroscopy, to use modern spectrophotometer instrumentation efficiently.

LIFELONG LEARNING

Ongoing, voluntary, self-motivated and systematic learning of adults who concluded initial education or training is called lifelong learning (Cliath & Rialtais, 2000). Education and training are critical factors for achieving the economic growth, competitiveness and social inclusion. And the need for education and training not for only young people, because research in natural and social science, technological improvements and professional experience are ongoing so adults should learn and practice what they need on these and practice them in their life. (*Adult learning: It is never too late to learn*, 2006)

Lifelong learning should supported by a systemic approach, for teaching and education planning. Cliath 2000, report the necessary properties for quality adult education. We summarize and adapted them for our purposes. A quality adult education should include the following.

- A holistic curriculum.
- A view of the student as a self-directed, self-motivated learner.
- A participative model.
- A solid course objective.
- A high-standard learning outcomes.

The curriculum should focused on learner's educational needs and personal background also it should reflects learner's experiences about the contents of the education. Courses should be supported both by the teachers and the learners. (Cliath & Rialtais, 2000)

Also European Commission (*Adult learning: It is never too late to learn*, 2006) advised that for a quality adult education teaching methods should cover the following:

- Teaching methods and materials should be organized to the specific needs of learns.
- Learning outcomes should be explicit.
- Education resources should be considered as a guidance, literacy provision and study skill developer.

In order to provide to good lifelong learning course for an industry worker both industry and education institute should work together they should combine institutes strategic capabilities and industries operational capabilities (Otala, 1994).

COURSE DESIGN

According to the lifelong learning strategies and literature review on spectrophotometry laboratory experiments we define a course content:

- Spectroscopy (1 hour)
- Spectrophotometry (3 hours)
- Spectrophotometer devices (1 hour)
- Particular spectrophotometry device and software (3 hours)
- Sample preparation (2 hours)
- Experiments (6 hours)

The total course period is two days. Hand-outs are prepared beforehand. There is not a textbook, we use the manuals and handouts. 3 quiz examinations are applied and evaluated. The details of the lectures are explained below.

Spectroscopy

In order to understand the concepts learners should first learn what spectroscopy is. We start with definition spectroscopy and theory background of it.

Spectrophotometry

Spectroscopy is study of interaction between matter and electromagnetic radiation. Spectrophotometry is the quantitative measurement of the absorption, transmission or reflection properties of electromagnetic waves through a matter. (Pavia, Lampman, Kriz, & Vyvyan, 2014) By spectrometric analysis the properties of materials can be understood and classified. In the second part of the course details of spectrophotometry is explained. The analyzing methods and how to observe the results are discussed.

Spectrophotometer Devices

This part of the course is deal with the devices and the properties of devices. Theoretical background and the working principles of the device are explained. The components of the instruments are observed. Different types of spectrophotometers and their application fields are discussed.

Particular Spectrophotometry Device and Software

Particular spectrophotometer that we have were observed before and in this part of the course it is taught to the learners. Measurement methods which is specific for the device is discussed and the evaluation of the output results are trained.

Sample preparation

Our samples were observed before the course. Specific sample preparation methods are organized and taught to the learners.

Experiments

The measurement which is specific for the company needs are examined before the course. And experiments are protocols are design and they are applied with the learners in this part of the course.

Course Materials

We organize hand-outs about the theoretical knowledge of spectroscopy and spectrometry. Protocols for sample preparation and experimental procedure has been revised and reports are developed. Finally spectrometer, light source and software manuals are revised and organized. Trainees used these materials. Spectrometer, light source, software, fiber cables and cuvette holder are shown in Figure 1 and 2.

Figure 1. From Left To Right: Fiber Cable, Light Source And Cuvette Holder.

Figure 2. From Left To Right: Spectrometer, Whole Measurement System And Software.

After an intensity absorbance measurement of the system is shown in Figure 3.

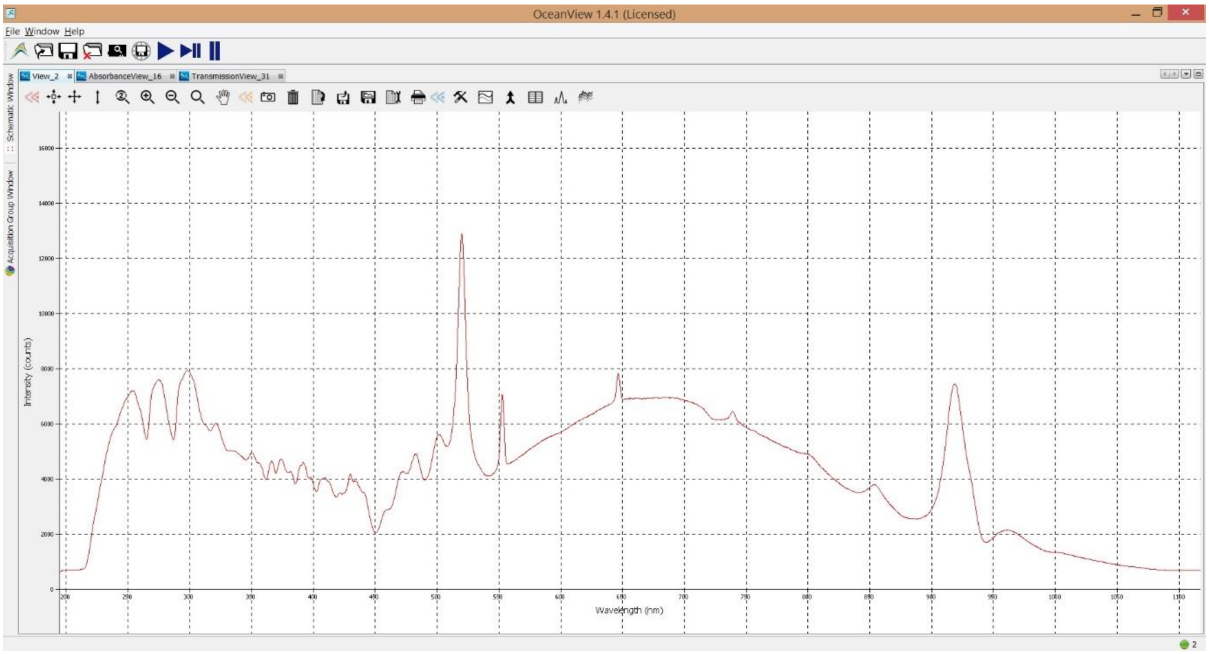

Figure 3. Absorbance Intensity Measurement Screen.

ASSESSMENTS

We did the course assessments in qualitative and quantitative ways. Qualitative ways we evaluate learners' responses on survey about their opinion of their knowledge and expertise. Quantitative way is their quiz examination results.

We have 5 learners 1 is biology laboratory technicians, 2 is biochemistry technicians and 2 are engineers.

For the qualitative analyses we did a survey before and after the course the questions are below:

- Do you have general knowledge of spectroscopy?
- Do you have a general knowledge of spectrophotometry?
- How well you know the spectrophotometer you have
- Do you know how to prepare your sample?
- Do you know how to analyze your results?
- Do you think that do you need to get a course on spectrophotometry?
- After the course do you think that you should get the course before?

The evaluation levels are: 1 for none, 2 for fair, 3 for average, 4 for good, 5 for very good. The survey evaluation results are given Table 1.

Table 1. Survey On Trainees' Qualitative Evaluation Of Progress.

	1. Trainee		2. Trainee		3. Trainee		4. Trainee		5. Trainee		Average	
Questions	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Do you have general knowledge about spectroscopy?	1	4	1	4	2	4	2	3	4	5	2,0	4,0
Do you have a general knowledge about spectrophotometry?	3	5	1	4	2	5	3	5	5	5	2,8	4,8

How well you know the spectrophotometer you have?	3	4	5	5	5	4	5	4	5	5	4,6	4,4
Do you know how to prepare your sample?	5	5	5	5	5	5	5	5	4	5	4,8	5,0
Do you know how to analyze your results?	2	4	2	5	3	5	4	5	4	5	3,0	4,8
Average	2,8	4,4	2,8	4,6	3,4	4,6	3,8	4,4	4,4	5,0	3,4	4,6
Do you think that do you need to get a course on spectrophotometry?	5		3		3		1		1		2,6	
After the course do you think that you should get the course before?		5		5		5		5		2		4,4

For the quantitative analyses we did 3 quiz examinations the quiz examinations are about:

- Spectroscopy, spectrophotometer and theoretical knowledge.
- Spectrophotometer device and software.
- Hands-on experience, sample preparation, graph analyzes.

1st quiz is about theoretical knowledge and applied in the end of the first day. 2nd quiz about spectrophotometer device and applied at the midday in second day. 3rd quiz applied at the end of the course. The results are given in Table 2.

Table 2. Quiz Evaluation For All Trainees.

QUIZES	1. T	2. T	3. T	4. T	5. T	Average
Spectroscopy, spectrophotometer and theoretical knowledge.	80	70	70	70	80	74,0
Spectrophotometer device and software.	70	60	80	80	80	74,0
Hands-on experience, sample preparation, graph analyzes.	70	70	80	70	90	76,0
Average	73,3	66,7	76,7	73,3	83,3	74,7

DISCUSSION

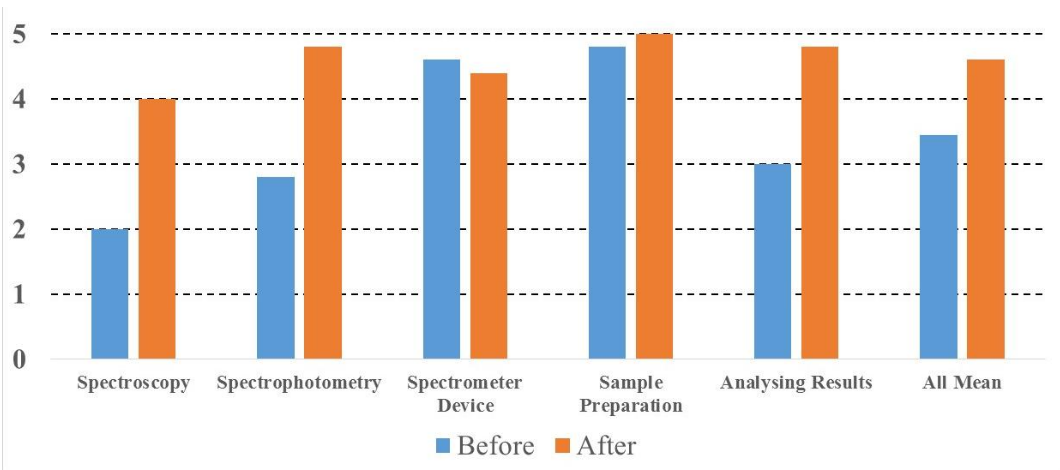

Figure 4. Survey On Trainees' Qualitative Evaluation Of Progress.

The survey on trainees' qualitative evaluation of progress in shown in Figure 4. They think that their knowledge was around average before the course and after the course their knowledge and expertise are good-very good. One of the important point is that they were think that their knowledge on spectrophotometer device was better than after course. This could be because they do not know what they know before.

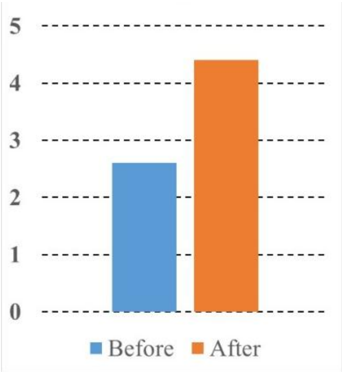

Figure 5. Trainees' Opinions On Course Requirement.

Trainees' opinions on course requirement is reported in Figure 5. And it is obvious that they thing thy do not need the course before the course after the course they agree that they need it.

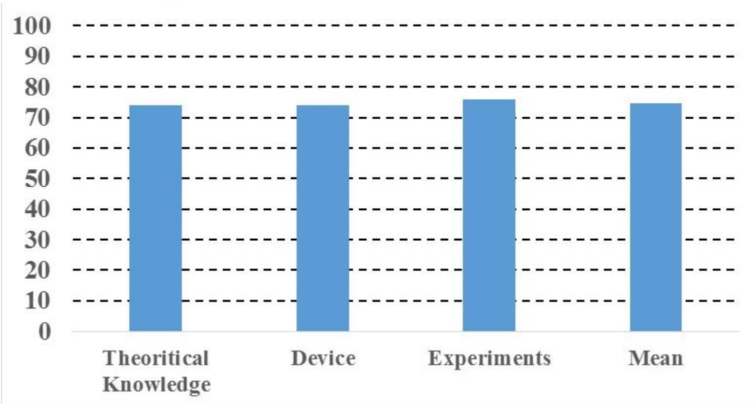

Figure 6. Quiz Evaluation For All Trainees.

Figure 6. and Figure 7. shows the quiz evaluation results, and it is obvious that they are successful.

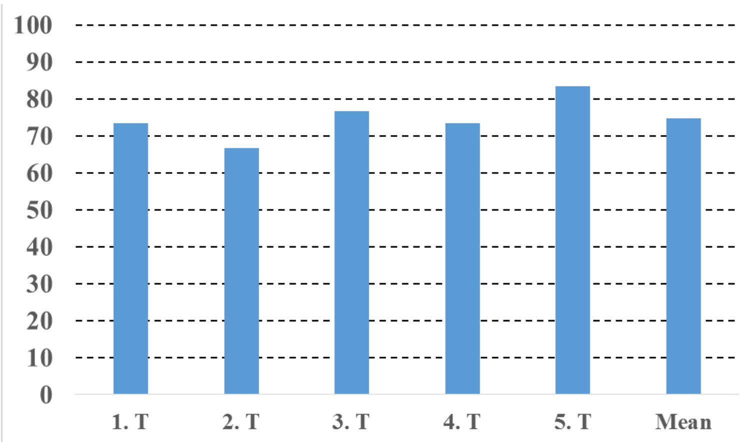

Figure 7. Trainees' Average Grades.

CONCLUSION

Successful companies are need to have a competitive nature, according to this they need to improve their workers performance. In order to improve our workers performance on spectrophotometry analysis we design a 2 day short course on spectroscopy and spectrophotometry. Lifelong learning is a crucial component according to the recent literature and teaching methods should be systematic due to this fact we collaborate with a university professor and his student for the course planning and evaluation.

We evaluate the course qualitatively and quantitatively, and we show that workers needed the course and they have improve themselves after the course.

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ONLINE LEARNING: CAN VIDEOS ENHANCE LEARNING?

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ABSTRACT: Higher education lecturers integrate different media into their courses. Internet-based educational video clips have gained prominence, as this media is perceived to promote deeper thought processes, communication and interaction among users, and make classroom content more diverse. This paper provides a literature overview of the increasing importance of online videos across all modes of instruction. It discusses a quantitative and qualitative research design that was used to assess on-line video pedagogy and perceptions of lecturers and students of video use.

Key words: online learning, online videos, ICT, blended learning,

INTRODUCTION

In recent years, many universities have increasingly used online learning resources as an adjunct to traditional modes of learning and as part of the Blended learning. Blended learning is the purposeful use of technologies in subject design to enhance the learning and teaching experience for teachers and students by enabling them to engage in ways not previously available to them (JCU Blended Learning Policy, 2014). One of the most promising approaches of blended learning that has attracted attentions among higher education lecturers is to integrate different media into courses. Internet-based educational video clips have gained prominence, as this media is perceived to promote deeper thought processes, communication and interaction among users, and make classroom content more diverse. Educational benefits of online affordances and web-based information have provided both students and academics such an opportunity to see different types of educational videos available only through an internet connection. According to Sherer and Shea (2011), integrating online videos to deliver a subject in any mode (traditional, online, or blended) provides many opportunities for students. For instance, it can enhance lectures, class discussions, exams, and even students' skill competency. Similarly, Lance and Kitchin (2007) argue that academics no longer need to carry out-dated videos and DVDs from class to class as they can simply present the video by accessing the internet during class, copying the link into their presentation slides, or even inserting them into their web-pages. These and other resources can be interwoven to make the classroom more diverse. For instance, Greenfield (cited in Lance & Kitchin, 2007) postulates that videos can offer "an accessible visual and emotional experience to students', presenting 'a literacy', and a new language – the 'language of images', and a form 'symbolic visual codes'" (p. 113). In a similar vein, Sherer and Shea (2011) state that the flexibility, accessibility, and content breadth of online videos provide opportunities for both teachers and students as they can be used to shape and contribute to subject content as well as increasing students' engagement in classroom activities.

Providing the students with the opportunity of complementing courses with the Internet-based educational video clips has been one of the crucial developments in higher education. Traditionally, courses were offered in internal or face-to-face mode. Today, however, owing to the growth of technology and ICT, most subjects are offered fully or partially blended. Sherer and Shea (2011) state that the use of online videos in higher education is increasing as part of the explosion of Web 2.0 tools that are now available. Thinking about how educational video clips can enhance learning gives academics the opportunity to adjust and update their traditional curriculum and teaching approaches to meet the needs of diverse learners in higher education. More recently, McCoog (2007), Henry et al. (2005), and the Bill and Melinda Gates Foundation (2010) highlight the importance of thoughtful and purposeful use of technology to facilitate students' achievements. They state that it should help exploration of other learning avenues in the process of differentiating instruction with clear educational goals. It should also engage students in creative information gap activities and real experiential learning. To address the obstacles to US educational innovations and tap the potential of technology, for instance, the Bill and Melinda Gates Foundation argue that utilizing technology intelligently can dramatically improve American students' readiness and completion. Furthermore, the emergence of the Net- generation indicates that universities have to address and include the role of technology in their teaching and learning. The Net-generations are "demanding a change in the classroom because of their ability to gather information faster than any other generation" (Willingham, 2010, p. 1). With the increased use of computers and technology comes the increased need to equip learners to engage with the challenges in different learning modes. In providing an optimal learning environment for learners, we need to understand students' experiences and perceptions, as well as how to best use technology affordances to enhance face-to-face and blended classes.

Online affordances and and web tools are typically designed to engage students and to improve the quality of their learning experience and outcomes. The reverse could also be true. Counter to the studies positing that a mixture of media with the course will meet the needs of more learners and lead to a better learning outcomes, Angiello (2010) and Means, et al. (2009) believe that the inclusion of more media (e.g., videos, and online quizzes) does not enhance the amount that they learn in courses. Thus, it is important to consider students' perceptions of the changes in educational aspects in parallel with technological innovations and different types of ICT resources. Integrating of students' preferences through understanding their perceptions of these innovations into their learning environment may facilitate meeting individual learning needs. The results of some studies have revealed the effectiveness of different technological modes of instruction and the positive perception of students (e.g., Evans, 2008; Karal, Çebi, & Turgut, 2011; Rose, 2009). This study aimed to provide insight about lecturers and students' perceptions at the school of Education, JCU, of integrating video affordances in their pedagogy.

METHODS

Participants

The study included 76 tertiary students of both genders studying at James Cook University and their lecturers (*N*=4). The students were taking undergraduate subjects at the schools of Education (i.e., ED3441). The lecturers (*N*=4) from the school of education were selected on the basis of their past teaching experience using technology (ICT) to support their instruction.

Research Tools

Using a mixed methods approach, the researchers validated and distributed an online questionnaire via SurveyMonkey including two sections. In the first part, the researchers aimed to identify participants' level of agreement with statements related to the use of videos in different modes of instruction through likert-type scale questions. The second part of the instrument included some open-ended questions to give students a clear voice on issues, experiences and perceptions of online videos utilized in different modes of instruction (online, blended or face to face). Semi-structured interviews with students (*N*=4) and their lecturers (*N*=4) were also used as a key qualitative dara source to further investigate their perspectives about learning through online videos, across different modes.

Data Collection Procedure

The quantitative phase of the study was carried out exclusively through the use of online survey as studies (e.g., Carini, Hayek, Kuh, Kennedy, & Ouimet, 2003; Delaney, Johnson, Johnson, & Treslan, 2010) have revealed its effectiveness and efficiency in collecting data. For the qualitative part, interviews with 4 studetns and 4 lecturers were conducted, audiotaped and transcribed.

RESULTS AND FINDINGS

Quantitative data

Initially, the 12 items of the researcher made questionnaire were subjected to principal components analysis (PCA) using SPSS version 22 to identify the more managable set of variables and factors. According to Pallant (2011, p. 122), "[F]actor analysis is used when you have a large number of related variables and you wish to explore the underlying structure of this set of variables". Principal components analysis revealed the presence of three components of learning experience, motivation and engagement (see Table 1).

Table 2: Principal Components Analysis

	Factor		
	Learning Experience	**Motivation**	**Engagement**
Using online videos helped me to reflect on what I was learning.	**.80**	.10	.14
Online videos used in the subject contributed to my learning.	**.66**	.28	.48
My reviews of online videos improved my performance in the subject.	**.66**	.31	.01
The use of online videos enriched the subject materials.	**.66**	.29	.47
Online videos helped me do better on assignments/exams.	**.61**	.27	.38
The use of online videos in the subject helped me understand the material better.	.33	**.75**	-.01
The use of online videos in the subject enriched my learning experiences in this class.	.38	**.61**	.35
Online videos provided me with valuable resources for this subject.	.52	**.61**	.19
The use of online videos in the subject stimulated my interest in class sessions.	.06	**.57**	.27
I prefer learning through videos more than through an in-class lecture.	.01	.04	**.52**
I was able to learn effectively because of the mix of videos used in this subject.	.29	.45	**.50**
Online videos made the class more interactive.	.14	.36	**.47**

The factors were then subjected to descriptive analysis and the results are shown in Table 2. Based on the results, the 3 main categories resulting from integrating online videos were learning experience (M=19), motivation (M=15.78) and engagement (M=10.81).

Table 3: Descriptive Statistics of three Factors (*N*= 76)

	Minimum	**Maximum**	**Mean**	***SD***
Engagement	4.00	15.00	10.81	2.01
Motivation	7.00	20.00	15.78	2.63
Learning Experience	9.00	25.00	19.00	3.22

Qualitative phase

The preliminary results of the interviews also revealed the educational values of the online videos such as:

- Increasing learners' engagement and promoting their critical thinking, decision making and creativity
- Offering useful conceptual links between the theory and practice as they can connect to experiments outside the university
- Providing an avenue for learners to visualize concepts that they might not have the opportunity to see during the subject
- Providing new avenues for lecturers to engage in rigorous and serious observations of classroom activity to support and improve learning and teaching and expanding what they present

CONCLUSION

This study attempted to explore the effectiveness of integrating online videos in support of students' learning. The findings revealed that students thought the videos could help them to improve their learning which also confirmed the previous studies and the positive perception of students (e.g., Evans, 2008; Karal et al., 2011; Lance & Kitchin, 2007; Rose, 2009; Sherer & Shea, 2011). The findings revealed that using videos to support learning and teaching could enhance students' learning experience, motivation and engagement with the course content and proved the videos' potential to satisfy the promising expectations of learning by assisting the delivery of high-quality services.

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ACCELERATING CHILDREN REASONING IN PRIMARY SCIENCE USING INDIGENOUS KNOWLEDGE SYSTEMS AND ARGUMENTATION - BASED INSTRUCTION.

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INTRODUCTION

Over the years researches in science education particularly at the primary school level have been focussed on instructional strategies that will accelerate children learning and to win them over for the sciences. The approach that seems to be mostly stressed is the conceptual change approach as against the teacher centred approach that mostly stressed rote learning. In the 1970's and 1980's there was a paradigm shift from the traditional way of teaching science as accumulation of facts to the constructivist approach (Akintunde, 2004; Ajaja, & Eravwoke, 2010). The constructivist approach to teaching emphasises an exploration of students prior knowledge and alternative conceptions in science. As asserted by Katniyon (2014) there is a big difference between school science and what African children bring from their home background and culture. As a result learners feel alienated and perceive science as abstract ideas since it fails to relate to the realities of their immediate environment and to their everyday life experiences. Hence the idea of science teaching that is aimed at exploring the prior knowledge of learners and gearing of teaching towards achieving conceptual change is a welcome idea.

Piaget is one of the proponents of constructivist approach to teaching. Piaget theory of cognitive conflict work underpinned science curriculum materials aimed at accelerating reasoning particularly at the primary age of schooling (Adey, Shayer and Yates 2001; Adey Robertson and Vanville 2001). As posited by Eduran , Ardac & Guzel (2006) it is difficult to explore student's prior knowledge and reveal their conceptions without the appropriate teaching strategies. One strategy that has been found useful in accelerating children learning is the cognitive accelerating programmes, where extensive coaching in and out of school over long periods of time did bring about changes in practice and positive effects on students reasoning. Students helping students to develop epistemological beliefs have also been recommended for science teaching that will accelerate children learning (Ochima, 2012). Argumentation based instruction is one of the teaching strategies that have evolved as a useful tool in accelerating children reasoning and subsequent achievement in primary.

Argumentation is a statement or statements advanced by an individual or a group to justify or refute a claim in order to attain the approbation of an audience (Van Eemeren, Grootendorst & Kruiger, 1987) or to reach consensus on a controversial subject matter such as integrating science and indigenous knowledge system (Ogunniyi, 2007a). Argumentation instruction allows students to articulate reasons for supporting a particular claim, attempt to persuade or convince their peers, express doubts, ask questions, relate alternative views and point out what is not known (Driver, Newton & Osborne, 2000). According to Nassbaum, Sinatra and Poliquin (2008) argumentation is central to scientific practice because scientists frame arguments, weigh evidence, construct warrants in support of hypotheses and discuss alternative explanations. Thus, scientists use arguments to establish theories, models and explanations about the natural world (Eduran, Ardac & Guzel, 2006). Argumentation is a reasoning strategy which comes under the reasoning domain of informal logic and critical thinking

An argumentation instructional model that has been used constantly by researchers in recent years is the Toulmin's (1958) Argumentation pattern (TAP) (Ogunniyi, 2007b). TAP consists of a claim, evidence (data), warrant, backing, rebuttal and a qualifier. Accordingly, claim, evidence and a warrant are the main ingredients of a practical argument while the other three (backings, qualifiers & rebuttals) may or may not be necessary in the justification of a claim.

A Claim – it is a statement or belief about phenomena whose merits are in question.

School science learning materials consist of statements that are conclusive which warrant that before learners can understand them, they question them in order to make sense of what they are to learn.

Evidence (Data) – they are facts or evidence used for supporting a claim.

The learner has to read through the facts or experimental observations, tables, graphs etc. and try to make sense out of the data.

Warrant – they are statements used to establish or justify the relationship between the data and the claim. One of the challenges that a learner encounters when reading learning materials or in discussions is not being able to find valid links between the claims and the evidence. They do not interrogate the evidence to see if it is valid or if it has anything to do with the claim or vice versa.

Backings – they are implicit assumptions underpinning the claim.

In many instances, the teaching and learning materials in science make many generalizations about a specific claim. These generalizations are governed by common experiences surrounding a particular claim. Science learning is sometimes complicated by having to differentiate between evidence and a backing or supporting information.

Qualifiers –these are conditions governing the claim.

A typical example of a claim requiring a qualifier could be: traditional beer causes oesophageal cancer. This may sound true, but not every beer sample contains the toxin that causes the disease nor do all who consume traditional beer develop the disease. This statement or claim is true provided that the fungus is found in the sample of beer; hence a qualifying statement should be included with the claim. Other factors might also be involved such the 'body chemistry' of the drinker, the amount of beer consumed etc. However, including the term 'probable' makes the claim less assertive and less categorical and hence less likely to be error - prone. This is another important aspect of argumentation which needs close attention in the process of teaching and learning. This phenomenon can also be observed in multiple choice questions where many statements appear to be true, but tend to be false because of the absence of relevant qualifiers in the statements.

Rebuttals – these are statements which show the claim to be invalid (Ogunniyi & Ogawa, 2008).

The process of learning requires sifting of information by carefully looking at the grounds given in the justification of a claim before deciding whether or not a particular claim is valid. Generally, school science approach will involve and integrate the above argumentation elements in the processes of justifying or rebutting claims made. The TAP and Contiguity Argumentation Theory (CAT) (Ogunniyi, 2007a) are used in this study because they are adaptable to IKS science classroom dialogical argumentation.

Argumentation based instruction as defined as an instructional strategy that is student-centred and teacher-mediated, individual and small group dialogue in a basic science lessons. According to Eskin, & Ogan-Bekiroglu, (2007) and Eduran, Ardac, Guzel (2006) argumentation based instruction should be at the core of every science learning and that it can lead students to reason and understand the epistemological bases of scientific practices. Providing students with plural accounts of phenomenal and evidence that can be deployed in an argument has been shown to lead to a more conceptual understanding (Katniyon, 2014).

Argumentation based instruction is anchored on the work of Kuhn (1991) who explored the basic capacity of individuals to used reasoned argument for effective learning. To Kuhn, valid argument does not come naturally, but that is acquired through practice. It is on this bases that he propounded that argument is a form of discourse that needs to be appropriated by children and explicitly taught through suitable instruction, task structured and modelling. Hence the need to develop pedagogical strategies as to how teachers could assist students develop their reasoning. How the teachers could identify the essential features of the argument and how they could model argument of quality for their students are essential in argumentation instruction. Tolhmin (1958) had earlier postulated that the essential elements of arguments are claims, data, warrants and backings. A claim in this light is an assertion that is believed to be true, which relies on evident or justifications that consist of data related to by a warrant. Warrant depends on a set of underlying assumptions or backings which may be implicit.

Group discussion and collaboration are said to be a major component of augmentation based instruction. (Zohar and Nenmet, 2002; Nussbaum, & Sinatra, 2003 ; Stone, 2009). In discussion, group student- student interaction is permitted. Hence the social structure of the classroom needs to be considered when designing activities that foster argumentation. This is supported by Howe and Mercer (2007) who take a socio- cultural perspective that learning is determined by social and communicative interaction that reflects the cultural values surrounding schools and classrooms. They show that features of exploratory talk, where children share knowledge, challenge ideas, evaluate evidence, and consider options in a reasoned and equitable fashion do promote learning.

Howe and Mercer (2007) identify three key areas in designing argumentation instruction. First that members of the group must be made to believe that all their contributions are important that the task for argumentation are challenging and relevant to the students and that all have to contribute, third that the task depends on a group effort and that all have to contribute. Hence for an argumentation instruction to be successful, the teacher needs to make explicitly clear the kinds of interaction he or she expect to take place in the group discussion. This implies that the teacher needs to understand the complexity of task design in an argumentation instruction.

Although argumentation based instruction has been found to improve students' reasoning and achievement in science (Katniyon, 2014), more needs to be done particularly in teaching and learning of primary science to further strengthen the efficacy of argumentation based instruction, overcoming the problems of science teaching and learning particularly at the primary school level. Primary science is an aspect of science that needs to be properly handled as it is the foundation upon which further learning of other science subjects is laid. Poor handling of it can repel students from reading higher level sciences. It is pertinent to note that there is no one teaching method that is suitable for the realization of all learning out comes. However innovative approaches that allows learners to verbalize their ideas in an interactive atmosphere with fellow students, can have the advantage of helping the students to step up their reasoning thereby discarding wrong ideas for new correct ones.

There also seems to be an insufficient research report on argumentation based instruction on students reasoning in primary science. Most of the works cited in literature are on secondary school sciences. The primary science concept considered in this study is the concept of energy. The choice of these concepts was necessitated because their cultural interpretations seem to be at conflict with scientific interpretations.

PURPOSE OF THIS STUDY

The study sets out to find out how teaching using indigenous knowledge system and argumentation based instruction can accelerate reasoning in primary science pupils on some energy concepts.

RESEARCH QUESTIONS

i. To what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of eclipse and shadow?

ii. To what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of dispersion of light and rainbow?

iii. To what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of reflection of sound and echo?

iv. To what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of electricity and lightning?

METHODOLOGY

The design of the study is a quasi-experimental design. The population was made up of all primary five pupils in Mangu LGA education zone of Plateau state Nigeria. A sample of 112 pupils comprising of 50 girls and 62 boys were selected for the study. The samples were divided into two groups Control and experimental. The control groups were taught using conventional method while IKSP and ABIwas usedto teach the experimental group. The instruments used for data collection was IKSP/ABI and dialogical argumentation work sheets (DAW). The experimental group used dialogical argumentation worksheets (DAW) containing statements that will prompt arguments amongst primary school children on the concept of energy, while the control group used dialogical argumentation worksheets (DAW) that do not contained statements that will prompt arguments amongst primary school children on the concept of energy.

The study was conducted using primary six pupils of government owned primary schools in Plateau state Nigeria. The study lasted for six weeks in the second term. Data obtained was quantitatively analyzed using Facione and Facione (1994) scoring rubrics. Facione and Facione developed a five point scoring scale for assessing levels of reasoning in argumentation instructions. The scoring scale is 0=submission of blank work sheets, 1=argue using indigenous knowledge or unscientific points, 2=draws conclusions with unscientific ideas, 3=accurately interprets questions and draws conclusions with scientific ideas and 4=identifies salient points and justifies conclusions.

RESULTS

Research question one: to what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of eclipse and shadow?

Table 1: Score Of Children In Science Reasoning On Eclipse And Shadow

Lesson /concept	0	1	2	3	4	N
Experimental group	0 (0.00%)	15 (26.29%)	28 (50.00%)	13 (23.21%)	0	56
Control group	0	25 (44.64%)	22 (39.29%)	9 (16.07%)	0 (0.00%)	56
Total	0	40	50	22	0	112

From Table 1, no respondent submitted a blank work sheet on the concept of**eclipse and shadow**. 25 pupils (44.64%) argue strongly using indigenous knowledge or unscientific points. 22 pupils (39.28%) draws conclusions with unscientific ideas and 9 pupils (16.07%) accurately interprets question and draws conclusions with scientific ideas. None of the respondents in this group could identify salient arguments and justifies conclusions. For the experimental group, only 15 pupils (26.79%) argue strongly using indigenous knowledge or unscientific points.28 pupils (50%) draws conclusions with unscientific ideas.13 pupils (23.21%) accurately interprets question and draws conclusions with scientific ideas. None of the respondents in this group could identify salient arguments and justifies conclusions.

Research Question 2: To what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of**dispersion of light and rainbow**?

Table 2: Score Of Children In Science Reasoning On Dispersion Of Light And Rainbow

Lesson /concept	0	1	2	3	4	N
Experimental group	0 (0.00%)	6 (10.71%)	31 (55.36%)	6 (10.71%)	0	56
Control group	0 (0,00%)	40 (71.43%)	12 (21.43%)	4 (7.14%)	0 (0.00%)	56
Total	0	46	43	10	0	112

From Table 2 no respondent in both experimental and control groups submitted a blank worksheet on the concepts of eclipse and shadows. 40 people (71.43%) in the control group argue strongly using indigenous knowledge or unscientific facts, 12 pupils (21.43%) draws conclusion with unscientific facts. 4 pupils (7.14%) accurately interprets questions and draws conclusions with scientific ideasNone of the respondents in that group could identify salient argument or justifies conclusions. Only 6 pupils (10.71%) in the experimental group argue strongly using indigenous knowledge or unscientific facts, while 31 pupils (55.36%) draws conclusion with scientific facts. 6 pupils (10.71%) argue with scientific ideas. None could identify salient argument or justifies conclusions.

Research Question 3: To what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of reflection of sound and echo?

Table 3: Score Of Children In Science Reasoning On Reflection Of Sound And Echo

Lesson /concept	0	1	2	3	4	N
Experimental group	0	7 (12.5%)	38 (67.86%)	9 (16.07%)	2 (3.57%)	56
Control group	0 (0.00%)	34 (58.93%)	16 (28.57%)	6 (10.71%)	0 (0.00%)	56
Total	0	41	54	15	2	112

From table 3, No respondent in both experimental and control group submitted blank sheet on the concept of reflection of sound and echo. 34 (58.93%), 16 (28.57%) and 6 (10.71%) from the control group argue strongly using indigenous knowledge points/draws conclusion with unscientific fact, accurately interprets questions/allow conclusions with scientific ideas. None of them could identify salient points/justifies conclusions respectively. On the other hand for experimental group only 7 pupils (12.5%) argue strongly with indigenous knowledge, as high as 38 pupils (67.86%) draws conclusions with scientific facts. 9 pupils (16.07) accurately interprets questions and draws conclusions with scientific ideas. 2 pupils (3.57%) were able to identify salient arguments and justifies conclusions.

Research Question 4: To what extent do teaching using ABI/IKSP accelerate reasoning amongst primary science pupils on the concepts of**electricity and lightning**?

Table 4: Score Of Children In Science Reasoning On Electricity And Lightning

Lesson /concept	0	1	2	3	4	N
Experimental group	0	14 (25.00%)	30 (53.52%)	12 (24.43%)	0	56
Control group	0	36 (64.39%)	5 (8.92%)	9 (16.07%)	0	56
Total	0	50	35	21	0	112

And analysis of Table 4 show that the science reasoning scores of children in both the control and experimental groups on the concepts of electricity and lighting differs. no respondent submitted a blank worksheet. 36 pupils (64.39%) argue strongly using indigenous knowledge. 5 pupils (8.92%) draws conclusions with unscientific points. 9 pupils (16.07%) could accurately interprets questions and draws conclusions with scientific ideas. None of them could identify salient arguments and justifies conclusions. For the experimental group, only 14 pupils (25.00%) argue strongly using indigenous knowledge or unscientific points. 30 pupils (53.51%) draws conclusions with scientific ideas. 12 pupils (24.43%) accurately interprets questions and draws conclusions with scientific ideas. None could identify salient arguments and justifies conclusions.

DISCUSSION

The worksheets used by the experimental group had some IKSP and scientific statements on the concepts eclipse and shadow, light and rainbow, sound and echo, electricity and lightning. These statements prompted the pupils to think and reason scientifically rather than just information or continue to dwell on unscientific thoughts. The Argumentation – based instruction Dialogical argumentation Worksheets (DAW) was a factor in promoting talk involving reasoning. Data from Table 1, 2, 3 & 4 shows that the reasoning and arguments of the experimental groups is tilted more towards the scientific explanations of the questions. The argumentation prompts provided help in tilting the justification and conclusions of the experimental groups more towards scientific reasoning.

Facione and Facione (1994) scoring rubrics was used for analysing reasoning quantitatively as presented in data in Table 1, 2, 3 & 4. This allowed the reasoning level of the experimental and control groups to be compared after instruction. The tables revealed that the experimental groups have a higher percentage of scientific reasoning than the control groups. There was a marked increase in the reasoning of the experimental group that were exposed to IKSP and ABI compared to the control group that used the worksheets without the prompts.

In each of the groups almost all the children showed high level of readiness to walk with the DAW worksheets. In the control group a high percentage of the pupils argue strongly using their ingredients knowledge or unscientific points. This shows that Nigerians pupils come into science classrooms with some traditional ways of interpreting the scientific concepts in light, sound and electrical energy. Ochima (2012) had earlier asserted

Cognitive conflict occurs amongst learners as they cross from the culture of home into the culture of school science

The present work agrees with Katniyon (2014) who found that Nigerian junior secondary school III science students held some cultural misinterpretation of some scientific concepts. In a survey, Katniyon discovered that 20 concepts in science topics which is problematic for children and requires dialogical argument for effective learning. The study also found that the DAW worksheets in ABI enable the pupils to reason scientifically. It enabled members of a group to ask relevant questions that lead to change from unscientific reasoning to scientific reasoning. It enabled the children to interact with each other. Example asking questions such as it God that takes sound to another place and one hears it as echo? Such questions helped them to move from unscientific interpretations to scientific interpretations.

CONCLUSION

The study set out to explore the reasoning process of children in primary science. The arguments provided by the children on the concept of energy showed that they have unscientific prior knowledge rooted in their IKS. The study also found that students reasoning can be accelerated using appropriate instructional strategy such as ABI. Providing the pupil's opportunity to argue using ABI and DAW worksheets was effective in creating an environment where argumentation can thrive and scientific reasoning enhanced.

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AN EFFICIENT MICROCONTROLLER COURSE WITH AN AFFORDABLE AND EASY TO USE DEVELOPMENT SETUP

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ABSTRACT: Microprocessors/Microcontrollers have been widely used in electronic products so they have been taught to electrical, computer and mechatronic engineering undergrads. Since medical electronics devices are also use microprocessors/microcontrollers, biomedical engineering undergrads should have knowledge and programming experience in microcontroller based systems. Due to this fact microprocessors/microcontrollers have been taught as a 5 hour/14 week lecture and laboratory course at the 5th semester in Başkent University Biomedical Engineering Program Ankara, Turkey.

The main difficulties in microcontroller programing course for a multidisciplinary program such as biomedical engineering are insufficient allocation in the curriculum, shortage of lab space and budget constraints. Also the complexity of the development setups and spending too much time to understand the setup instead of experimenting it are problems for students and instructors. Students lose their attraction while spending time to effectively use of development tools. For this reason an efficient microcontroller course with its laboratory and a project work is developed which puts emphasis on learning the futures of microcontroller based system and applying many instrumentation designs. In order to increase the efficiency of the course an affordable, easy to use and modular development board with a free compiler for 2K program code and a free programmer software are used and important improvements are applied.

Throughout the paper the details about the lectures, laboratories and development tools and their improvements are described. The methodology for active learning and syllabus design and determination of learning objectives are discussed. The efficiency of the course is tested by overall grades and responses of students. A remarkable success observed on the results.

Key words: microcontroller education, instrumentation, biomedical engineering, high-level design tools

INTRODUCTION

A microprocessor is a single integrated chip which can perform computation of programs to control a microprocessor based system. Although microprocessors have arithmetic, logic, control and timing unit and registers inside they are not capable of working alone because microprocessors need memory, input & output ports and bus systems in order to work properly. That’s why a microprocessor based system should include at least those components. As a result microprocessor based system require many chips on a considerably large printed circuit board (PCB) with a power supply. The total cost of a microprocessor based system becomes high for a simple electronic device (Hamrita & McClendon, 1997; Hanson, 1981).

For a wide range of application microcontrollers are preferred instead of microprocessor based systems because with the development of integrated chip technology they become cost efficient and practical for many applications. Microcontrollers are a simple microprocessor based system so they have their own microprocessor, memory and input & output ports in a single chip also some of them may include many electronic circuits such as operational amplifiers, signal generators, analog to digital converters, sensors etc. Although they have simple processing power many interface chips are included in a microcontroller so they are widely applied in almost all field of electronic products.

In microprocessor related course the main course objectives are usually to learn the microprocessors architecture and interface, to experience programming and to do practical applications. It is possible to cover these objectives by using a microcontroller. (Mayer, Jackson, & Lockley, 1995) Because of the complexity and high cost many universities have replaced their microprocessor related course to a microcontroller related course, by that way similar course objectives can be achieved with a more practical and efficient way. (Hamrita & McClendon, 1997; Ibrahim, 2014)

Microprocessors/Microcontrollers have become pervasive in many electronic products including biomedical electronic devices so it is important that biomedical engineering undergrads have experience with microprocessors/microcontrollers. Due to this fact there is a microprocessor course in Başkent University Biomedical Engineering Department, Ankara, Turkey and the course have been thought using a microcontroller since 4 years.

A microprocessor/microcontroller design which is capable of performing a particular job is called an embedded systems. To design an embedded system there should be an integrated development environment (IDE) and a programmer adaptor and software. An IDE consist of a smart text editor, compiler and debugger. These tools in IDE are for engineers to write programs, to compile it, generate a final form for the program that is suitable for execution on target microcontroller and to program the microcontroller. A program adaptor is a small hardware interface between IDE and microcontroller and a programmer software is a PC software which control programmer adaptor. There are many IDE and programmer adaptor alternatives for microcontroller applications. (Hass & Su, 2012)

Ongoing improvements in microcontroller technology lead to fast, flexible and low cost solutions, but increasing complexity challenges for students and instructors. Now microcontroller courses are usually difficult for students to understand and also difficult for professors to teach.

The reasons for a microcontroller course is hard and complex are:

- A microcontroller is a complex systems with a detailed, brand and model specific datasheet, programming reference and family reference materials which are over one thousand page.
- The specific integrated development environment and programmer adaptor and software for microcontroller application development require specific knowledge.
- A microcontroller design requires both programing and electronics knowledge.
- Microcontroller applications requires and embedded system design with some extra electronic components which requires extra knowledge in application domain.
- Microcontroller education requires a significant hands-on laboratory experience.

In order to deal with all these difficulties professors should spend a considerable amount of time for course preparation. Developing laboratory experience and configuring IDE for microcontroller education also requires even greater time. Even with a good course preparation it is almost always difficult for educators to teach and students to learn all of these subject in the short hours assigned to the course. (Ghosh, Mangat, Shinde, Date, & Sharma, 2013; Peng, 2009; Reese & Jones, 2010) In order to learn the application aspect of microcontrollers, students should know extra information which is specific for the used microcontroller, IDE and programmer adaptor. Due to all these facts a typical course can only focus on microcontroller architecture, assembly language and few very simple application (Mayer et al., 1995; Peng, 2009), but it is also important for students to have the ability to design and practice a microcontroller based system for different applications.

In order to design an effective microcontroller course the objectives should be defined according to the time, resource and purpose constraints.

According to the literature review and professors, students and employers responses it is important to practice applications than to learn the details of microprocessor organization for our biomedical engineering students we design the course. In this paper we report the course objectives and course syllabus. We described how we choose the microcontroller, IDE platform, programmer and demo board according to described constraints. We report the details of them. We define the advantages and disadvantages of them. One of the important disadvantage of demo board is only one peripheral component can easily connect to it because of its interfaces allow only one peripheral device. This is a big problem because for a simple sensor and inductor application it is only possible to connect one of them. So we design and manufacture a practical display board which can be easily interface with the demo board. With the display connection to demo board it is possible to apply many sensor to a practical, USB connected power supplied, cost effective and easy to use platform for programming and testing the microcontroller application. We report the laboratory experiments. To demonstrate the improvement of the course we report and discuss some of the student's opinions course initial results of course objective achievements. Finally we define the future plans.

COURSE DESIGN

Students who are enrolling to this course are sophomores who should already completed Circuits and Systems, Electronics, Computer Programming I-II and Electromagnetics Theory courses, and also they should complete the laboratory courses for Circuits and Systems, Electronics, Computer Programming I and II. The only pre-requisite for this course is Digital Design course and its laboratory. So sophomores for this course have some background on electronics, programming and digital design also they have hands-on laboratory experience on these subjects.

Course Objectives

In an efficient microcontroller course with the time and resource constraints, course objectives should be:

- To learn,
    - The basics of computer organization and microprocessors.
    - The fundamentals of microcontrollers.
    - The main peripheral devices used in microcontroller based system.
    - Some extra peripheral devices for applications of microcontroller based system.
- To practice,
    - Applications as possible as many using microcontrollers.

Weekly Course Plan

1- Microprocessor definition, components, properties and working principles.
2- Microprocessor based systems.
3- Microcontroller definition, components, properties and working principles.
4- Microcontroller based circuit design (Embedded Design).
5- Editor, Compiler and Debugger.
6- Embedded design with a well-known microcontroller.
7- A high level programming language and it properties.
8- Microcontroller based port activation and using applications.
9- Microcontroller based simple control and indicator applications.
10- More on high level programming language and it properties.
11- Display and microcontroller applications.
12- A/D converter applications using microcontroller.
13- Interrupts and microcontroller applications.
14- Serial communication protocols and microcontroller applications.

Course Materials

In order to achieve the course objectives course materials should be organized as the following:

- A well-known, widely used and easy accessible microcontroller should be selected.
- A low cost, efficient and practical Development Setup with many application possibilities should selected.
- Resources for course, microcontroller, development setup and design examples should be easy accessible and reliable.

A low cost, efficient and practical Development Setup should have the following properties:

- IDE with a widely used programming language and its compiler.
- A practical Programmer and Demo Board which can be connected to USB without any extra supply.
- Lots of peripheral connections of sensor, controls and indicators for different application.
- In the Demo Board there should be a slot for interface with peripherals which makes the demo board a single board with the peripherals, no extra supply, no extra wiring etc.
- They do not require bread board so no wiring and connection problems which eliminates many errors.
- Resources: manuals, textbooks, example codes and designs.
- Development setup should be cost effective so students can use it in their home.
- Interfaces should be reliable and stabile for eliminating errors.

DEVELOPMENT SETUP

In order to organize the development setup first is choosing the microcontroller. There are many constraints for choosing the microcontroller. It should be well known so students can access many applications, examples, program code. Professors and students should access the microcontroller and its family however some brands are not easily supplied in our country. C programming language is universal and the most used high level language for microcontrollers so it should support C language. According to all above constraints we decided to use PIC microcontroller of Microchip®. The second is choosing the IDE and programmer compatible with PIC microcontroller. The last is deciding the Demo board which is preferable for microcontroller applications.

MikroC Editor, Compiler and Debugger

Since we choose PIC microcontroller we should choose a development setup which is compatible with PIC microcontrollers. We have some constraints as described in course design section than we choose the products of MikroElektronika®. For the programming language we choose MikroC which is ANSI C programming code and MikroC Pro for PIC is an editor, compiler and debugger for PIC devices from MikroElektronika®. It is powerful compiler with advanced optimizations, lots of hardware and software libraries. It has a comprehensive help file and lots of ready-to-use examples designed. Its license is free for 2K of program which is very important because students can use it in their homes. ("MikroC Pro for PIC," 2015) Usually this kind of software's are expensive and students only able to use them in school. There is a 644 page manual, MikroC Pro for PIC Manual, for programming definition and examples which we considered one of the text book for our course and is very resourceful for students.

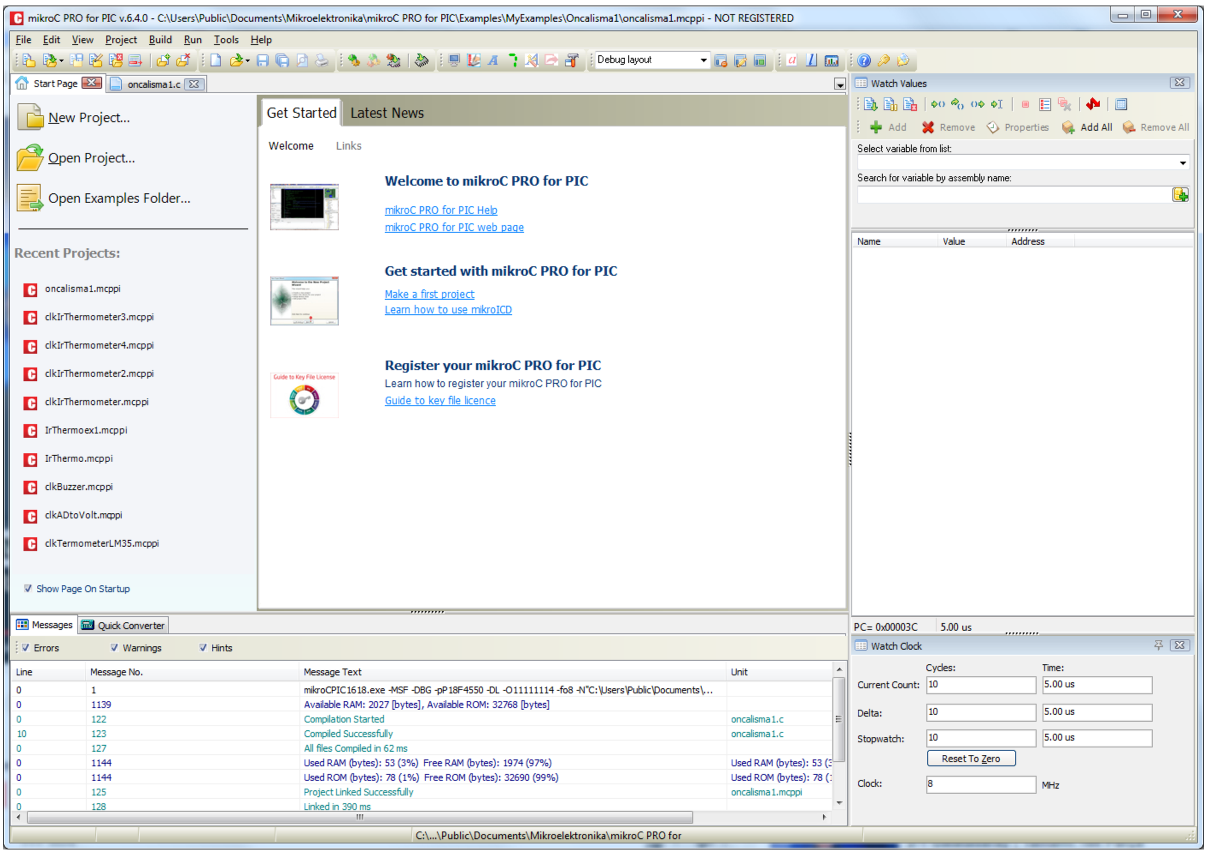

Figure 1. The Screen Shoot of the MikroC Pro for PIC IDE.

The Computer Programing I, II and their laboratory courses are mandatory for our students and in those courses C and C++ are thought as a programming language so our students already know the C programming language. According to the surveys taken over the past decades have shown that about %80 of the embedded projects uses C and C++ . (Barr, 2009) Due to this fact C language for primary programming language seems reasonable. And MikroC is powerful and practical alternative. Also in MikroC Pro IDE it is possible to compline assembly language as well.

MikroC programming language is a ANSI C based programming language to control the PIC microcontrollers and in the MikroC Pro for PIC IDE there are several ready to use code routines which are called libraries which helps programmer to write programmers in a simple and fast way. A user could also create a custom library for custom purposes also codes could be written in PIC assembly language which is the human understandable version of machine language. Some of the build in libraries are given in Table 1.

Table 1. Some of the MikroC Programming Language build in libraries

Library Name	Description
ADC	Analog to digital conversion library
Compact Flash	Compact flash card control library
EEPROM	EEPROM memory control library
Graphic LCD	Graphic LCD control library
LCD	LCD control library
I2C, SPI	I2C and SPI Serial communication protocol control library
Keypad	Keypad control library
Ethernet	Ethernet communication library
Button	Button control library
Multi Media Card	Multi Media Card control library
One wire	One wire communication protocol library
PWM	Pulse width modulated signal output library
Sound	Buzzer sound control library with PWM and pulse signal output
UART	UART communication protocol control library
USB HID	USB HID communication protocol control library
Standard ANSI C	Standard ANSI C libraries like math, constant etc.
Other	Other many MikroC specific libraries.

Pic Clicker Development Board

As a demo board and programmer we decided to use PIC Clicker Development Board of MikroElektronika®, because it is compatible with MikroC Pro for PIC IDE, it can be connected to a PC with a USB port for programming, it costs only 19$ for the product and can be supplied from the website of producer with an international shipping cost of 9$ which is really cheap and the shipping time is one week. Also there are some Turkish companies who are selling the product with similar price. ("PIC clicker," 2015) It has a PIC18F47J53 microcontroller with many application possibilities, and a microbus for Click Boards which are application purpose sensor and control boards with over than 100 different possibilities. ("Click Boards," 2015) Click Boards are very useful application add on boards, in the laboratory example section some examples with their functions are shown. They can connect to MikroBus port easily. With these add on boards application board can be connected without any wiring which is very time consuming if wiring is needed. Pic Clicker Development Board is both for introductory and advanced application by using different Click Board.

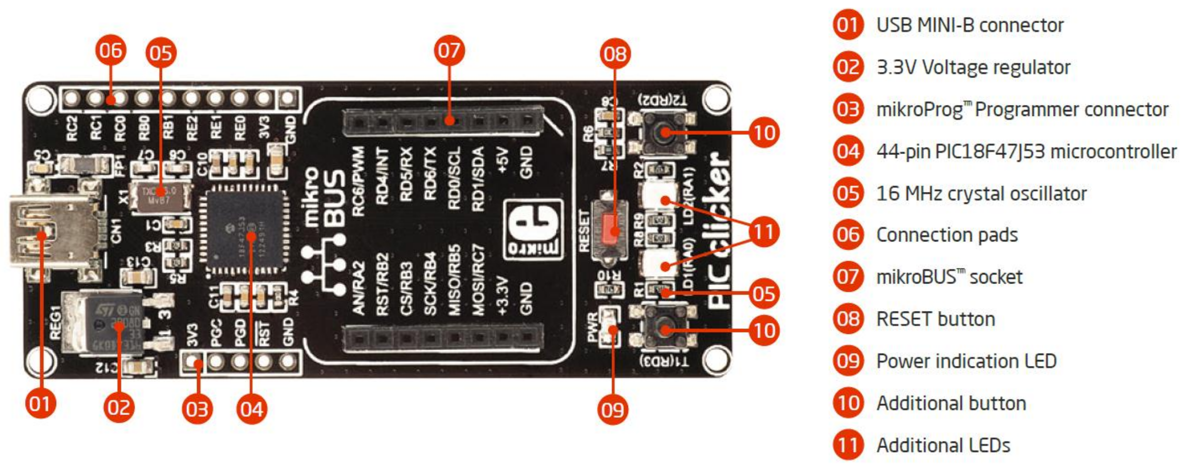

Figure 2. PIC Clicker And Its Components ("PIC clicker," 2015).

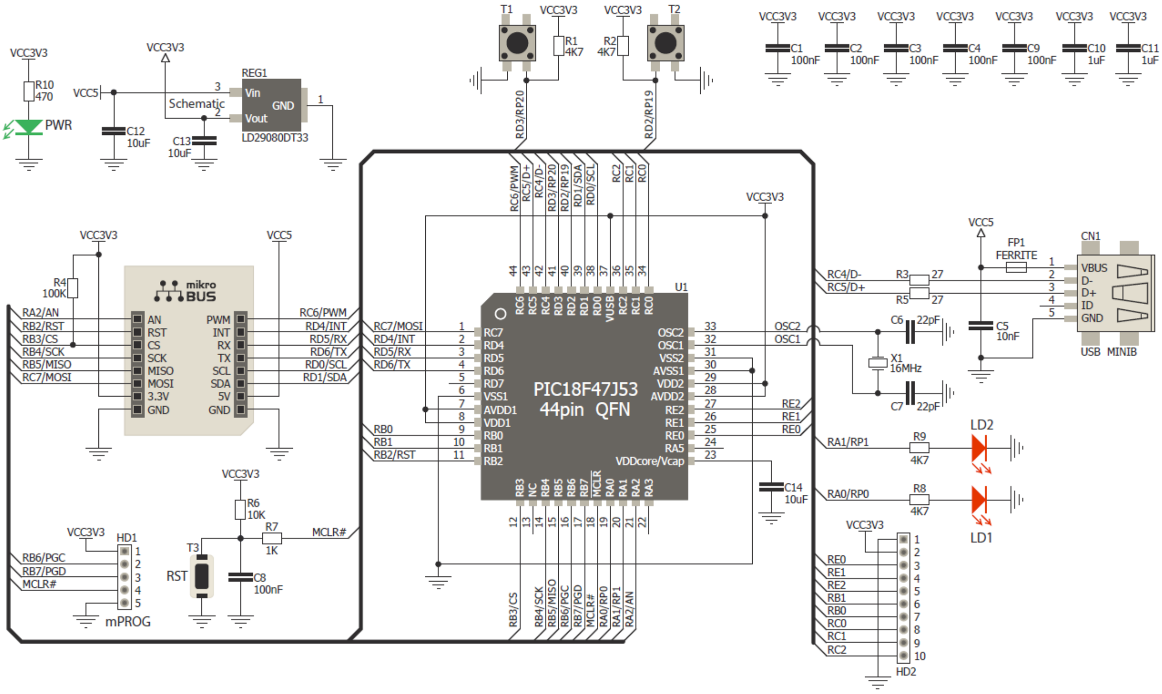

Figure 3. PIC Clicker Circuit Schematics ("PIC clicker," 2015).

LCD Display for Pic Clicker

PIC Clicker Development Board and MikroC IDE are efficient, practical and cost effective microcontroller application development solution and MikroElektronica® produce over 100 click boards for different applications. But PIC Clicker has some drawback. It has only one port (Mikro Bus) for click boards so for a simple design with a sensor and display it is only possible to mount the sensor. Also MikroElektronica® does not produce a display solution for PIC Clickers. For this reason we develop our display solution which can connect to extra ports other than Micro Bus port. The simple 8 character liquid crystal display (LCD) costs 6$ and produced by Fordata Electronics Co. Ltd. China. (*Datasheet: Fordata Electronics Co. Ltd., FDCC0802C-RNNYBH-16LE, Specification Character Type Dot Matrix Module*, 2008) The LCD controller is a commonly used alphanumeric dot matrix LCD controller and the control interface and protocol is a de-facto standard for this type of display. The character set of the controller includes ASCII characters. (Wilmshurst, 2010)

The LCD board can be connected to other unused ports by that way Mikro Bus port still available for Click Boards.

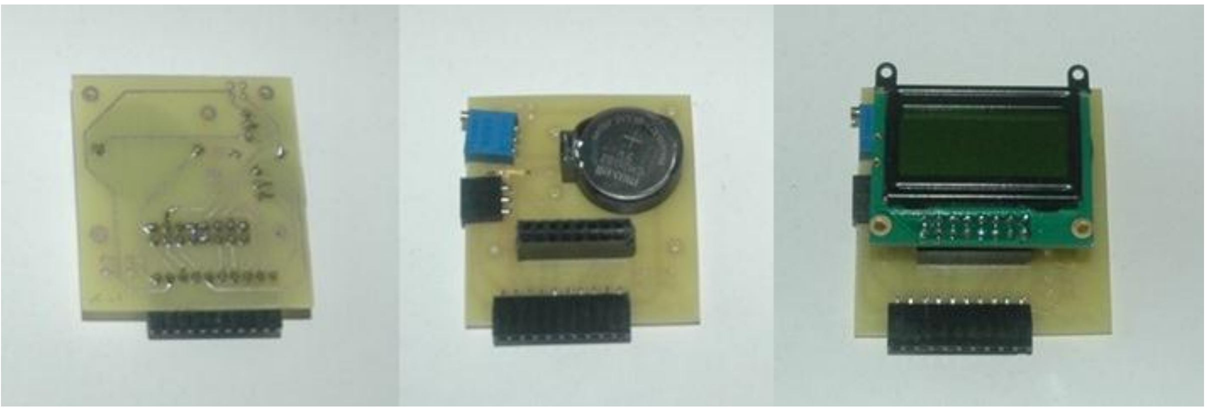

Figure 4. Designed And Manufactured LCD Display Compatible With PIC Clicker.

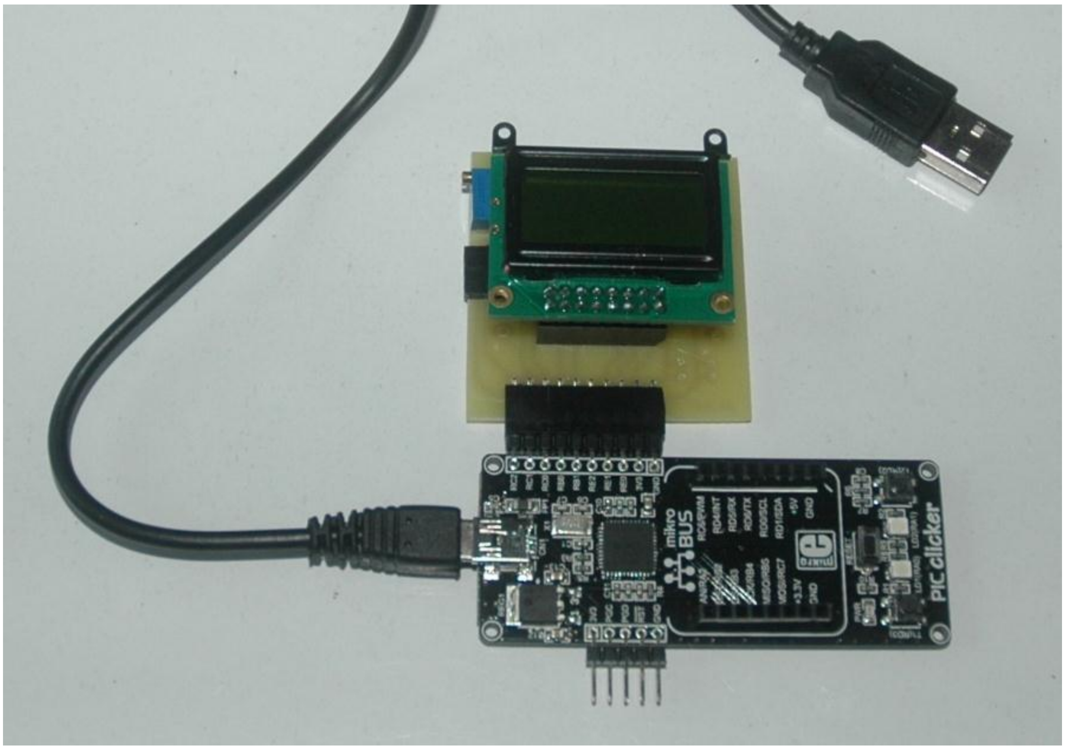

Figure 5. Development Setup consist of PIC Clicker Programmer and Demo Board and LCD display.

Pic Clicker USB Programmer

After the program code has been written it needs to compile to form the executable machine code, which is name .hex code. This code is also a file and compiler produce it if there is no syntax error in the code. This file should be transferred to microcontroller's program memory so microcontroller could be able to run this code from its program memory, this transfer operation is usually called burning or programming. Programming is usually done with a specific adaptor which is the connection between microcontroller and PC and programmer software which runs on PC. By using PIC Clicker as a programmer and Demo Board we do not need an extra adaptor, but we still need a programmer software to send the .hex file to microcontroller. MikroC Pro for PIC IDE has a programmer software with required driver for PIC Clicker. The microcontroller can be programmed with bootloader which is preprogrammed by default for PIC Clicker. To transfer .hex file from a PC to microcontroller (mikroBootloader USB HID) is used which is shown in Figure 6.

Figure 6. Programmer Software in MikroC Pro for PIC.

LABORATORY EXPERIMENTS

The laboratory experiments are designed for the students so they can program a microcontroller and test the program. The topics covered in laboratory experiments can be categorized as features and properties of development tools, addressing modes, mathematical operations, interfacing concepts and applications.

For each laboratory experiments a custom prepared handouts were provided. In this handouts there are the objectives, explanation and introduction information for the experiment also a preliminary work is expected from students which consists of pseudo codes and questions. Before each laboratory a quiz is asked to the students about the laboratory preliminary work and theory concepts. This handouts are for students to work before laboratory and optimize the laboratory hours. While laboratory session professor and teaching assistant helps and questioned students about their designed and evaluate their performances. At the end of the laboratory each students and sometime groups with two students prepared a report about their design and explained details. The laboratory quizzes, preliminary works, laboratory progress and reports are evaluated all equally as the laboratory grade. The laboratory description is reported in Table 2.

Table 2. Description of Laboratory Experiments

Laboratory Number	Title	Details
Lab 1	Introduction to Integrated Development Environment (IDE)	Students are introduced with the editor, compiler, debugger, and programmer. They code simple programs and obtain .hex file to be programmed for microcontroller.
Lab 2	Introduction to Development Board	Students are introduced with the programmer and demo board. They design simple application and program the microcontroller.
Lab 3	Port Usage as Input and Output.	Simple button and light control application. This components are already on the PIC Clicker, they learn how to control the ports, input and output.
Lab 4	Buzzer Control Application	This is the first laboratory experiment which a Click Board is used. Students are introduced with the Mikro Bus and interfacing the PIC Clicker with Click Boards. Buzzer click board is connected to PIC Clicker and Sound library of MikroC programming language is experienced. Sound library uses pulse width modulation concepts which is a useful concept for microcontroller design.
Lab 5	LCD Application	Students learn how to control to LCD screen. They apply simple application where they display their names, they shifted screen so whole name could be displayed. Also they designed a counter with stop, pause, up and down counting option. They also learn timing concepts.
Lab 6	A/D conversion Application	A/D conversion is almost a must for microcontroller application most analog sensor outputs analog voltage value so it should be converted to digital and displayed. We designed a simple potentiometer Click Board and used in this experiment which functions as a voltage divider and student could observe the voltage value on LCD.
Lab 7	Interrupt Application	Interrupt is one of the very important concepts in microcontroller programming. Students are asked to design a counter which is controlled by hardware interrupts. Its virtual simulation is also applied.
Lab 8	Infrared Thermometer Application	Infrared Thermometer Click Board is connected to Mikro Bus and communicated using I2C protocol to communicate with the micro controller. Students are experienced about the I2C communication protocols in this experiment.

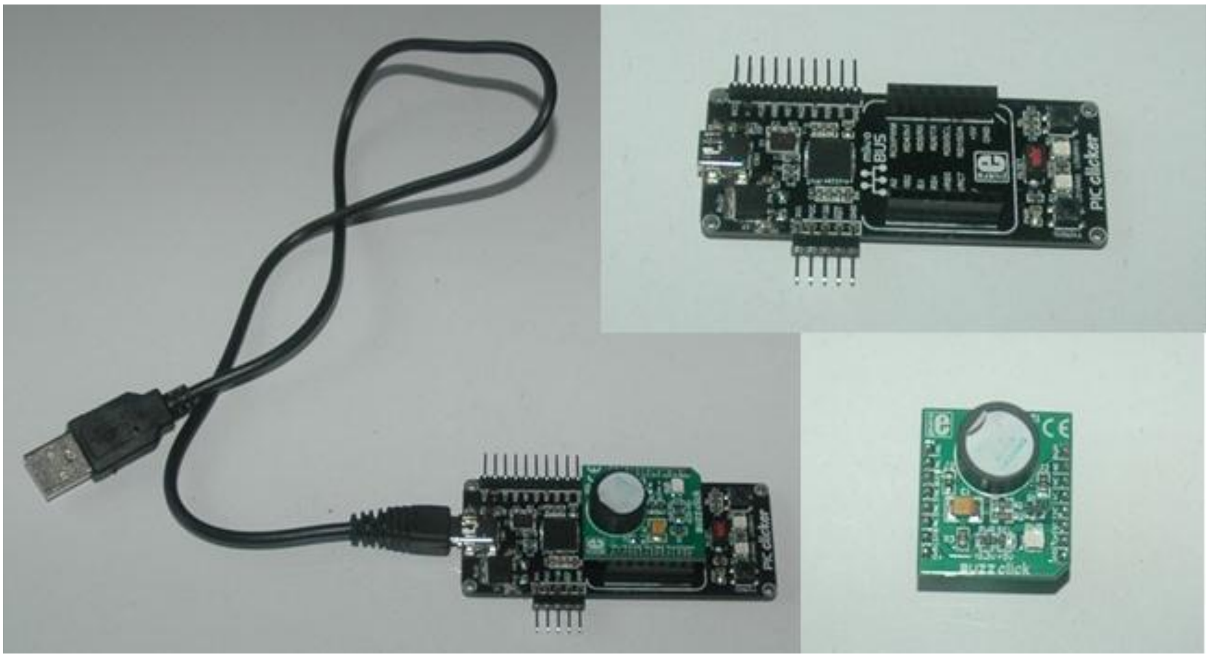

Figure 7. Buzzer Click Board (Right Bottom), PIC Clicker (Top) And Buzzer Click Board Connected To PIC Clicker With A USB Connection To Programming (Left).

In Figure 7 PIC Clicker itself can be used in Lab 2 and 3 because it has 2 led light and 2 buttons on itself which are used for experiencing input and output. Buzzer Click Board in used in Lab 4. USB connection makes it very practical to program and supply power to devices. In Figure 8 all of the required hardware for the laboratory experiments are shown.

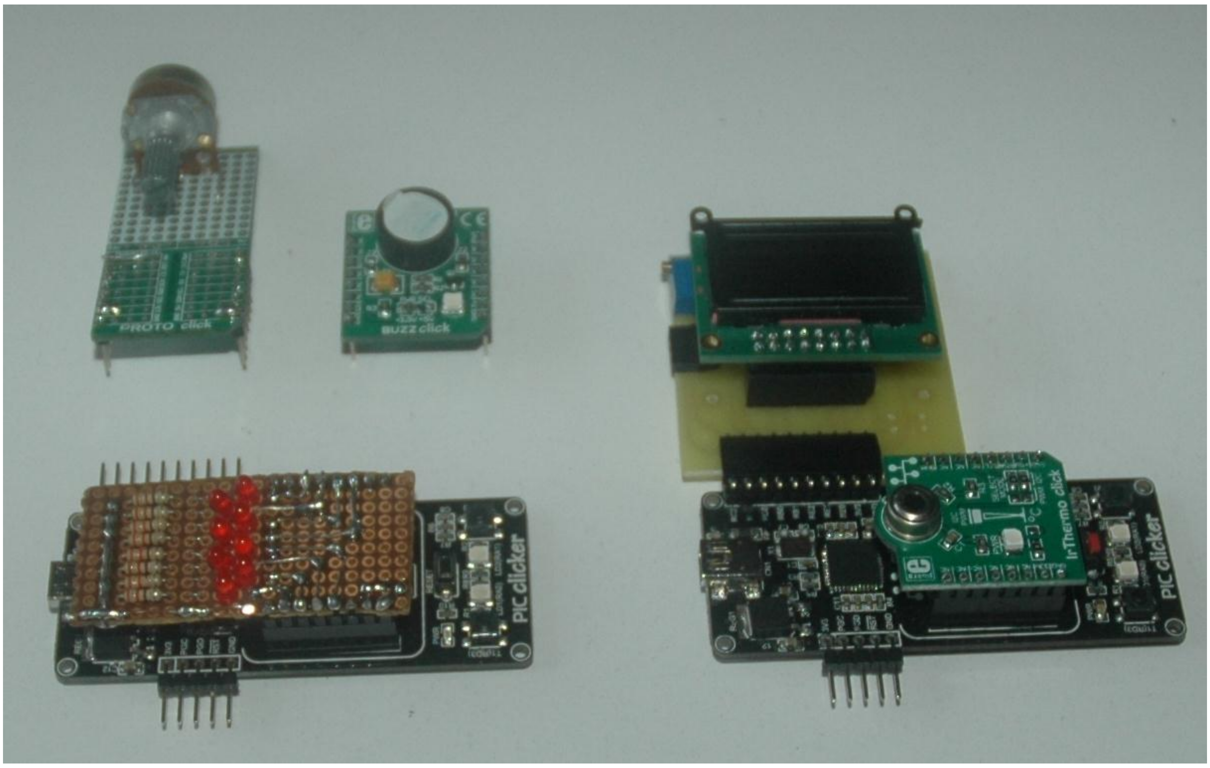

Figure 8. A Custom Made Potentiometer Voltage Divider Click Board (Top Left), Buzzer Click Board (Top Middle), A Custom Made 8 LED Light Click Board Mounted On A PIC Clicker (Bottom Left), A Custom LCD And Infrared Thermometer Mounted On A PIC Clicker (Right).

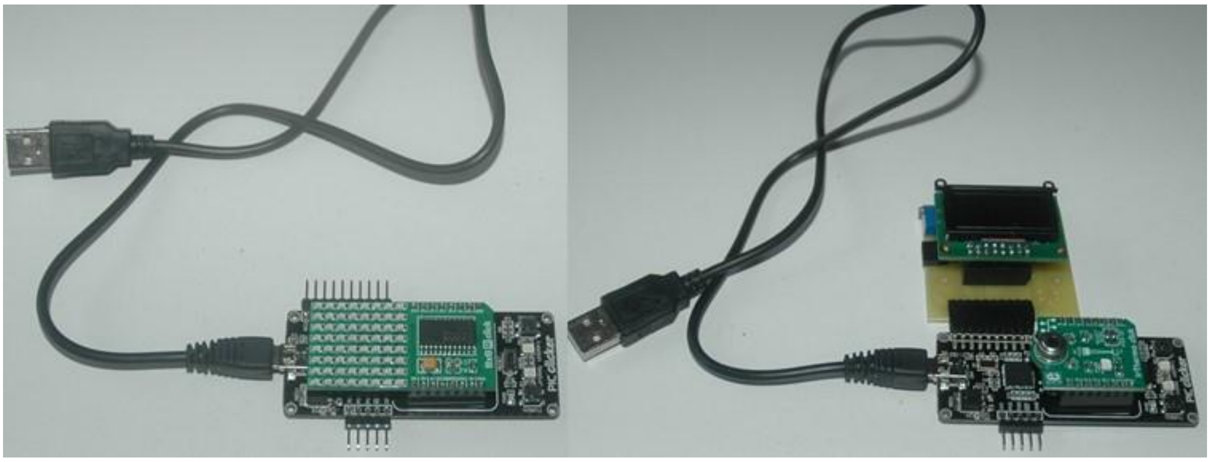

Figure 9. An 8x8 LED Light Click Board Mounted On A PIC Clicker (Left) And Infrared Thermometer Mounted On A PIC Clicker (Left) With USB Connections.

In Figure 9, two different possible application is shown both uses serial communication protocols but in the first one there is no need to a display which is better for early laboratories. In the second configuration a complete infrared thermometer solution is shown, it is used in the last laboratory experiments students able to measure their body temperature and ambient temperature.

ASSESSMENTS

The learning outcomes of the course are, at the end of the course students should be able to:

1- To understand the fundamentals of microprocessors, microprocessor based systems and microcontrollers.
2- To state the fundamentals of electronic design with a microcontroller.
3- To experience with a modern programming language.
4- To experience with a modern IDE and programmer (development tools).
5- To experience at least four different application of microcontroller design.
6- To do a microcontroller based design individually or as a member of a team.

We have tested those learning outcomes by quizzes, midterm and final exam, laboratory grade and performance grade. The results of satisfying the learning outcomes reported in Figure 10. From the results almost all of the outcomes are satisfied above 60%. Which is an adequate results for a difficult course. 1 and 3 outcomes are satisfied above 70% this mostly shows students success on theoretical subjects. 4 is satisfied at %78 which is the highest one because development tools are really simple and practical. 2, 5 and 6 are around %60 which are mostly related to hand-on experiments, mostly hard part.

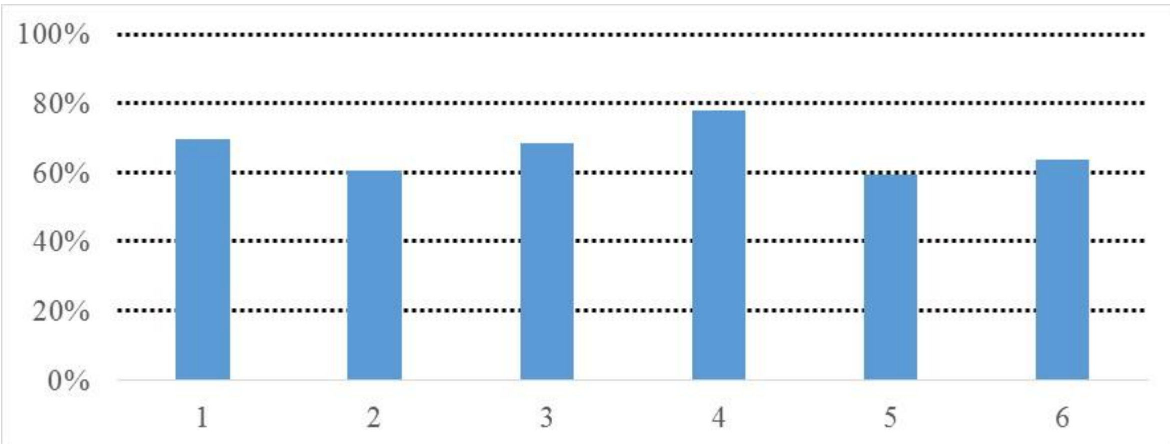

Figure 10. The Results Of Satisfying The Learning Outcomes, According To Student's Grades.

STUDENT OPINIONS

The student's feedback has been generally encouraging. One of the positive feedback form student's evaluations that they like the development setup and praise that they can make a whole working device. They also reported that course combined theory and hand-on learning. In the evaluation their opinion their motivation for this course is highly motivated. (According to the survey on students motivation. Question: Did you motivated for the course. (1) Did not motivate, (2) Fairly motivated, (3) Motivated, (4) Very motivated, (5) Highly motivated)

The cost of the development setup is affordable for students so most of the students obtained the setup after the course which shows the motivation of them to design microcontroller applications.

CONCLUSION

In this study we survey the literature, address the problems in microcontroller education and offer course objectives for a microcontroller course. In order to achieve those objectives effectively under the constraints of time and cost we choose a development setup and improve it. We have also developed laboratory experiments for the development setup.

For the development setup we use a free IDE software for 2K of program code; MikroC Pro for PIC which has its own programmer and use a programmer and demo board; PIC Clicker. We also use many Click Board which are for different applications can be connected easy to PIC Clicker using Mikro Bus interface, like a brick design. We add an LCD display to development setup in order to widen the application range which is custom made LCD board. It can be mounted to PIC Clicker by using other ports than Mikro Bus so does not block other Click Boards. It is unique for our development setup so by this display circuit it is possible to do many applications using click boards and pic clicker. In some lectures and laboratories a virtual simulation software is also used for design purposes. In microcontroller courses usually the development setups are complex and expensive, our setup is simple and cost effective, which led us to spend more time on applications.

The assessments according to the students satisfying of lecture outcomes and students opinions. They both shows a remarkable satisfactory results. One of the main gain of this course is that students are highly motivated. In the future we are planning to add more applications and a project work.

Our improvements of this course are ongoing, further development will be reported in the future publications.

ACKNOWLEDGMENTS

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INSTRUMENTAL APPROPRIATION OF A COLLABORATIVE, DYNAMIC-GEOMETRY ENVIRONMENT AND GEOMETRICAL UNDERSTANDING[1]

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ABSTRACT: To understand learners' appropriation of technological tools and geometrical understanding, we draw on the theory of instrumental genesis (Lonchamp, 2012; Rabardel & Beguin, 2005), which seeks to explain how learners accomplish tasks interacting with tools. To appropriate a tool, learners develop their own knowledge of how to use it, which turns the tool into an instrument that mediates an activity between learners and a task. The tool used in our study is the Virtual Math Teams with GeoGebra (VMTwG) environment. It contains a chat panel and multiuser version of GeoGebra. The learners are seven middle and high school mathematics teachers who participated in a professional development course in which they collaborated synchronously in VMTwG to solve geometrical tasks. We use conventional content analysis to analyze the work of a team consisting of two high school teachers. Our analysis shows that the teachers' appropriation and application of the dragging feature of VMTwG shaped their understanding of geometrical relations, particularly dependencies. This informs the broader question of how and what mathematical knowledge learners' construct using certain technologies.

Keywords: dynamic geometry, instrumental genesis, professional development, collaboration, geometric reasoning.

INTRODUCTION

Understanding geometry is important in itself and for understanding other areas of mathematics. It contributes to logical and deductive reasoning about spatial objects and relationships. Geometry provides visual representations alongside the analytical representation of a mathematical concept (Davis, 1992; Goldenberg, 1988; Piez & Voxman, 1997). Pairing learning geometry with technological tools of Web 2.0 can allow learners to investigate collaboratively geometrical objects, properties, and relations and develop flexible understanding of geometry. The Common Core State Standards for Mathematics underscores that mathematics educators should seek to develop students' mathematical practices so that they "use appropriate tools strategically," including dynamic geometry environments (Common Core State Standards Initiative, 2010, p. 7). However, though teaching with technology is recommended, meta-analytic studies show that teaching mathematics with technology cannot guarantee positive influence on learning (Kaput & Thompson, 1994; Wenglinsky, 1998). Consequently, careful investigations are required to understand the appropriation of technology and how it shapes mathematics learning. To contribute to this understanding, we describe the influence of learners' appropriation of online dynamic geometry tools on their geometric understanding. This paper responds to the question: How does learners' appropriation of an online, collaborative dynamic geometry environment shape their geometrical understanding?

LITERATURE REVIEW

Researchers investigated the use of technology in learning mathematics for different purposes. The first group of researchers focused on investigating the effect of introducing certain technologies in learning mathematics. For example, Hohenwarter, Hohenwarter, and Lavicza (2009) engaged 44 middle and high school mathematics teachers in four workshops to learn about different geometric and algebraic topics in a dynamic geometry environment (DGE), GeoGebra, to investigate changes in teachers' mathematical knowledge in general. Similarly, Sinclair and Yurita (2008) investigated teacher's changes in mathematical discourse after introducing the use of dynamic geometry software in classroom. These studies did not focus primarily on how the teachers interacted with DGE, their main goals were investigating the impact of introducing such technologies on learning and teaching mathematics.

Other studies focused on certain aspects of interacting with DGEs. Arzarello, Olivero, Paola, and Robutti (2002) studied the dragging action in DGE and the cognitive processes behind each different type of dragging. They

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identify two levels of cognitive processes linked to dragging: ascending (moving from drawings to theory) and descending processes (moving from theory to drawings). Ascending processes allow users to investigate the drawings freely to look to patterns and invariants. Descending processes are used with a theory in mind to validate or test properties. Dragging within those two cognitive levels can vary between wondering dragging, bound dragging, guided dragging, dummy locus dragging, line dragging, linked dragging, and dragging test (Arzarello et al., 2002). Baccaglini-Frank and Mariotti (2010) used the work of Arzarello et al. to develop a model that tries to explain cognitive processes behind different types of dragging. They used four different types of dragging: wondering dragging, maintaining dragging, dragging with trace activated, and dragging test. Wondering dragging is dragging that aims to look for regularities while maintaining dragging is dragging a base point so that the dynamic figure maintain certain properties. Dragging with trace activated is dragging base point with trace activated on them. Drag test is dragging base points to test whether certain properties will meet certain conditions (Baccaglini-Frank & Mariotti, 2010).

The last group of studies looked at the instrumental transformation of technological tools to instruments that mediate users' activity with those tools. An example of these studies is Guin and Trouche's (1998) study. They investigated the instrumention process that group of studetns used to transform graphing calculatros to mathematical instrument. They conclude that instrumentaion process is a complex and slow process and that interacting with technolical tools in learning mathematics might not result in transforming the tool into an instrument.

Based on our review, there is need for studies that investegate how users, through the instrumentaion process, interact with each other in DGEs. The users' interactions with DGEs have an influence on their thinking and learning of geometry (Hegedus & Moreno-Armella, 2010; Rabardel & Beguin, 2005), which makes investigating how learners appropriate an online, collaborative dynamic geometry environment important. It can help mathematics educators understand how DGEs shape learners' geometrical understanding.

THEORETICAL PERSPECTIVE

To understand learners' appropriation of technological tools, we draw on a Vygotskian perspective about goal-directed, instrument-mediated action and activity. Instrumental genesis (Lonchamp, 2012; Rabardel & Beguin, 2005) theorizes how learners interact with tools that mediate their activity on a task. To appropriate a tool, users (teachers, students, or learners in general) develop their own knowledge of how to use it, which turns the tool into an instrument that mediates an activity between users and a task. The basic concept of the theory is that users engage in an activity in which actions are performed upon an object (matter, reality, object of work…) in order to achieve a goal using an artifact (technical or material component). Rabardel and Beguin (2005) emphasize that the instrument is not just the tool or the artifact, the material device or semiotic construct, it is "a mixed entity, born of both the user and the object: the instrument is a composite entity made up of an artifact component and a scheme component." (p. 442). An instrument is a two-fold entity, part artifactual and part psychological as utilization schemes. The user acquires a utilization scheme and applies it to the artifact.

Artifacts are subject to two kinds of utilization schemes. The first kind of utilization schemes is usage schemas, which are directly related to the artifact. It constitutes the basic knowledge of how to operate or use the artifact. For example, driving a car for an experienced driver such as changing gears or turning the steering wheel, or being familiar with the components of a digital camera and knowing how to use them. The second kind of utilization schemes is instrument-mediated action schemes, which are more related to the transformations that can be done to the object. These schemes are concerned with the activity, which can be individual or collective, that will lead the users, using the artifact, to reach a desired goal. For the example of driving a car, the instrument-meditated action scheme will be more focused on the other variables on the road that a driver needs to be aware of and react to their existence to be able to reach the final destination (Lonchamp, 2012; Rabardel & Beguin, 2005).

Just interacting with an artifact is not an instrument-mediated activity. In instrument-mediated activity, instruments mediate users' activity or action to achieve a certain goal. While engaging in an activity, users monitor consciously the continuous transformation of an object towards their goal. This mediator role that instruments play governs the user-object relations, which might take epistemic or pragmatic forms. The epistemic mediation form focuses on the object and its properties. In this form, the instrument helps the user understands the object and its structure. On the other hand, in the pragmatic mediation form, the user is mainly concerned with the required actions while using the instrument to transform the object into the desired final result (Lonchamp, 2012; Rabardel & Beguin, 2005). The final result is the final transformation of the object, which might not match exactly the initial goal. The user may find certain form of the transformed object satisfying enough and, therefore, end the activity.

During an activity that is mediated by an instrument, it is understandable that the artifact affects the activity; however, users play a major role in shaping the activity. The users' interactions with an artifact shape the activity. Two different users can approach an artifact differently, develop different utilization schemes, and create two different activities and instruments.

The transformation of an artifact or tool into an instrument, or instrumental genesis, occurs through two important dialectical processes that account for potential changes in the instrument and in the learners, instrumentalization and instrumentation. The instrumentalization process is defined as "the process in which the learner enriches the artifact properties" (Rabardel & Beguin, 2005, p. 444). In this process, the user selects and modifies the properties of the artifact, for example, using a wrench as a hammer. The second process of instrumental genesis is instrumentation. This process is about the development of the learner side of the instrument. The development of the learner is basically the assimilation of an artifact to a scheme and the adaptation of utilization schemes. With the example of using a wrench as a hammer, the learner already had acquired the utilization scheme of a hammer and when a hammer was not available at the time of the action, the learner chose the wrench and associated it to the hammer utilization scheme. This is an example of "direct assimilation of artifact into a utilization scheme" (Rabardel & Beguin, 2005, p. 446), which changes the meaning of the artifact. During the act of assimilation, the learner employs previous utilization schemes to new artifact. In our example, acquiring the hammer utilization scheme led the learner to choose the wrench and not another tool because he is aware of the functions of the hammer and its structure which makes him look for a similar tool that can take the same scheme. In the situation where a new artifact cannot be assimilated to previously acquired utilization scheme, the learner adapts utilization schemes and makes the necessary modifications to it.

Through the two processes of instrumental genesis, instrumentation and instrumentalization, dialectically the tools influence the thinking of the learner and the learner influences the design of the tools. On the one hand, the structure and functionality of tools shape how the learner uses the tool, which result in shaping the learner's thinking. On the other hand, the learner's interactions with the tool also shapes the tool and how is used.

With dynamic geometry environments (DGEs), the feedback that the software gives to the user after manipulating dynamic objects affects the user's interaction with the software. The environment reacts to the users' actions through engineered infrastructure that responds to the theory of geometry. This reaction can inform the users' actions and can shape users' thinking. Dragging the "hot-spots" of a dynamic figure can change the geometric properties of the figure and can provide insights into its construction process. Hot-spots are "points that can be used to construct mathematical figures, e.g. join two points with a segment, or construct a piecewise graph, and then used to dynamically change the construction." (Hegedus & Moreno-Armella, 2010, p. 26).

The relationship between the user and the DGE is a result of co-action between the two (Hegedus & Moreno-Armella, 2010). The notion of co-action has two sides: (a) the user's action can guide DGE and (b) DGE's reaction can guide the user. A dynamics software environment allows users to act on it and, in turn, reacts to their actions. As users drag (click, hold, and slide) a hotspot of a geometric figure, the DGE redraws and updates information on the screen, preserving all constructed mathematical relations among objects of the figure. In redrawing, the DGE creates a family of not only visually but also mathematically similar figures. Users may then attend to the reaction of the DGE and experience and understand underlying mathematical relations such as dependencies. DGEs "remember" underlying mathematical relations among various objects of a construction. For instance, if a point P is the midpoint of a segment AB, then as the length or position of segment AB changes, P's relationship to AB remains invariant, namely that P is equidistant from the line segment's endpoints A and B.

Dynamic geometry environments can be seen as a tool that learners can appropriate through the instrumentation process. Learners will need to acquire utilization schemes – usage schemes and instrument-mediated activity schemes – to appropriate the tool. In DGE, the usage schemes includes knowledge about the software use and its functionalities. The second level of utilization schemes for a DGE includes knowledge of geometry and dependencies. When learners appropriate a DGE as an instrument, they will be able to use it to demonstrate geometrical concepts and solve geometrical problems. This appropriation may result in knowledge of how to use dynamic geometry software as well as knowledge of geometry. The geometrical knowledge can be a special type of knowledge shaped by DGE. Within DGEs, Straesser (2002) sees that geometry is "lived in differently, broader scope, has a new, more flexible structure, [and] offers easy access to certain heuristic strategies." (p. 331). Balacheff and Kaput (1996) claim that characteristics of DGEs result in creating new mathematics, a geometry that is different from Euclidian geometry in the plane.

METHODS

Data comes from a project that integrates a cyberlearning environment with digital tools for collaborative geometrical explorations grounded in a pedagogical approach that engages learners in developing significant mathematical discourse. The project investigates learners' actions as they occur through an iterative coevolution of the technology and curricular resources in the context of engaging, reflective collaborative learning experiences of significant mathematical discourse by in-service teachers and their students. The data for this paper comes for an online professional development course for middle and high school teachers that occurred in the semester of fall 2014. In small teams, seven New Jersey mathematics teachers engaged in interactive, discursive learning of dynamic geometry through collaborating to solve tasks in a computer-supported, collaborative-learning environment: Virtual Math Teams with GeoGebra (VMTwG). They also read and discussed articles about collaboration (Mercer & Sams, 2006; Rowe & Bicknell, 2004), mathematical practices (Common Core State Standards Initiative, 2010), accountable talk (Resnick, Michaels, & O'Connor, 2010), technological pedagogical content knowledge (Mishra & Koehler, 2006), implementing technology in mathematics classroom (McGraw & Grant, 2005), and validating dynamic geometry constructions (Stylianides & Stylianides, 2005) and analyzed logs of their VMTwG interactions to examine, reflect, and modify their collaborative and mathematical practices.

VMTwG, a product of a collaborative research project among investigators at Rutgers University and Drexel University, is an interactional, synchronous space. It contains support for chat rooms with collaborative tools for mathematical explorations, including a multi-user version of GeoGebra, where team members can define dynamic objects and drag the hotspots around on their screens. VMTwG records users' chat postings and GeoGebra actions. The research team designed dynamic-geometry tasks that encourage participants to discuss and collaboratively manipulate and construct dynamic-geometry objects, notice dependencies and other relations among the objects, make conjectures, and build justifications.

For this paper, we analyze the work of Team 3, which consists of two high school mathematics teachers. Before this course, both teachers did not have any experience with dynamic geometry. The teachers met in VMTwG synchronously for two hours twice a week. We selected this team's data since it demonstrated conspicuously how the team members built an understanding of the dragging affordances of a DGE. To understand how teachers interact with VMTwG environment and how the environment shapes their geometrical knowledge, we used the discursive data generated from their work on two tasks, Task 8, which they worked on in the fourth week, and Task 21, which they worked on in the seventh week. Task 8 (see Figure 1) asks the teachers to discuss the construction of equilateral triangle and then construct it and Task 21 (see Figure 2) asks teachers to construct a perpendicular line that passes through an arbitrary point. The discursive data includes the logs of teachers' chat communications and their GeoGebra interactions. Using conventional content analysis (Hsieh & Shannon, 2005), we analyzed their discursive data to understand the developmental process of instrument appropriation and the implications of that appropriation. In addition, we used the construct of co-action to understand when, why, and how do teachers interact with base points; what feedback do they perceive and what do they do with this feedback; and how does the feedback shape their subsequent actions.

RESULTS

Our analysis focuses on understanding how the teachers' appropriation of VMTwG shapes their geometrical understanding. Specifically, our results show how through co-action teachers' interaction with VMTwG leads to shaping the their understanding of affordances of dragging in GeoGebra while working on constructing an equilateral triangle (Task 8). Our results in a later VMTwG session also show how the VMTwG environment shapes the knowledge that the teachers develop while working to construct a perpendicular line that goes through an arbitrary point as well as their heuristic to solve the problem (Task 21).

Appropriating dragging

Task 8 asks teachers to drag objects and then to discuss (in the chat window) what they notice about the given figure and then construct a similar one in GeoGebra (see Figure 1). Among other things, previous tasks engaged the teachers in noticing as they drag hotspots variances and invariances of objects and relations of figures.

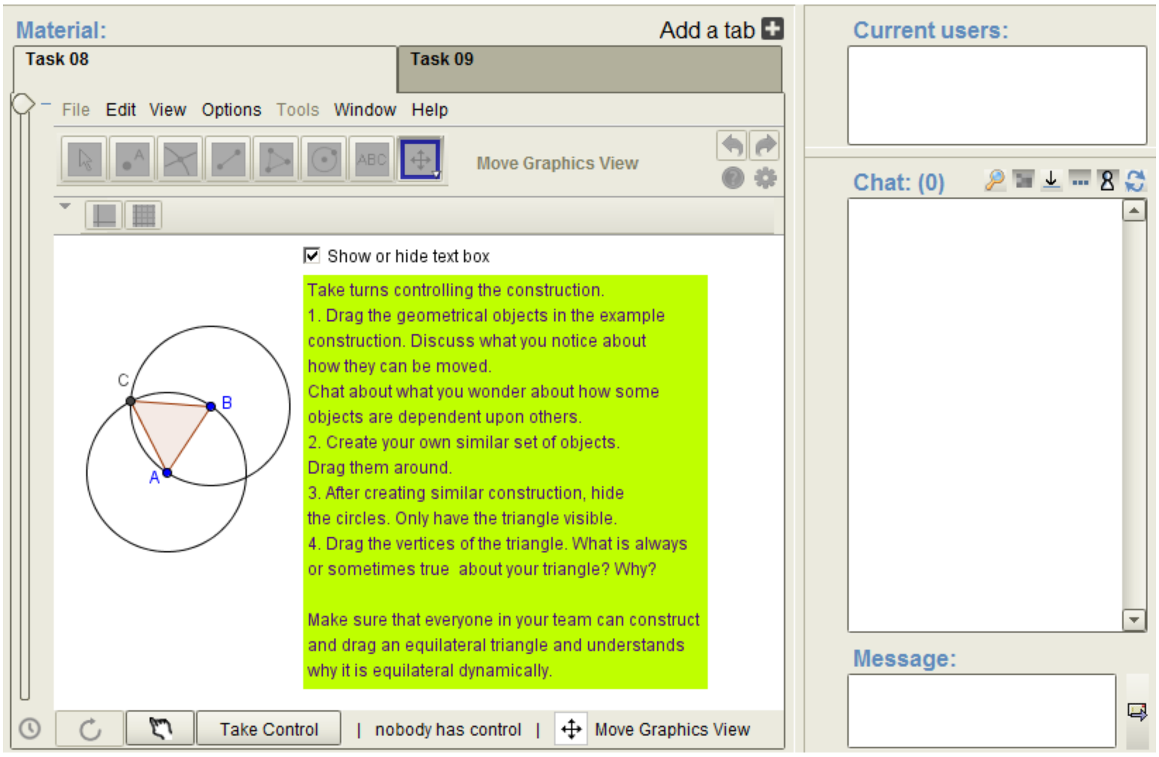

Figure 1: Task 8: Constructing Equilateral Triangle.

This task was intended to extend the teachers' experience with dragging and geometrical dependencies. Before this session, the teachers have already worked on some basic geometrical objects (such as lines, lines segments, circles, and circles whose radius is dynamically dependent on a line segment) and were asked to drag and notice relationships among the objects. Those tasks mainly aimed to familiarize the teachers with the functionality of the VMTwG environment and to the cognitive habit of noticing and wondering about the behavior of object and relations among objects. That is, the tasks engaged the teachers in becoming aware of co-active relations between their actions and reactions of the VMTwG environment. Below, their chat posting shows that they focused on relationships that were visually apparent. It also shows that the teachers, gouri and sophiak, felt the necessity to revisit their understanding of dragging after being instructed to create an equilateral triangle.

#	User	Chat Post
26	sophiak	It seems that point C is fixed but pts A&B are not. I am thinking somehow A&B were used to create the circles which is why the make the circles bigger or smaller.
27	sophiak	How about you try to explore now?
28	gouri	ok I'll continue on with #2 [the second instruction in Task 8] as well
29	sophiak	No, I would like to create the objects as well. I think it is valuable if we both explore
30	gouri	C does seem fixed/constrained
31	gouri	sure - how about i do it and then you do it as well after?
32	sophiak	Sounds good. Please type what you do.
33	gouri	So far I created 2 circles
34	gouri	and overlapped the D point as the raius point for E
35	gouri	one more try
36	gouri	ok - i deleted the other circle because i dont need it
37	gouri	I somehow thought i could create all 3 points, abc through two circles
38	sophiak	How did you create F?
39	gouri	I added a point
40	gouri	then the polygon tool for the triangle
41	sophiak	Did you want to explore your picture to see if it behaves the same way as the original?
42	gouri	ok
43	gouri	[after dragging for few minutes] I noticed that it's the points that make the circle dynamic

44	gouri	and not the circle (in black) itself

Our analysis of this excerpt reveals two aspects of this team's instrumentation process: collaboration and tool use, which parallels their mathematical understanding. From a collaboration point of view, the team was trying to establish collaborative norms by starting tasks by exploring the pre-constructed figures and then reproducing those figures. In lines 27 and 29, sophiak suggests explicitly that gouri explores before she constructs. This team's evolving collaborative norm seems to be to start with each member exploring and sharing noticing and then each member constructing the figures.

With regards to teachers' actions towards solving the task, the teachers started by stating their noticings of the construction. In line 26, sophiak mentions that point C is fixed and points A and B are not and states that points A and B are used to construct the two circles. She states that since dragging points A and B effects the circles then they are used in constructing the circles. It indicates how sophiak views the relationship between dependency and construction and how she is starting to identify the hotspots of the figure. Her comment at line 26 seems to indicate that she is connecting prior experience (A and B's independent role) with other tasks to what she notices about the size of the circles. The co-action—dragging points A and B with the change in the circumference of the circles—provides epistemic mediation since sophiak acquires knowledge about the relationship between the base points, A and B, and the circumference of the circles. The second team member, gouri, takes control, agrees that point C is "fixed/constrained", and tries to construct a similar figure. She successfully creates a similar figure to the task's figure. In lines 33 to 40, gouri describes to sophiak the process of her construction then, and following sophiak's suggestion in line 41, drags and tests gouri's construction and the pre-constructed figure. She states after dragging in lines 43 and 45 that "the points that make the circle dynamic and not the circle (in black) itself". These comments suggest that gouri was concerned with what is being dragged in a dynamic geometry environment and what makes it dynamic.

This event shows that the teachers are distinguishing between dragging that affects other geometrical properties in addition to the location of an object–dragging the points that relates to the construction–and dragging that only affects the location of an object–dragging the circumference of a circle. The second teacher here is also showing her understanding of the hotspots of the figure. The DGE's reaction informed the teachers' dragging. The co-action between the teachers and the environment helped the teachers develop an understanding of the dragging functionality in DGE. This shows how teachers appropriate the environment through developing their understanding of dragging and dependencies. In this session, the teachers started to pay more attention to how constructions in DGE take place.

Constructing perpendicular lines

Teachers' understanding of dragging different type of objects, hotspots and other objects, in DGE helped them appropriate the environment, which influenced the type of knowledge that teachers developed in later sessions in the course. To further illustrate this, we now discuss the teachers' work on Task 21 (see Figure 2). Between Task 8 (constructing equilateral triangle) and Task 21, the teachers used the compass tool to copy line segments and to construct different types of triangles. Task 21 invited them to construct a perpendicular line that passes through an arbitrary point on a given line (see Figure 2).

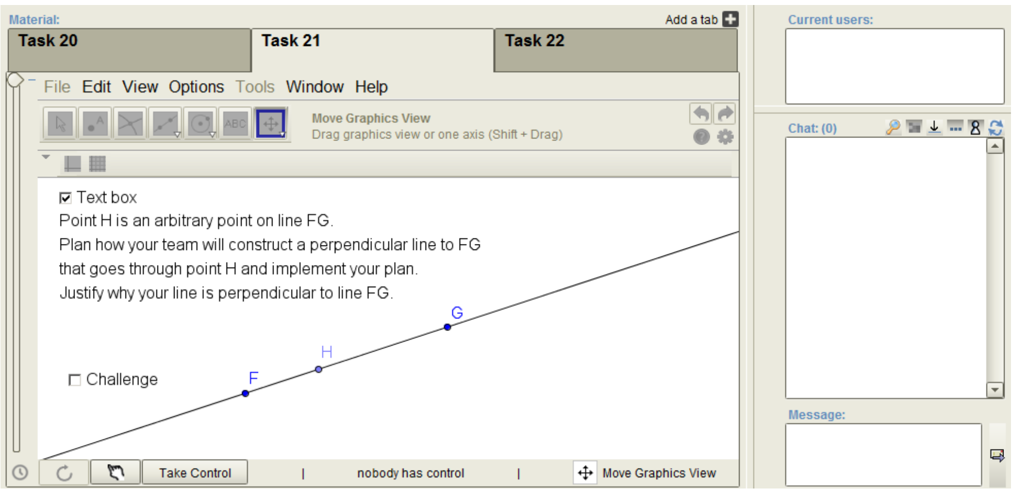

Figure 2: Task 21: Constructing Perpendicular Lines That Passes Through An Arbitrary Point.

In the preceding task, Task 20, the teachers constructed a line perpendicular to a give line (see Figure 3). In this task, our intent was to enable the teachers to develop insight and skill to solve Task 21. However, after working on Task 20, this team of teachers were unable to solve Task 21 in their first attempt. As Mason and Johnston-Wilder (2006) note that "What is intended, what is activated (implemented), and what is attained or constructed by the learners are often rather different" (p. 27). In written feedback, we suggested that in their next synchronous session they revisit Task 20 and try to use its technique to solve Task 21.

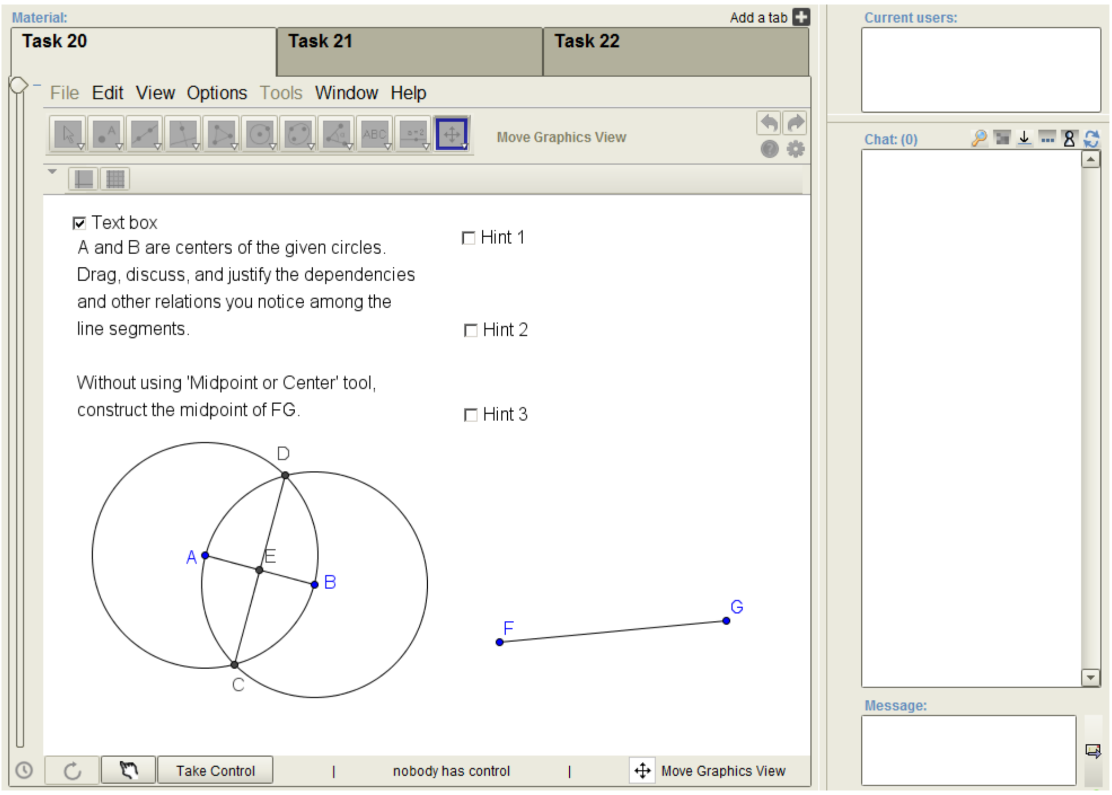

Figure 3: Task 20: Constructing Perpendicular Line.

The teachers met again to solve Task 21. To do so, within Task 21, they created a new GeoGebra workspace or tab and labeled it, "Task21-again" (see Figure 4) and successfully solved it. Interestingly, however, their solution did not rely on the solution of Task 20 in the way we anticipated. We intended that Task 20 would help the teachers see that one way to solve Task 21 is by constructing a circle that has the arbitrary point as center then mark the two intersection points of this circle with the given line to identify the radius for two other circles that will intersect in two points. Connecting those two intersecting points will create a perpendicular line that passes through the arbitrary point. Instead, the teachers develop another approach.

The teachers used some insights from Task 20 to construct perpendicular lines multiple times. They started by constructing a line AB and an arbitrary point C (see Figures 4 and 5). Then using the technique from Task 20, they constructed a line EF perpendicular line to AB (constructed circles with common radius AB, marked their intersections points E and F, then hid the circles) and dragged points A and B to test the construction. On that line, they marked point G and, employing the Task-20 technique, used it and point E to construct line IJ perpendicular to EF, which make IJ parallel to AB. After that, they construct circle EC and marked the intersection point of this circle with line IJ, point K. They dragged point C to test the behavior of the construction. Finally, they construct line KC, which is perpendicular to AB and passes through the arbitrary point C.

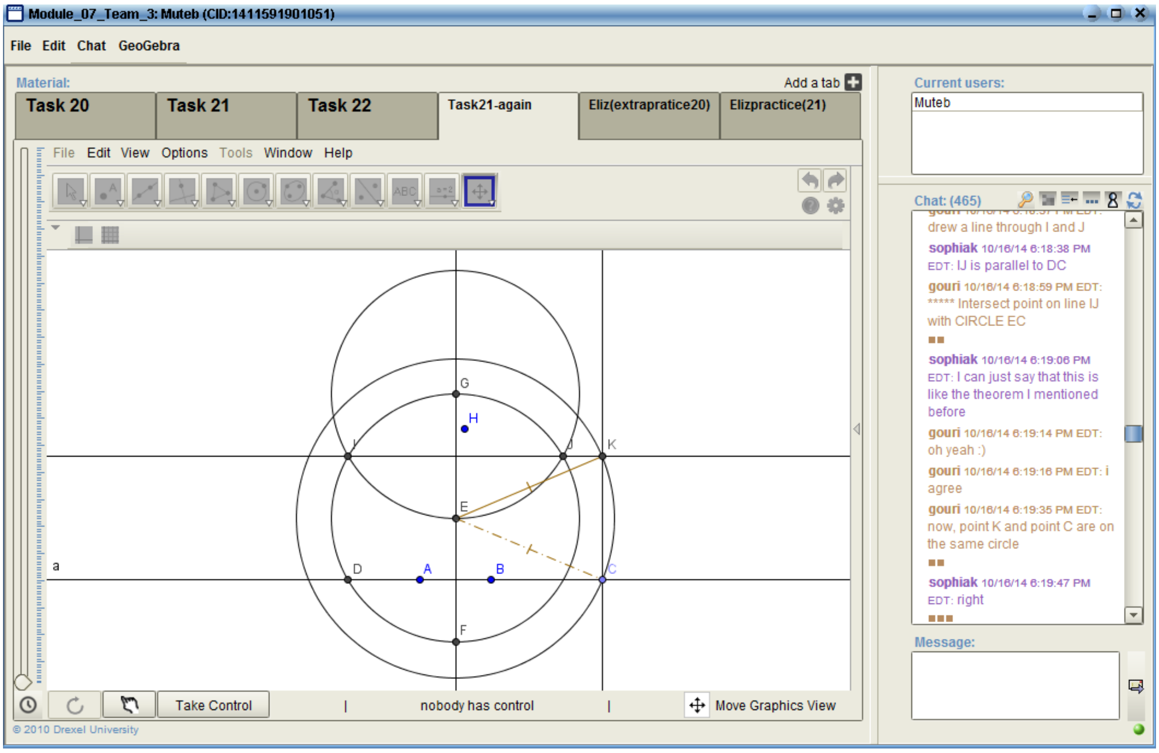

Figure 4: Team 3's Solution To Task 21 In VMTwG.

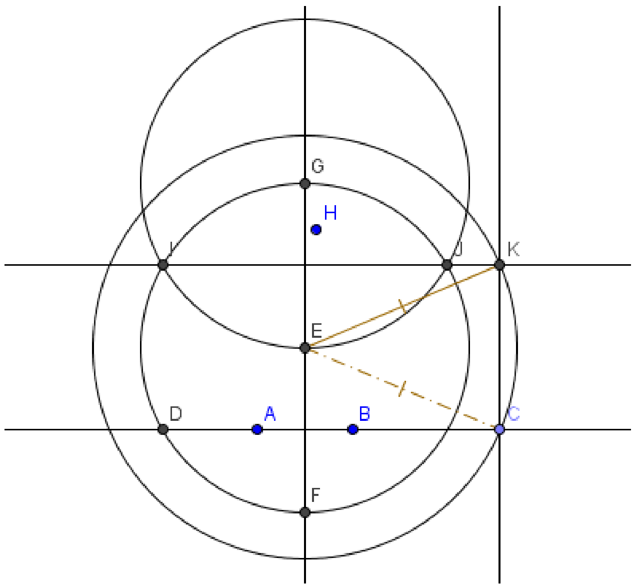

Figure 5: Team 3's Solution To Task 21.

Proving that KC is perpendicular to AB is beyond the scope of this paper; however, it can be done easily using triangle congruency. The teachers struggled for about an hour to solve this task. They passed the control of GeoGebra to each other and tried to make sense of each other's actions. They referred to Task 20 a few times and discussed how they could use it in solving Task 21. They collectively constructed their final solution. After each step of their construction, they dragged points A, B, and C to make sure that at each stage their construction maintained properties they intended. Their appropriation of dragging–what to drag, how to drag, and what to expect–was dominant in their problem solving of Task 21.

DISCUSSION

A team of two high school teachers were introduced to collaborative, online, dynamic geometry environment, VMTwG, in a semester long professional course. During this course, they interacted in VMTwG to notice variances and invariances of objects and relations in pre-constructed figures or figures that they constructed and to solve open-ended geometry problems. Our analysis of their interactions allowed us to understand how they appropriate the environment and how this appropriation affects their geometrical knowledge. At the beginning of the course, the teachers started by focusing on appropriating the dragging affordance of DGEs. They paid special attention to the characteristics of the objects that being dragged. Their interactions indicate that they see the significance of dragging the hotspots of a construction (Hegedus & Moreno-Armella, 2010). The co-action of the VMTwG environment that occurs while they drag different objects in Task 8 helped the teachers identify the hotspots and use them to test their construction and become aware of dependencies. The need for more than wondering dragging (Arzarello et al., 2002; Baccaglini-Frank & Mariotti, 2010) in this task motivated the teachers to develop more purposeful dragging. They used maintain dragging to check if the triangle maintains its properties and later on, drag to test the validity of their construction (the drag test).

Their process of appropriating VMTwG started with dragging and then looking at and understanding dependencies in dynamic constructions. Team 3's interaction with VMTwG suggests that while appropriating DGE, constructing dynamic figures in DGEs comes last, after dragging and dependencies.

While trying to solve Task 21, as mentioned above, the teachers referred to Task 20 multiple times and collectively constructed their solution for Task 21. They dragged the hotspots of their construction after each step. Their understanding of dragging hotspots helped them solve the task. In constructing a perpendicular line that passes through an arbitrary point, the teachers constructed a rectangle. Their procedure anticipates work they will be doing in a later task.

Understanding how instrumentation process occurs in DGEs informs implementing DGEs in learning and teaching mathematics. The appropriation of dragging is an important aspect of transforming dynamic geometry tool into an instrument. The environment's reaction to dragging helps users identifying the independent, partially independent, and constrained points in any geometric figure, but users need to be attentive to dragging points and see whether geometric properties are maintained. It is also important to anticipate DGE to shape users' knowledge by developing relational understanding of geometric notions.

Finally, further research is needed to understand what other aspects of DGEs are important in the instrumentation process. Investigating how the appropriation of different aspects or tools of DGEs might influence learners' knowledge is also needed. Additionally, research is needed to investigate how teachers may implement DGE in their teaching.

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LEARNING AND USER ANALYTICS IN MOBILE TECHNOLOGY TOOLS: A LITERATURE REVIEW

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ABSTRACT: The purpose of this study is to examine relatively new educational technology, learning and user analytics, in general and their potential usage in mobile tools and learning. In accordance with this aim, relevant theoretical and empirical research studies were found through an extensive literature survey and then they were subjected to content analysis. The reports of these studies conducted between 2010 and 2015 were reached through online search engines, thesis centers, databases and journals by using appropriate keywords. Findings from the content analysis were organized into two main themes as (a) learning and user analytics and (b) learning and user analytics in mobile tools. The former focused on the personalization of learning environments, evaluation of educational conditions, prediction of student performances, and the potential of learning analytics in development of new or alternative learning approaches. The latter explored such issues as mobile tools and their future importance, their usage as instructional tools, and the place and importance of learning analytics in mobile tools. Moreover, it also explored the consequences of increasing functions and uses of mobile tools in learning management systems. The findings of this literature review and implications were discussed within the context of mobile learning and suggestions were given to future research and educational practices.

Key words: learning analytics, educational data mining, mobile learning, literature review

MOBİL TEKNOLOJİ ARAÇLARINDA ÖĞRENME VE KULLANICI ANALİTİKLERİ: BİR ALANYAZIN DERLEMESİ

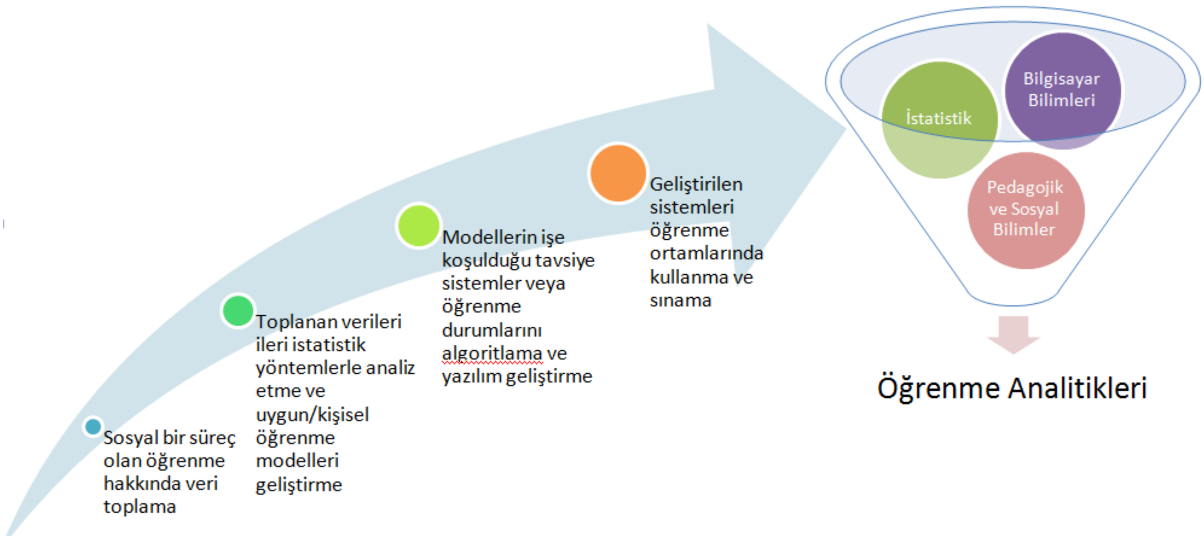
ÖZET: Bu çalışmanın amacı; genelde oldukça yeni bir eğitim teknolojisi olan öğrenme ve kullanıcı analitikleri özelde ise bu analitik araçların mobil teknoloji cihazlarında kullanılmalarının eğitsel potansiyellerini irdelemektir. Bu amaç doğrultusunda öğrenme ve kullanıcı analitikleri üzerine yapılmış kuramsal ve empirik çalışmalar kapsamlı bir alanyazın taraması ile tespit edilmiş ve içerik analizine tabi tutulmuştur. 2010-2015 yılları arasında yapılmış ilgili çalışmaların raporlarına internet üzerindeki arama motorlarından, tez merkezlerinden, veri tabanlarından ve çevrimiçi dergilerden uygun anahtar kelimeler kullanılarak ulaşılmıştır. Bu çalışmaların içerik analizleri sonucunda elde edilen bulgular (a) öğrenme ve kullanıcı analitikleri ve (b) mobil araçlarda öğrenme ve kullanıcı analitikleri şeklindeki iki tema altında toplanmıştır. Birinci temada öğrenme ortamlarının kişiselleştirilmesi, öğrenci eğitim durumlarının değerlendirilmesi, öğrencilerin gelecek performansının tahmin edilmesi ve eğitimde yeni yaklaşımlara yön göstermesi bakımından öğrenme analitiklerinin potansiyeline değinilmiştir. İkinci temada ise mobil araçlar ve gelecekteki önemi, bu cihazların öğrenme aracı olarak kullanılması ve mobil cihazlarda öğrenme ve kullanıcı analitiklerinin yeri ve önemi gibi konulara yer verilmiştir. Ayrıca mobil cihazların artan işlem becerileri ve kullanışlılığının eğitimde kullanılan öğrenme yönetim sistemlerine etkilerine değinilmiştir. Çalışmada elde edilen bulgular mobil araçlarda öğrenme bağlamında tartışılmış ve gelecekteki araştırmalara ve eğitsel uygulamalara yönelik öneriler sunulmuştur.

Anahtar sözcükler: öğrenme analitikleri, eğitsel veri madenciliği, mobil öğrenme, alanyazın taraması

GİRİŞ

Teknoloji günlük hayatımızın hemen her alanına girmiş bulunmaktadır. Bilgisayarın hayatımıza ilk girişi bir hesap makinesiyken günümüzde yapay zekâya sahip olması için çalışmalar yapılmaktadır. Yapay zekâya sahip bilgisayarların insan gibi fikirler üretebilen bir teknoloji haline gelmesi beklenmektedir. Teknoloji bu kadar ileri düzeydeyken ülkelerin eğitim sistemleri de bu gelişmelerden etkilenmektedir. Öğrenme içeriğinden öğretim yöntem ve tekniklerine kadar köklü değişimler yaşanmaktadır. Ancak, birçok eğitsel materyaller, oyunlar, öğrenme yönetim sistemleri geliştiriliyor olsa da öğrenmenin kişiselleştirmesi ve öğrenenlerdeki bireysel farklılıklar yeterince dikkate alınmamaktadır. Öğrenmenin bireyselleştirmesi günümüzün en önemli ihtiyaçlarından birisidir. Çünkü hazırbulunuşluk, ilgi, istek ve öğrenme stilleri gibi etkenlerdeki bireysel farklılıklar öğrenmenin gerçekleşmesinde de farklılıklara neden olmaktadır (Inan & Lowther, 2007). Öğretimin tasarlanmasında bu bireysel farklılıkların dikkate alınması öğrenmenin daha hızlı, etkili ve kalıcı olmasını sağlamaktadır (Şimşek; 2002). Güncel analiz ve raporlarda (Horizon Report, Roadmap, vb.) yakın gelecekte öğrenme ve öğretim süreçlerini etkileyecek eğitim teknolojileri arasında "kişiselleştirilmiş öğrenme sistemleri" gösterilmektedir (Ng'ambi, 2013; Spector, 2013). Kişiselleştirilmiş öğrenme bilişsel psikolojideki yeni yaklaşımları ve güncel teknolojilerinin sunduğu potansiyelleri kullanarak bireylerin ilgi ve ihtiyaçlarına uygun ve özelleştirilmiş öğrenme aktivitelerini içerir.

Öğrenmenin kişiselleştirilmesi için öğrencilerin öğrenme sürecindeki davranış ve deneyimlerini yansıtan verilerin toplanması ve dinamik bir şekilde modellenmesi gerekmektedir. Öğrenciler hakkında veriler toplanması ve eğitsel kararlar almada kullanılması eğitimde veri madenciliği olarak da bilinmektedir. Teknoloji destekli öğrenme bağlamında, bu tür verilerin kullanılarak öğrenme modellerinin geliştirilmesi olarak bilinen "öğrenme analitikleri" adlı yeni bir araştırma alanı gelişmiştir (Elias, 2011). Öğrenme Analitikleri Araştırma Topluluğu (The Society for Learning Analytics Research) öğrenme analitiklerini genel olarak; öğrenme süreç ve ortamlarını optimumlaştırmak için öğrenen ve öğrenme bağlamları hakkında özelliklerin ölçülmesi, toplanması, analiz edilmesi ve yorumlanması olarak tanımlamaktadır (Siemens & Gasevic, 2012). Dolayısıyla bu süreç teknik ve sosyal boyutları içermekte olup pedagojik ve sosyal bilimleri, istatistik ve bilgisayar bilimlerini kapsamaktadır (Şekil 1). Öğrenme analitikleri bağlamında toplanacak veriler arasında öğrencilerin sosyal ağları, öğrenme eğilimleri, aktivitelere katılım düzeyleri, kişisel bilgileri ve performans göstergeleri yer alabilir. Özellikle e-öğrenme ortamlarında kullanılan öğrenme/içerik yönetim sistemleri (Moodle, Blackboard, vb.) kullanıcı profilleri ve davranışları hakkında kolayca birçok kayıt (web log) tutabilmektedir. Ayrıca bu sistemlerde kullanılabilecek SNAPP, LeMo, eLAT gibi verilerin toplanması ve görselleştirilmesini sağlayan özel öğrenme analitik yazılımları da geliştirilmiştir.



Şekil 1. Öğrenme Analitikleri Uygulama Süreci

Öğrenme analitikleri hem ölçme ve değerlendirmenin yapılmasında hem de öğrenmenin kişiselleştirilmesinde kullanılabilmektedir. Örneğin, bir öğrenme etkinliğinde zorluk yaşayan öğrenci için, veritabanında daha önce benzer zorluğu yaşayan öğrencilerin profillerinin incelenmesi sonucunda uygun çözüm yolları ve aktiviteleri sunan öğrenme analitik modelleri geliştirilebilir (Spector, 2013). Bunun en basit ve yaygın örneği internetteki alışveriş sitelerinde kullanıcı izlerinin toplanarak kişilere özel reklam ve önerilerinin sunulması şeklinde görülmektedir. Öğrenme analitikleri oldukça yeni ve gelişmekte olan bir teknolojidir. Eğitim ortamlarına ve öğrenenlere yönelik potansiyellerinin belirlenmesi için sistematik ve etraflı araştırmalara ihtiyaç vardır.

Bu derlemenin amacı genelde öğrenme ve kullanıcı analitikleri özelde ise bu analitik araçların mobil teknoloji cihazlarında kullanılmalarını ve eğitsel potansiyellerini irdelemektir. Bu amaç doğrultusunda öğrenme ve kullanıcı analitikleri üzerine yapılmış kuramsal ve empirik çalışmalar kapsamlı bir alanyazın taraması ile tespit edilmiş ve içerik analizine tabi tutulmuştur. Son 10 yıl içinde yapılmış ilgili çalışmaların raporlarına internet üzerindeki arama motorlarından, tez merkezlerinden, veri tabanlarından ve çevrimiçi dergilerden uygun anahtar kelimeler kullanılarak ulaşılmıştır. Bu çalışmaların içerik analizleri sonucunda elde edilen bulgular (a) öğrenme ve kullanıcı analitikleri ve (b) mobil araçlarda öğrenme ve kullanıcı analitikleri şeklindeki iki tema altında toplanmıştır.

ÖĞRENME VE KULLANICI ANALİTİKLERİ

Öğrenme analitikleriyle ilgili yapılan çalışmalarda genel olarak öğrenme analitiğinin ne olduğu, faydaları, öğrenme analitik araçları, öğrenme yönetim sistemlerinde öğrenme analitikleri ve öğrenme analitiğinde kullanılan veri türlerine değinilmiştir.

Siemens ve Gasevic (2012) online eğitimin hızla gelişen eğitim ortamlarından biri olduğuna değindikleri çalışmada öğrenme analitiklerini disiplinlerarası bütüncül bir süreç olarak ele almışlardır. Öğrenme analitiklerini öğrenciler ve kullanılan materyaller hakkında veriler üzerinden öğrenme biçimlerini anlayabilmeyi ve öğrenme ortamlarını ve materyalleri uyarlayabilmeyi sağlayan yöntemler olarak tanımlamıştır. Öğrenme analitiklerinin teknik ve sosyal bilimlerin merkezinde durduğuna değinerek yeni araştırmacıların hızla çalıştığı ve gelecek vaat eden konulardan birisi olarak görmektedirler.

Bach (2010) öğrenme analitiğini öğretim müfredatındaki öğrenme hedeflerine ulaşmada yardımcı olabilmek için akıllı modelleme ve gelişmiş analitik tekniklerin öğretim sürecinde kullanılması olarak tanımlamıştır. Öğrenme analitiklerinin yükseköğretimde öğrenciler için önemli fırsatlar (öğrenmenin değerlendirilmesi ve öğrenme ortamının uyarlanması gibi) sağlayacağı önerisinde bulunmuştur. Çalışmasında öğretim analitiklerinin öğrenci verilerini kaydetme, saklama ve analiz etme ile öğrencilerin öğrenme karakteristiklerini belirleme olarak görmüştür. Öğrenme analitiklerinin en önemli noktası verilerde öğrenme ile ilgili değerli bilgileri belirleyebilmektedir. Öğrenme analitiklerinde kullanılan veri türlerini; test puanları, sınıf notları, demografik ve psikografik özellikler, öğrenme stilleri, tercihleri veya tercihleri, öğrenme/içerik yönetim sistemleri etkinlik bilgileri ve anket verileri şeklinde özetlemiştir.

Dietz-Uhler ve Hurn (2013) çalışmalarında analitik öğrenmenin hızla gelişmekte olduğunu vurgulamışlardır. Öğrenme analitiğini öğrencilerin öğrenme araçlarını kullanırken dersleri kayıt altına alan ve öğrencilerin gelecek performanslarını artırmada hangi öğrenme araçlarının kullanacağını tahmin etmeye yarayan araçlar olarak tanımlamışlardır. Öğrenme analitiklerinin öğrencilerin başarısını artırmaya ve öğrencilerin başarı durumlarının tespit edilmesine yardımcı araçlar olarak açıklanmıştır. Öğrenmenin kişiselleştirilmesinde, dersleri düzenlemede ve öğrenci başarısı üzerinde büyük etkisi vardır.

Retalis, Papasalouros, Psaromiligkos, Siscos ve Kargidis (2006) Piraeus Üniversitesi'nde internet tabanlı öğrenme analitikleri konusunda yaptıkları çalışmada internet tabanlı öğrenme ortamlarında anlama ve değerlendirmenin önemine değinmiştir. Bu bağlamda öğrenme analitiğini; öğrencilerin kendi öğrenme yollarını öğrenmek için öğrenci durumları, günlük girdileri ve ortalama zaman aralığı gibi kullanım istatistiklerini üreten ve analizlerle öğrencileri öğrenme durumlarına göre kümeleyebilen sistemler olarak tanımlamışlardır. Yaptıkları çalışmada iki yüksek lisans dersinde cosylmsAnalytics analiz aracıyla öğrencilerin öğrenme ortamına girişleri, ortalama öğrenme ortamında geçirdikleri süre, ders içindeki forumu kullanma istatistiklerinden yararlanılmıştır. Bu çalışmada kullanılan yaklaşımın hala geliştirme aşamasında olduğuna ve sonuçların gerçek durumlarda kullanmak için yeterli olmadığına değinilmiştir. Gelecekte yapılacak çalışmalarda uygulama yazılımlarında yapılabilecek iyileşmeleri öğrenme analitiğinin umut verici konuları arasında görmüşlerdir. Benzer şekilde, Aljohani ve Davis (2012) öğrenme analitiğini son zamanlarda öğrenci verilerinin elde edilmesi için geliştirilmiş ve gelecek için önemli olabilecek çalışmalar olarak görmektedir. Öğrenme analitiği uygulamalarında birçok zorluklar olmasına rağmen düşük düzeydeki öğrencilerin öğrenmesinde çok faydalı olduğu kanıtlanmıştır.

Siemens vd. (2011) açık öğrenme ortamlarının analitikleri çalışmalarında öğrenme analitiğini; öğrenciler hakkında öğrenme ortamı içinde öğrenmeyi iyileştirmek için veriler toplayan, analiz eden ve öğrencinin öğrenme başarısını artıran araçlar olarak tanımlamışlardır. Öğrenme analitiklerinin ilk, orta ve lise sonrası eğitimde başarıyı artıracağından söz edilmiştir. Öğrenme analitiklerinin faydalarını analiz edilen verilerle öğretmenlere doğru değerlendirme ortamı sağlayacağına, başarısı düşük öğrencileri daha çok geri kalmadan erken belirleneceğine ve öğrenme ortamının kişiselleştirilmesini sağlamaktadır. Ayrıca öğrencilerin hangisinin ek öğretime ve zamana ihtiyacı olduğunu, hızlı öğrenen öğrencileri belirlenmesiyle öğrencinin ders başarısına göre hedeflere ulaşabilmesi için yardımcı araçlar sağlayarak öğrencinin değerlendirilmesinde önemli rol oynamaktadır.

Gülbahar ve Ilgaz (2014) Moodle öğrenme ortamında SAS öğrenme analitikleri araçlarını inceledikleri çalışmada öğrenme analitiğini; öğrenme-öğretmenin kalitesinin incelenmesi ve başarının artırılması için öğrenme sırasında kaydedilmiş verileri kullanan alan olarak tanımlamıştır. Öğrenme analitikleriyle öğrenme ortamından öğrenme sırasında birçok veri toplanabileceğine değinmiştir. Öğrenme analitiklerinde açık kaynak kodlu öğrenme sistemlerinden en çok Moodle'ın kullanıldığını ve Moodle ile toplanan günlük verilerle öğrenme faaliyetleri, dersler, programlar ve kurumlar hakkında eğitimcilere yol göstericidir. Moodle'da geliştirilen iki ders için uygulanan öğrenme analitiği sonucunda öğrencilerin ders içinde harcadıkları zaman bilgileri öğrenme içeriklerinin düzenlenmesinde öğretmenler rehber olarak kullanabilir.

Jo, Yu, Lee ve Kim (2015) alanyazındaki tanımların ortak noktalarını öğrencilerin gelecekteki performanslarını tahmin etmek, eğitim sürecinin ve öğrenci başarısının iyileştirilmesi için müdahalelerde bulunmak ile öğrencilerin kendi öğrenmelerini geliştirmeleri olarak açıklamışlardır. Yaptıkları çalışmada öğrenme analitikleri olarak öğrenme yönetim sisteminde geçirilen toplam süre, sisteme giriş frekansı, katılımdaki süreklilik, eğitimcilerle etkileşim, diğer öğrenenlerle etkileşim, öğrenme materyalleriyle etkileşim, ödevler ve değerlendirmeler, tartışma ve forumlara katılımı olarak belirlemişlerdir. Bu değişkenleri kullanarak öğrenme yönetim sisteminde kullanıcı analitiklerinin öğrenci durumlarına etkisini incelemişlerdir. Yüz yüze yaptıkları bir dersin analizinde öğrenme analitiğinin öğrencilerin gelecekteki performansının tahmininde kullanılabilir. Çalışmanın bir ders olduğunu çeşitli dersler ve değişkenlerle yeni araştırmalar yapılması önerilmiştir.

Dyckhoff, Zielke, Bültmann, Chatti ve Schroeder (2012) yaptıkları çalışmada eLAT öğrenme analitikleri aracını kullanmışlardır. eLAT sayesinde öğretmenlerin öğrencileri keşfetmesi, öğrenci başarılarını değerlendirerek öğrenci ihtiyaçlarının belirlenmesi ve öğretimin öğrenciye göre düzenlenmesi sağlanmıştır. eLAT e-öğrenme sisteminde öğrencilerin harcadıkları zaman, dersteki tartışmalara katılımı, ödevleri yapma düzeyleri, ders içeriğindeki materyalleri kullanmaları gibi verileri oluşturmaktadır. Öğrencilerin verileri gizlilik ilkeleri ihlal edilmeden veri tabanlarına kaydedilmektedir. Öğretmene ulaşan bu veriler ile öğrenciler değerlendirilebilmektedir.

Siemens ve Long (2011)'e göre öğrenme analitiklerinin yüksek öğrenimde önemli rolü vardır. Ancak öğrenme analitiklerinin günümüzde hala uygulama deneylerde erken safhalardadır. Teknolojinin hızla gelişmesi eğitim, iş ve birçok sektörde analiz tekniklerine ilgi artmaktadır. Öğrenme analitiklerinin kullanımıyla eğitimde öğretmenler öğrencilerin performanslarını her an ölçebilecek ve öğretim etkinliklerinin planlanmasında yardımcı olacaktır. Ayrıca öğrencilerin başarıları hakkında bilgi almaları öğrencilere cesaret verici ve motive edici olacaktır.

Hung, Hsu ve Rice (2012) Öğrenme analitikleri aracı kullanarak öğrencilerin demografik değişkenlerin ders başarılarına etkisini inceledikleri ve öğrenci durumlarıyla genel yargılara ulaştıkları çalışmalarında öğrenme analitik araçları kullanarak daha zengin veriye ulaşabilmek için birden fazla (anket verileri, etkili ders tasarımı, öğrenme çıktıları) formun ilişkilerinin incelenmesini vurgulanmıştır.

Tablo 1: Üniversitelerde Kullanılan Öğrenme Analitik Araçları (Dietz-Uhler & Hurn, 2013)

Kurum	Öğrenme Analitik Aracı	Veri Kullanımı
University of Central Florida	ETS (Executive Information System)	Veri yönetimi
Rio Salado Coummunity College	PACE (Progress and Course Engagement)	Öğrencilerin ilerlemeleri ve derste yaptıklarının izlenmesi
Nortbern Arizona University	GPS (Grade Performance System)	Öğrencilerin sorunlarının ve akademik başarılarının izlenmesi
Purdue University	Course Signal Systems	Öğrencilerin sorunlarının ve akademik başarılarının izlenmesi
Ball State University	Visualizing Collaorative Knowledge Work	Öğrencileri izlemek ve performans tahmini
University of Michigsn	E^2 Coach	Öğrenci destekleri ve müdahalelerin izlenmesi
University of Maryland Baltimore Country (UMBC)	Blackboard LCMS	Öğrenci performanslarının izlenmesi ve başarıların tahmin edilmesi
Graduate School of Medicine. University of Wollongong	BIRT (Business Intelligence and Reporting Tools)	Bakım konularının devamının ortaya konması

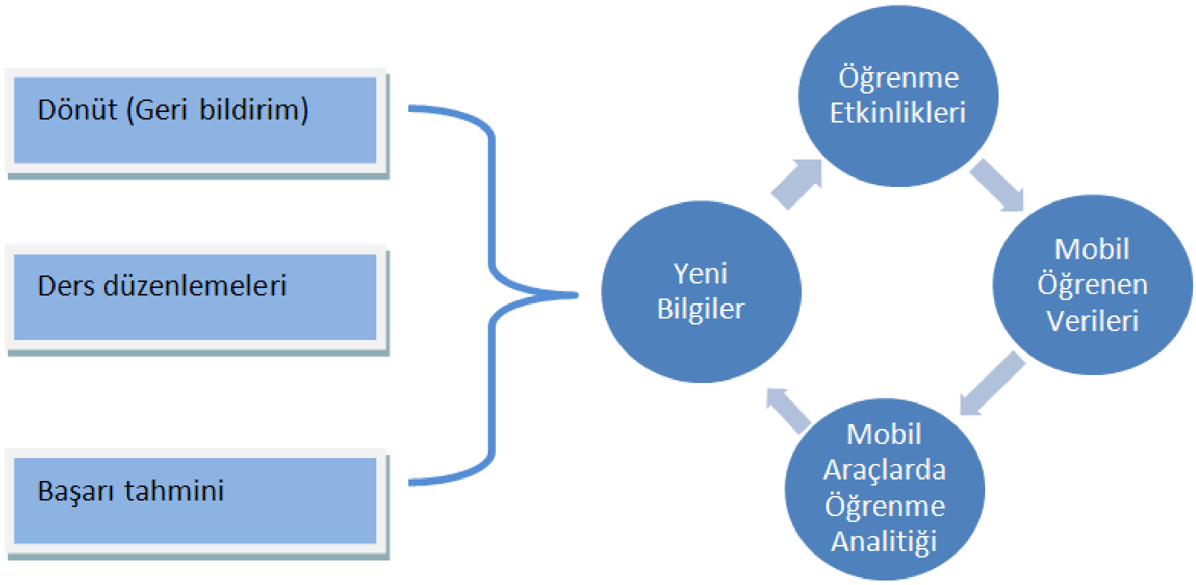
MOBİL ARAÇLARDA ÖĞRENME VE KULLANICI ANALİTİKLERİ

Mobil cihazlar teknolojideki gelişmelerin hızıyla farklı şekillere bürünmektedir. Dolayısıyla, mobil cihazların tanımlanması bu karışıklığı giderecektir. Guy (2012) mobil cihazları kısaca veri iletişimi yapabilen sabit bir klavyesi olmayan cebe sığabilen araçlar olarak tanımlanmıştır. Günümüz bilgisayarlarının taşınabilirliğindeki ilerlemeler ile tablet bilgisayarlarda mobil cihazlar olarak kabul edilmektedir (Kinash, Brand & Mathew, 2012; New Generation Technologies for Learning, 2011). Guy (2012) mobil cihazları; cep telefonları, kişisel cep bilgisayarları, akıllı telefonlar, tablet bilgisayarlar, taşınabilir medya çalarlar (İpod, Mp3 çalarlar) ve taşınabilir oyun konsolları (Playstation, Vita, Nintendo, 3DS) şeklinde sıralamaktadır. Yapılan çalışmalar yakın gelecekte mobil cihazların eğitim ortamlarında kullanılan en önemli eğitim teknolojileri olacağını işaret etmektedir (Martin, Diaz, Sancristobal, Gil, Castro & Peire, 2011; Spector, 2013).

Teknolojinin en çok ve hızlı gelişim gösterdiği alanlardan biri olan telefonlar günümüzde arama yapmak ve kısa mesaj göndermenin dışında internet bağlantı hızı, ekran boyutunun büyümesi, hızlı işletim sistemleri ve işlemcileriyle hayatımızda bilgisayarların yerine geçmeye başlamıştır. Bu gelişmelerin tüm taşınabilir cihazlarda görülmesi mobil cihazları yaygın kullanmaya teşvik etmiştir (Aljohani & Davis, 2012). Mobil cihazlar ile her yerde ve her zaman erişimin olması ve taşınabilirliği bu araçların artan öneminin sebeplerindendir. Günümüzde insanların %80'i internet erişiminde araç olarak mobil cihazları kullanmaktadır (Johnson, Smith, Willis, Levine & Haywood, 2011). Google'un 2014 yılındaki kullanıcı analitikleri çalışmasında Türkiye'de akıllı telefon kullanımı 2013'e göre üç katına çıkmıştır. Gelişen teknoloji ile artık mobil cihazlar laptopların ve masaüstü bilgisayarların yerini alacak gibi görünmektedir.

Son yıllarda mobil cihazlara artan ilgi bu cihazlarda eğitimin gerçekleştirilebileceği fikrini ortaya çıkardı. Mobil cihazlardaki internet bağlantı hızının artması, ekran boyutlarının büyümesi ve işlem kapasitesinin artması, mobil cihazların öğrenme aracı olarak da kullanılmasını sağlamıştır. Eğitim amacıyla mobil araçların kullanılmasına kısaca mobil öğrenme denilmektedir. Mobil öğrenme ağa erişimi olan taşınabilir mobil cihazların eğitim ve öğretim süreçlerinde etkileşimli kullanılarak etkili öğrenmenin sağlanmasıdır (Saran, 2013). Öğrencileri kâğıt kalem ve çanta maliyetlerinden kurtaran mobil cihazlar otobüste, yolda ve kafede bilgiye ulaşmada kullanılan araçlar haline gelmiştir.

Bu bağlamda, mobil öğrenme analitikleri öğrencilerin mobil araçlarda kullandıkları öğrenme materyallerini kullanma verileri olarak tanımlanabilir (Aljohani & Davis, 2012). Mobil cihazların eğitim süreçlerinde kullanılması öğrencilerin öğrenme süreçlerinin kontrolünü zorlaştırmıştır. Okuldan bağımsız öğrenmelerin gerçekleşmesi, öğrencinin öğrenme deneyimleri ile ilgili bilgileri gizleyebilmektedir. Dolayısıyla bu araçlara kurulacak kullanıcı analitikleri yazılımları mobil cihazlar ile öğrenmeye çalışan öğrencilerin izlenmesini ve başarılarının değerlendirilmesini kolaylaştıracaktır. Mobil araçlarda öğrenme analitiği sadece değerlendirme boyutunda değil öğrencinin daha az çaba ile anlamlı ve kalıcı öğrenmesini sağlamak için tavsiyeler ve modeller sunmaktadır.



Şekil 2. Mobil Araçlarda Öğrenme Analitiği Uygulama Süreci (Aljohani & Davis, 2012)

Aljohani ve Davis (2012) mobil öğrenme analitiklerinin nasıl uygulanabileceğini açıklayan Şekil 2' de öğrenme etkinlikleri mobil öğrenme analitiğinin ilk aşamasıdır. Öğrenme etkinliklerinden önce yapılması gereken hangi tür verilerin (öğrenci derse katılımı, tartışma forumlarına katılım, ders içinde geçirilen süre vd.) analizi ile öğrenci performans tahmininde anlamlı sonuçlara ulaşılabileceğini belirlemek gerekir. Mobil öğrenme verilerinde ise hedef davranışlara (eğitimin amaçlarına) göre öğrenci verilerinin toplanmasıdır. Mobil araçlarda öğrenme analitiği en önemli adımdır. Çünkü öğrenme faaliyetlerinin öğretim hedeflerini karşılayıp karşılamadığı bu süreçte belirlenir. Ayrıca eğitimcilere öğrenciler hakkında çok geç olmadan öğrencilere yardımcı olmasını sağlamaktadır. Toplanan verilerin analizinde birçok istatistiksel yöntemler kullanılabilir. Ayrıca öğrenme analitiğinin en önemli amaçlarından başarı tahmini için sınıflandırma ve regresyon gibi yöntemler kullanılabilir. Öğrenme analitiğinin tamamlanması sonucunda elde edilen yeni bilgiler üç şekilde sınıflandırılmıştır. İlk olarak dönüt (geri bildirim) bölümünde öğrencilerin kendi başarılarından haberdar olmaları ve motive edilmesidir. İkinci bölümde öğrenme sürecinde karşılaşılan problemlerin çözümünde uygulanabilecek uygun yöntem ve teknikleri geliştirmek için kullanılabilir. Son bölümde ise öğrencilerin öngörülerini artırma ve öğretmenlerin öğrencilerden beklentilerinin elde edilmesidir.

Sonuç olarak, öğrenme analitikleri geleceğin öğrenme yöntemlerini belirlemede, öğrenci başarısını belirlemede ve tahmin etmede, en iyi öğretim modelini hazırlayarak kişiselleştirilmiş öğretim ortamlarına hazırlanmasında önemli bir yere ve potansiyele sahiptir. Mobil teknolojilerin gelişmesi ve yaygınlaşması günümüzde eğitimin her yerde yapılabileceği fikrini ortaya çıkarmıştır. Eğitimin mekândan bağımsız ve informal olması öğrenmenin izlenmesi, değerlendirmesi ve yönlendirilmesinde bir takım zorluklara neden olmaktadır. Öğrenme analitiklerinin öğrenenin davranışlarını kayıt etme ve analiz etme potansiyeli bu zorlukların giderilmesinde kullanılabilir. Ancak, bu potansiyelin getireceği katkıların sistematik olarak araştırılması gerekmektedir. Alanyazın bu alan bakımından oldukça bakir görülmektedir. Alanyazındaki araştırmalar kuramsal çerçeveyi oluşturduğu açık ancak öğrenme analitiği konusunda yapılan deneysel ve uygulamaya dönük çalışmalar -2 ders kapsamında ele alınmış olması bu alanda uygulamaya dönük birden fazla dersi kapsayan yeni çalışmalara ihtiyaç duyulduğunu göstermektedir.

Öğrenme analitiklerinin yeni bir araştırma konusu olması ve mobil araçların geleceğin önemli eğitim teknolojileri olması bu alanda yeni araştırmalar yapılmasını gerekli kılmaktadır. Lisansüstü eğitimdeki AR-GE faaliyetlerinin bu alanda yapılması teşvik edilmelidir. Özellikle lisans ve lisansüstü eğitimde mekândan bağımsız öğrenmelerin artmasıyla öğrenci başarısı değerlendirilmesi ve öğrenci durumlarının tahmin edilmesi için mobil öğrenme analitikleri üniversitelerin öncül yatırımlarından olmalıdır. Ayrıca etkili bir mesleki rehberlik sağlayabilmek için her kademede (ilkokul, ortaokul, lise) öğrencilerin başarı tahminleriyle hangi çalışma alanlara daha uygun olduğunun belirlenmesinde kullanılabilir. Mobil araçların analizi ile FATİH projesinin etkililiği belirlemede, öğrencilerin tablet bilgisayarları benimseme ve kullanmalarına dair değerlendirmelere ulaşılabileceğinden Türkiye’de ve dünyada bu alanda yeni araştırmalara ihtiyaç duyulmaktadır.

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A CONTENT ANALYSIS OF THE STUDIES RELATED INSTRUCTIONAL TECHNOLGIES AREA IN CONTEXT OF SCIENCE EDDUCATION

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ABSTRACT: The aim of this study was to analyze the articles of the last ten years, which appeared in different sources, about "instructional Technologies in context of science education'' in Turkey. For this purpose, ERIC database, YÖK (Higher Education Council) database were searched by using "technology based teaching" ''computer supported teaching'' and ''animation'' as keywords. Moreover, journals published in Turkey and which are possible to be reached electronically were searched using the same keyword. 50 studies in the science education context were analyzed by means of standards obtained from the related literature; research topic, place and year of publication, number of authors, working group size, the class-level working group, research design and methods of data collection and data analysis tools. The results provided us the general scope of researches about instructional technology in Turkey.

Keys words: science education, instructional technology, content analysis

FEN BİLİMLERİ EĞİTİMİNDE ÖĞRETİM TEKNOLOJİLERİ ALANINDA YAPILAN ÇALIŞMALARIN BETİMSEL İÇERİK ANALİZİ

ÖZET: Bu araştırma "fen bilimleri eğitiminde öğretim teknolojileri" alanında son on yılda Türkiye'de yapılan çalışmalara ilişkin bir içerik analizi gerçekleştirmek amacıyla yapılmıştır. "Teknoloji tabanlı öğretim" , "bilgisayar destekli öğretim" ve "animasyon" anahtar sözcükleri ile ülkemizde yayınlanan eğitim dergileri, ERIC ve Yüksek Öğretim Kurumu [YÖK] tez veri tabanı taranarak elde edilen 50 çalışma (Fen eğitimi alanında) analiz edilmiştir. Bu çalışmalar literatür elde edilen kriterlere göre analiz edilmiştir. Türkiye'de elektronik ortamda yapılan araştırmalar seçilmiş ve dokuz başlık altında (araştırma konusu, yayımlanma yeri ve yılı, yazar sayısı, çalışma grubu büyüklüğü, çalışma grubunun sınıf düzeyi, araştırma deseni ve yöntemi, veri toplama araçları ve veri analiz yöntemleri) incelenmiştir. Elde edilen sonuçlar Türkiye'deki mevcut durumu ortaya çıkarmıştır.

Anahtar sözcükler: fen bilimleri eğitimi, öğretim teknolojisi, içerik analizi

GİRİŞ

Günümüzde küresel anlamda birçok değişim ve gelişimler gerçekleşmektedir. Bu değişim ve gelişimlerin en başında bilgi toplumlarının ortaya çıkışı ile birlikte hiç şüphesiz teknoloji gelmektedir. Teknoloji insanoğluna birçok alanda kolaylıklar getirdiği gibi eğitim alanında da teknolojinin rolü tartışılmaz bir konum almıştır. Günümüzde eğitim teknolojileri çok büyük bir hızla gelişme göstermektedir. Teknoloji, donanımsal ve kuramsal boyutuyla eğitimin bütün yönlerini etkilemektedir. Eğitim ortamlarında bilimselliğin ön plana çıkarılabilmesi için öğretmenlerin teknolojik gelişmelerden yaralanmaları gerektiği kaçınılmaz bir gerçektir (Çağlar, 2007).

Türkiye'de ve yurt dışında yeni bilgi teknolojilerin okullarda kullanımı ve öğretmenin rolü, öğretmenlerin internet kullanımı, okul yöneticileri ve öğretmenlerin teknolojiye yönelik tutumları, öğretmenlerin bilgisayara kullanma durumu, bilgisayar öz-yeterlilikleri gibi konularda birçok çalışma bulunmaktadır (Akbaba, 2000; Akkoyunlu, 2002; Demiraslan & Usluel, 2005). Öğretim sürecinde yeni teknolojilerin kullanımı tüm okul türleri ve sınıf seviyeleri için önemli olmakla birlikte özellikle Fen Bilimleri dersleri için ayrıcalıklı bir konuma sahiptir. Milli Eğitim Bakanlığı'nın hazırladığı Fen Bilimleri dersi öğretim programında bilgisayar ile diğer bilgi ve iletişim teknolojilerinin öğrenme ve öğretme sürecinde kullanımının öğretmen ve öğrenciler için sunduğu fırsatlar belirtilmekte ve bu teknolojilerden faydalanılmasının gerekliliği vurgulanmaktadır (MEB, 2004).

Bununla birlikte Fen Bilimleri dersinin içeriğine bağlı olarak yeni teknolojilerden beklentiler oldukça fazladır. Fen Bilimleri dersinde çok sayıda soyut, karmaşık ve dinamik yapıya sahip konu yer almaktadır. Bu tür konularda öğrencilerin bilgi kazanımı ve bilgilerin transferinde güçlüklerle karşılaşılırken öğretmenler de konuların öğrencilere anlaşılır biçimde aktarılmasında sorunlar yaşamaktadır. Bu nedenle ilköğretim birinci ve ikinci kademe Fen Bilimleri derslerinde yer alan konuların aktarılmasında yeni teknolojiler çeşitli imkânlar sunmaktadır. Ses, resim, grafik, animasyon, benzetim gibi çeşitli materyallerin tek tek veya bir arada kullanılması ile öğrencilerin birden fazla duyu organına hitap edilebilmektedir. Bu durum konuların aktarılması ve anlaşılır olmasına önemli ölçüde yardımcı olmaktadır (Kahyaoğlu, 2011).

Alan yazında eğitim ve öğretim teknolojileri konularında içerik analizi çalışmalarının yapılmış olduğu görülmektedir. Gülbahar ve Alper (2009) yaptıkları içerik analizi çalışmasında, Ankara Üniversitesi Eğitim Bilimleri Fakültesi, Hacettepe Üniversitesi Eğitim Fakültesi, Gazi Üniversitesi Eğitim Fakültesi, TOJET ve TOJDE dergilerini taramışlar ve 2005-2007 yılları arasında Türk yazarlar tarafından, Türkiye'de yapılan öğretim teknolojileri ile ilgili araştırmaları incelemişlerdir. Makaleleri konu, hedef kitle, kuramsal temel, örneklem seçme yöntemi, örneklem büyüklüğü, araştırma türü, araştırma yöntemi, veri toplama teknikleri ve referans sayıları olmak üzere dokuz başlık altında incelemişlerdir. Araştırmalarda en çok e-öğrenme ve uzaktan eğitim konularının işlendiğini, örneklem seçme yöntemi olarak çoğu araştırmacının erişebileceği örneklem üzerinde çalıştığını ve yabancı kaynaklara yerli kaynaklardan daha fazla miktarda atıf yapıldığını belirtmişlerdir. Kuramsal temel konusunda yapılan çalışmaların tüm çalışmaların %20sini oluşturduğunu ve bu sayının da yetersiz olduğunu vurgulamışlardır.

Erdoğmuş (2009), evrenini Türkiye'de eğitim teknolojileri bölümlerinde basılan tüm doktora ve yüksek lisans tezlerinin oluşturduğu çalışmasında 215 yüksek lisans ve 32 doktora tezi incelemiştir. Tezleri nitelikleri (yazar, üniversite, tez yöneticisi ve basım yılı), araştırma konusu, araştırma yöntemi, örneklem tipi, örneklem boyutu, veri toplama yöntemleri ve araştırma çevresi açısından sınıflandırmıştır. Yüksek lisans tezlerinin ODTÜ (%21,9), Gazi Üniversitesi (%14,9), Ankara Üniversitesi (%13,5) ve diğer üniversitelerden, doktora tezlerinin de Ankara Üniversitesi (%46,9), ODTÜ (%37,5), Anadolu Üniversitesi (%12,5) ve Gazi Üniversitesi'nden (%3,1) olduğunu, en çok incelenen konuların sırasıyla ortam dağıtım sistemi biçimi, medya karşılaştırma çalışmaları ve öğrenen değişkenleri olduğunu, çalışmaların araştırma yöntemlerinin deneysel (%35,2), alan araştırması (%24,7), örnek olay (%13) şeklinde olduğunu, tezlerin çoğunda elverişli örneklem tercih edildiğini, anket, başarı testi ve görüşme yöntemlerinin en sık kullanılan veri toplama araçları olduğunu ve son olarak da araştırmacıların en çok yüksek eğitim kurumlarını araştırma ortamı için kullandıklarını tespit etmiştir.

Şimşek ve arkadaşları (2009), Türkiye'de 2000-2007 yılları arasında Anadolu Üniversitesi, Ankara Üniversitesi, Çukurova Üniversitesi, Gazi Üniversitesi, Hacettepe Üniversitesi, Karadeniz Teknik Üniversitesi, Marmara Üniversitesi, Orta Doğu Teknik Üniversitesi ve Sakarya Üniversitesi'nde eğitim teknolojisi alanında tamamlanmış olan 259 yüksek lisans tezini konular, yöntemler ve sonuçlarına göre incelemişlerdir. Tezlerin büyük çoğunluğunu nicel araştırmaların (%79) oluşturduğunu belirtmişlerdir. Veri toplama araçlarına bakıldığında sırasıyla anketler, testler ve ölçeklerin, veri analizlerinde betimsel istatistik (%35), t-testi (%20) ve varyans analizi (%17) kullanıldığını tespit etmişlerdir. En çok araştırılan konuların ise bilgisayar destekli öğretim, alternatif öğretme-öğrenme yaklaşımları, web destekli öğrenme, eğitsel teknoloji kullanımında yaşanan sorunlar, internet tabanlı öğrenme ve uzaktan eğitim olduğunu belirtmişlerdir.

Sert (2010), tez çalışmasında, Social Science Citation Index' te (SSCI) indekslenmiş, öğretim teknolojileri alanında yapılan 1989 – Temmuz 2009 tarihleri arasında yayımlanan, Türkiye adresli ve hedef kitlesi Türkiye'den seçilen 173 makaleyi içerik analizi kullanarak incelemiştir. Makaleleri, demografik özellikleri (yazım dili, yazar sayısı, bulundukları dergiler, basım yılları, yazar adları, yazarların belirttikleri kurum adları, atıf sayıları), anahtar kelimeleri, çalışılan konuları, makale türleri, araştırma yöntemleri, örnekleme teknikleri, örnekleme boyutları, veri toplama araçları ve hedef kitleleri açısından analiz etmiştir. Bulgulara göre, makalelerde konusu bakımından "öğrenen çıktılarının" en fazla çalışılan konu olduğu tespit etmiştir. Tutum ve öğretmen eğitiminin en çok tercih edilen anahtar kelimeler olduğunu belirtmiştir. Makalelerin çoğunda "alan araştırması" yapılmış olduğunu, hedef kitle olarak da en fazla üniversite öğrencilerinin tercih edilmiş olduğunu belirtmiştir. Çalışılan hedef kitlelerin çoğunluğunun elverişli örneklem ile belirlendiğini, örneklem sayılarının da 31-100 arasında olduğunu görmüştür. İncelenen makalelerin yazarlarının büyük çoğunluğunun Hacettepe Üniversitesi ve Orta Doğu Teknik Üniversitesi mensubu olduğu, çalışmaya dâhil edilen makalelerin sayısı bakımından "Educational Technology & Society" adlı derginin ilk sırada yer aldığı sonucuna ulaşmıştır.

Araştırmanın Amacı ve Gerekçesi

Bilginin kapsamının, bilgiye erişim şeklinin ve hızının değiştiği, bilgiye erişimde yeni kanalların ortaya çıktığı günümüzde okullardan bilgiye ulaşma ve onu etkili bir şekilde kullanma becerileriyle donatılmış, teknolojiyi kullanabilen bireyler yetiştirmeleri beklenmektedir. Bu nedenle de eğitim kurumları bilişim teknolojilerinden yararlanma çabası içinde değişik uygulamalar yürütmektedirler. Bu süreçlerin en önemli unsuru ise öğretmenlerdir.

Okullarda teknolojik donanımın giderek daha yaygın bir şekilde sunuluyor olması ve teknoloji kullanımının yaygınlaşması ile birlikte öğretmenlerin de teknolojiyi etkili olarak kullanmaları konusuna daha çok odaklanılmaktadır. Bu bağlamda okullarda teknoloji kullanımıyla ilgili çalışmaların incelenmesi ve sonuçların değerlendirilmesi önem taşımaktadır. Bu amaçla bu çalışmada, son on yılda Fen Bilimleri öğretmenlerinin öğrenme-öğretme sürecinde teknoloji kullanım durumlarının ele alındığı çalışmalar incelenerek bir içerik analizi çalışması yapılmıştır. Alan yazında yalnızca Fen bilimleri öğretmenlerinin öğretim teknolojilerini kullanım durumları ile ilgili bir çalışmanın daha önce yapılmamış olması bu çalışmanın alan yazına katkıda bulunacağını ve gelecekte yapılacak olan çalışmalara yol gösterici olabileceğini düşündürmektedir. Bu bağlamda ulaşılan çalışmalar araştırmanın konusu, çalışma grubu büyüklüğü, çalışma grubunu belirleme türü, araştırma türü, veri toplama araçları, veri analiz yöntemleri (kullanılan istatistiksel yöntemler) gibi değişkenler açısından incelenmiştir. Çalışmada aşağıdaki sorulara cevap aranmıştır;

1. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmalarda yaygın olarak hangi konularda çalışılmıştır?
2. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmalar hangi dergilerde yayınlanmıştır?
3. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili tezler hangi üniversitelerden yazılmıştır?
4. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmalar yaygın kaç yazarlıdır?
5. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmaların yıllara göre dağılımı nasıldır?
6. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmalarda hangi araştırma desenleri yaygın olarak kullanılmıştır?
7. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmalarda hangi yöntemler kullanılmıştır?
8. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmaların örneklem büyüklükleri nasıl değişmektedir?
9. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmaların örneklemlerinin sınıf düzeyi nasıl değişmektedir?
10. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmalarda hangi veri toplama araçları kullanılmıştır?
11. Fen bilimleri eğitiminde teknoloji kullanımı ile ilgili araştırmalarda kullanılan veri analiz yöntemleri hangileridir?

Araştırmanın Sınırlılıkları

- Araştırma fen bilimleri eğitiminde teknoloji kullanımı ile ilgili internet ortamından ulaşılabilen ve yurt içinde yapılan 50 çalışma ile (Ek) sınırlıdır.
- İncelenen makaleler 15 dergi ile sınırlıdır.
- İncelenen çalışmalar 2003-2014 yılları ile sınırlıdır.
- Çalışmaların içerik analizi incelemesi 11 kriterle sınırlıdır.

YÖNTEM

Bu çalışma içerik analizi temele alınarak gerçekleştirilmiştir. Cohen, Manion ve Morrison (2007) içerik analizinin; metinlerin düzenlenmesi, sınıflandırılması, karşılaştırılması ve metinlerden teorik sonuçlar çıkarılmasından oluşan bir araştırma tekniği olduğunu vurgulamışlardır. Bu çalışmada içerik analizi, bu yönlerinin yanı sıra birbirlerine benzeyen verileri belirli kavramlar ve temalar çerçevesinde bir araya getirerek okuyucunun anlayacağı biçime dönüştürmesi nedeniyle tercih edilmiştir (Bauer, 2003; Fraenkel ve Wallen, 2000; Yıldırım ve Şimşek, 2005)

Verilerin Analizi

Çalışmadan elde edilen veriler; içerik analizleri türlerinden betimsel içerik analiz tekniğine göre analiz edilmiştir. Betimsel içerik analizi ile birbirinden bağımsız olarak yapılan nitel ve nicel çalışmalar incelenip düzenlenmekte ve alandaki genel eğilimler belirlenmektedir (Selçuk ve ark., 2014).

Araştırma kapsamında içerik analiziyle incelenen çalışmalardan elde edilen veriler betimsel istatistikî yöntemler (yüzde ve frekans) kullanılarak çözümlenmiştir. Oluşturulan veritabanında kayıtlı bulunan veriler ile ilgili olarak, her bir araştırma sorusunun cevabına karşılık gelecek şekilde verilerin frekansları ve bu frekanslara bağlı olarak yüzde oranları hesaplanmıştır. Sonuçta elde edilen sayısal veriler çizelgeler ve grafikler halinde sunulmuştur.

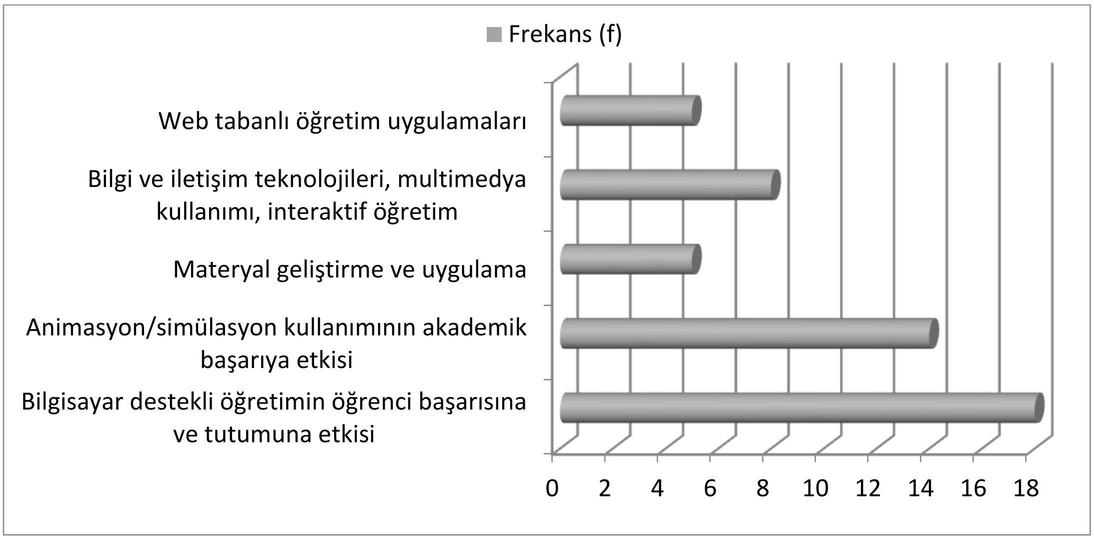
BULGULAR

Bu bölümde; verilerin analizinden elde edilen sonuçlar ilgili kategorilere göre gruplandırılıp, yüzde (%) ve frekans (f) cinsinden ifade edilerek, tablolaştırılmış ve analiz sonuçlarına dayalı yorumlar yapılmıştır.

Yükseköğretim Kurulu Ulusal Tez Merkezi resmi sitesinden ulaşılan tezlerin ve bazı dergilerinde yer alan makalelerin araştırma konusuna ve yıllara göre dağılımı, yazar sayısı, çalışma grubunun büyüklüğü ve sınıf düzeyleri, tezlerin yazıldığı üniversiteler ve makalelerin yer aldığı dergiler, kullanılan araştırma modelleri, veri toplama araçları, verilerin analiz yöntemleri tablo ve grafiklerde sunulmuştur.

Tablo 1. Çalışmaların Konularına Göre Dağılımı

Araştırma Konusu	Frekans (f)	Yüzde (%)
Bilgisayar destekli öğretimin öğrenci başarısına ve tutumuna etkisi	18	% 36
Animasyon/simülasyon kullanımının akademik başarıya etkisi	14	% 28
Materyal geliştirme ve uygulama	5	% 10
Bilgi ve iletişim teknolojileri, multimedya kullanımı, interaktif öğretim	8	% 16
Web tabanlı öğretim uygulamaları	5	% 10
Toplam	**50**	**%100**

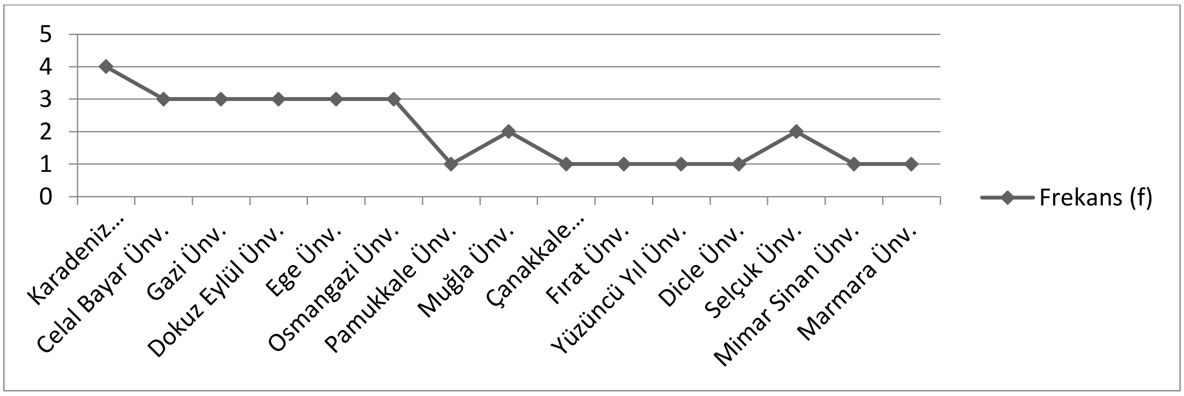


Şekil 1.Çalışmaların Konularına Göre Dağılımı

Tablo 1 ve Şekil 1 incelendiğinde bilgisayar destekli öğretimin öğrenci başarısına ve tutumuna etkisi konusunda 18 çalışma, animasyon/simülasyon kullanımının akademik başarıya etkisi konusunda 14 çalışma, bilgi ve iletişim teknolojileri, multimedya kullanımı, interaktif öğretim konularını içeren 8 çalışma, materyal geliştirme ve uygulama ve web tabanlı öğretim konularında ise 5'er çalışmanın olduğu görülmektedir.

Tablo 2. Tezlerin Yazıldığı Üniversiteler

Üniversite Adı	Frekans (f)	Yüzde (%)
Karadeniz Teknik Üniversitesi	4	% 13,3
Celal Bayar Üniversitesi	3	% 10
Gazi Üniversitesi	3	% 10
Dokuz Eylül Üniversitesi	3	% 10
Ege Üniversitesi	3	% 10
Eskişehir Osmangazi Üniversitesi	3	% 10
Pamukkale Üniversitesi	1	% 3,33
Muğla Üniversitesi	2	% 6,66
Çanakkale Onsekiz Mart Üniversitesi	1	% 3,33
Fırat Üniversitesi	1	% 3,33
Yüzüncü Yıl Üniversitesi	1	% 3,33
Dicle Üniversitesi	1	% 3,33
Selçuk Üniversitesi	2	% 6,66
Mimar Sinan Güzel Sanatlar Üniversitesi	1	% 3,33
Marmara Üniversitesi	1	% 3,33
Toplam	**30**	**% 100**



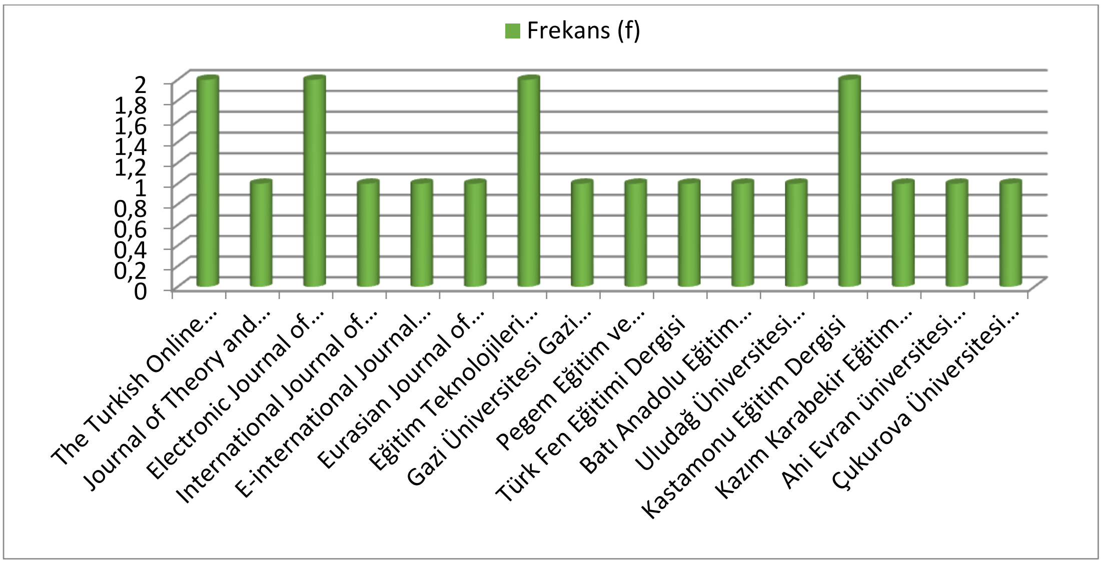
Şekil 2. Tezlerin Yazıldığı Üniversiteler

Tezlerin yazıldığı üniversitelerin dağılımını gösteren tablo ve grafik incelendiğinde; Karadeniz Teknik Üniversitesi'nden 4 tez, Celal Bayar Üniversitesi, Gazi Üniversitesi, Dokuz Eylül Üniversitesi, Ege Üniversitesi ve Eskişehir Osmangazi Üniversitesi'nden 3'er tez, Muğla Üniversitesi ve Selçuk Üniversitesi'nden 2'şer tez, Pamukkale Üniversitesi, Çanakkale Onsekiz Mart Üniversitesi, Fırat Üniversitesi, Yüzüncü Yıl Üniversitesi, Dicle Üniversitesi, Mimar Sinan Güzel Sanatlar Üniversitesi ve Marmara üniversitesi'nden 1'er tezin yer aldığı görülmektedir.

Tablo 3. Makalelerin Yayımlandığı Dergiler

Dergi Adı	Frekans (f)	Yüzde (%)
The Turkish Online Journal of Educational Technology	2	% 10
Journal of Theory and Practice and Education	1	% 5
Electronic Journal of Social Sciences	2	% 10
International Journal of Human Sciences	1	% 5
E-international Journal of Educational Research	1	% 5
Eurasian Journal of Educational Research	1	% 5
Eğitim Teknolojileri Araştırmaları Dergisi	2	% 10
Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi	1	% 5
Pegem Eğitim ve Öğretim Dergisi	1	% 5
Türk Fen Eğitimi Dergisi	1	% 5
Batı Anadolu Eğitim Bilimleri Dergisi	1	% 5
Uludağ Üniversitesi Eğitim Fakültesi Dergisi	1	% 5
Kastamonu Eğitim Dergisi	2	% 10

Kazım Karabekir Eğitim Fakültesi Dergisi	1	% 5
Ahi Evran üniversitesi Eğitim Fakültesi Dergisi	1	% 5
Çukurova Üniversitesi Eğitim Fakültesi Dergisi	1	% 5
Toplam	**20**	**% 100**

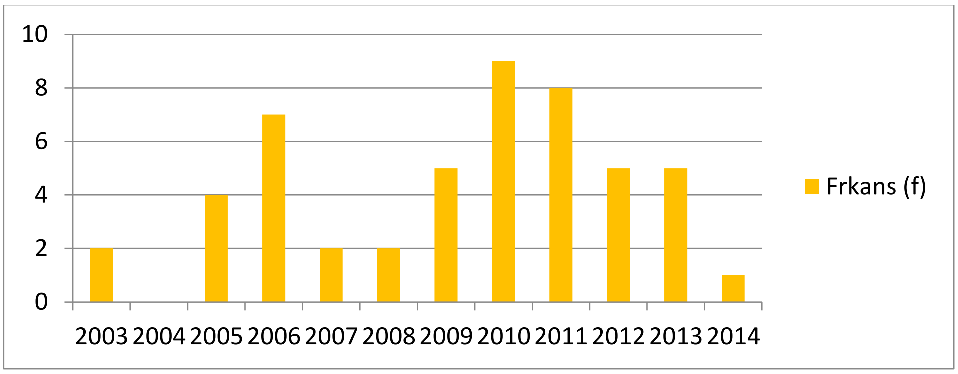


Şekil 3. Makalelerin Yayımlandığı Dergiler

Tablo 3 ve Şekil 3'e bakıldığında; The Turkish Online Journal of Educational Technology, Electronic Journal of Social Sciences, Eğitim Teknolojileri Araştırmaları Dergisi ve Kastamonu Eğitim Dergisi'nde 2'şer makale, Journal of Theory and Practice and Education, International Journal of Human Sciences, E-international Journal of Educational Research, Eurasian Journal of Educational Research, Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi, Pegem Eğitim ve Öğretim Dergisi, Türk Fen Eğitimi Dergisi, Batı Anadolu Eğitim Bilimleri Dergisi, Uludağ Üniversitesi Eğitim Fakültesi Dergisi, Kazım Karabekir Eğitim Fakültesi Dergisi, Ahi Evran üniversitesi Eğitim Fakültesi Dergisi ve Çukurova Üniversitesi Eğitim Fakültesi Dergisi'nden 1'er makale bulunduğu görülmektedir.

Tablo 4. İncelenen Çalışmaların Yıllara Göre Dağılımı

	Tezler		Makaleler		Toplam	
Yayımlanma Yılı	**Frekans (f)**	**Yüzde (%)**	**Frekans (f)**	**Yüzde (%)**	**Frekans (f)**	**Yüzde (%)**
2003	-	-	2	% 10	2	% 4
2004	-	-	-	-	-	-
2005	2	% 6,66	2	% 10	4	% 8
2006	6	% 20	1	% 5	7	% 14
2007	2	% 6,66	-	-	2	% 4
2008	2	% 6,66	-	-	2	% 4
2009	5	% 16,6	-	-	5	% 10
2010	7	% 23,3	2	% 10	9	% 18
2011	3	% 10	5	% 25	8	% 16
2012	2	% 6,66	3	% 15	5	% 10
2013	1	% 3,33	4	% 20	5	% 10
2014	-	-	1	% 5	1	% 2
Toplam	**30**	**% 100**	**20**	**% 100**	**50**	**% 100**

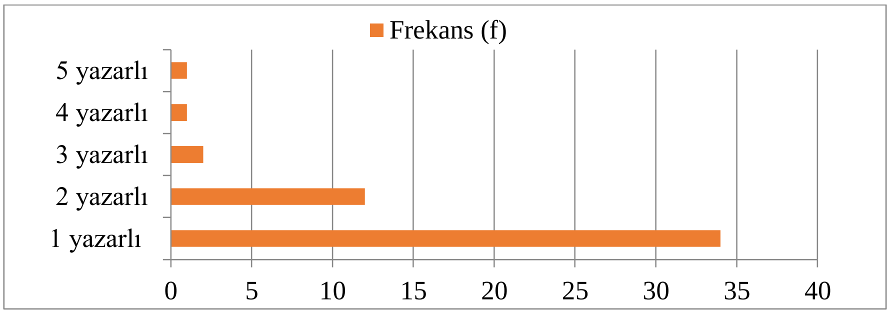


Şekil 4. İncelenen Çalışmaların Yıllara Göre Dağılımı

İncelenen çalışmaların yıllara göre dağılımının verildiği Tablo 4 ve Şekil 4 incelendiğinde; 2003, 2004 ve 2014 yılları dışında her yıla ait en az 1 tezin bulunduğu görülmektedir. 2010 yılına ait 7 tez, 2006 yılına ait 6 tez, 2009 yılına ait 5 tez, 2011 yılına ait 3 tez, 2005, 2007, 2008 ve 2012 yıllarına ait 2'şer tez ve 2013 yılına ait 1 tezin bulunduğu görülmektedir. Makalelerin yıllara göre dağılımı ise; 2011 yılında 5 makale, 2013 yılında 4 makale, 2012 yılında 3 makale, 2003, 2005 ve 2010 yıllarında 2'şer makale ve 2006 ve 2014 yıllarında 1'er makalenin yer aldığı; 2004, 2007, 2008 ve 2009 yıllarına ait makalenin bulunmadığı görülmektedir.

Tablo 5. Çalışmaların Yazar Sayılarına Göre Dağılımı

Yazar Sayısı	Frekans (f)	Yüzde (%)
1 yazar	34	% 68
2 yazar	12	% 24
3 yazar	2	% 4
4 yazar	1	% 2
5 yazar	1	% 2
Toplam	**50**	**%100**

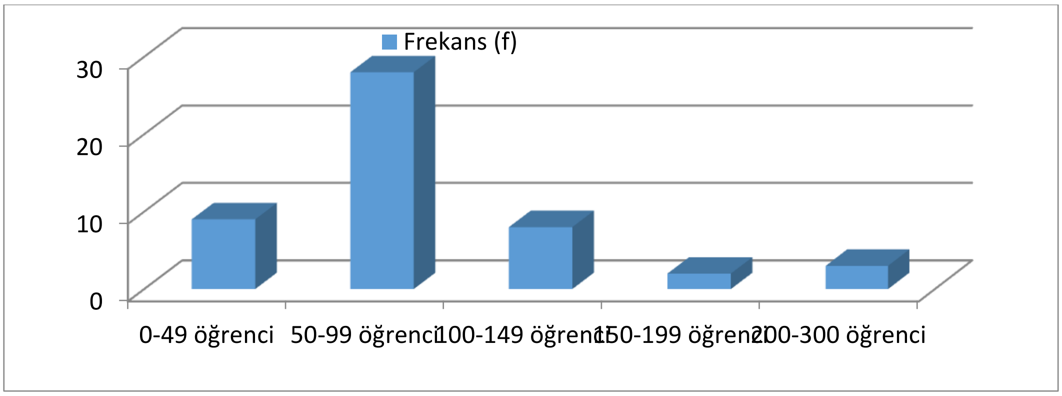


Şekil 5. Çalışmaların Yazar Sayılarına Göre Dağılımı

Çalışmaların yazar sayılarına göre dağılımının verilmiş olduğu tablo ve grafiğe bakıldığında; tek yazarlı 34 çalışmanın yer aldığı görülmektedir. Bu yığılmanın sebebinin çalışmaların 30'unun tez olması sebebiyle tek yazarlı olmasından kaynaklanmaktadır. Makalelerin yazar sayılarına baktığımızda; 2 yazarlı 12, 3 yazarlı 2, 4 ve 5 yazarlı 1'er çalışmanın olduğu görülmektedir.

Tablo 6. Çalışmalardaki Örneklem Büyüklüğünün Dağılımı

Örneklem Büyüklüğü	Frekans (f)	Yüzde (%)
0-49 öğrenci	9	% 18
50-99 öğrenci	28	% 56
100-149 öğrenci	8	% 16
150-199 öğrenci	2	% 4
200-300 öğrenci	3	% 6
Toplam	**50**	**%100**

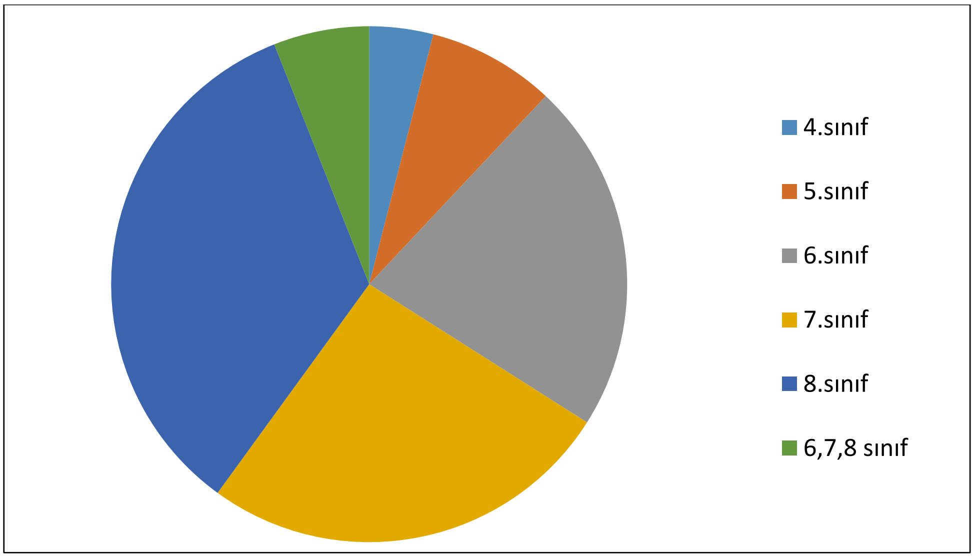


Şekil 6. Çalışmalardaki Örneklem Büyüklüğünün Dağılımı

Tablo 6 ve Şekil 6'daki verilere göre bu çalışma kapsamında incelenen çalışmaların 9'unda 0-49 arasında, 28'inde 50-99 arasında, 8'inde 100-149 arasında örneklem seçildiği görülmektedir. Öte yandan 2'sinde 150-199 arasında, 3'ünde 200-300 arasında çalışmanın yapıldığı, büyük örneklemlerin çok fazla tercih edilmediği görülmektedir.

Tablo 7. Çalışmalardaki Örneklem Grubunun Sınıf Düzeyleri

Sınıf Düzeyleri	Frekans (f)	Yüzde (%)
4. sınıf	2	% 4
5. sınıf	4	% 8
6. sınıf	11	% 22
7. sınıf	13	% 26
8. sınıf	17	% 34
6, 7 ve 8.sınıf	3	% 6
Toplam	**50**	**% 100**

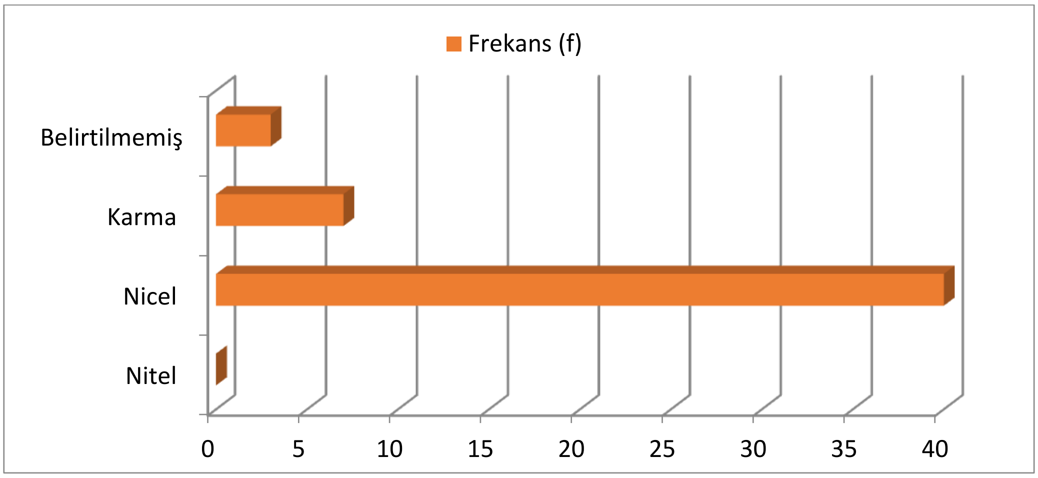


Şekil 7. Çalışmalardaki Örneklem Grubunun Sınıf Düzeyleri

Çalışmalardaki örneklem grubunun sınıf düzeylerinin dağılımının verildiği Tablo 7 ve Şekil 7 incelendiğinde; sırasıyla en çok 8. Sınıf (% 34), 7. Sınıf (% 26) ve 6. Sınıf (% 22) öğrencileri ile çalışıldığı, 5. Sınıf (% 8) ve 4. Sınıf (% 4) öğrencilerinin daha az tercih edildiği, 6. 7. ve 8. Sınıf öğrencilerinin birlikte oluşturduğu örneklemin yalnızca 3 çalışmada kullanıldığı, karma örneklem grubunun çok tercih edilmediği görülmektedir.

Tablo 8. Çalışmalarda Başvurulan Araştırma Desenlerinin Dağılımı

Araştırma Deseni	Frekans (f)	Yüzde (%)
Nitel	-	-
Nicel	40	% 80
Karma	7	% 14
Belirtilmemiş	3	% 6
Toplam	**50**	**100**

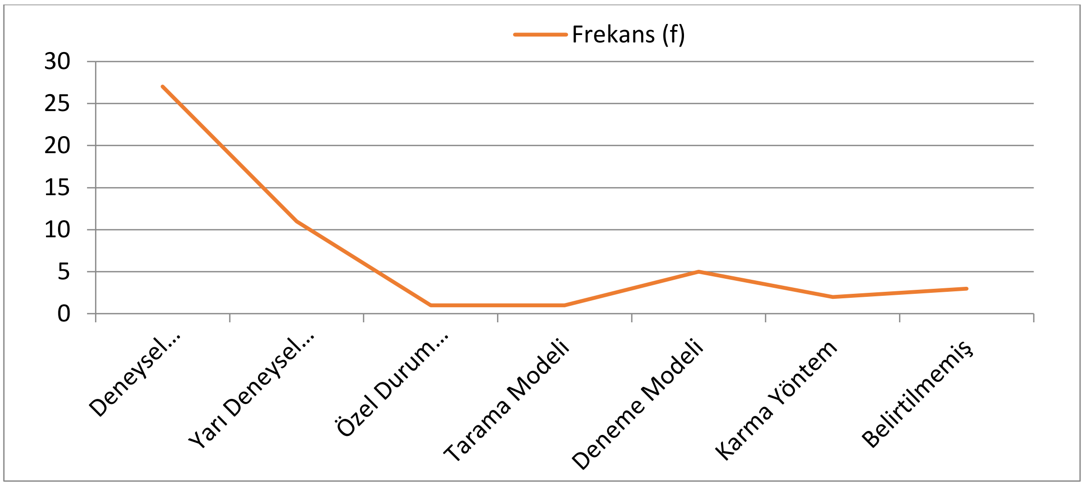


Şekil 8. Çalışmalarda Başvurulan Araştırma Desenlerinin Dağılımı

Yukarıdaki tablo ve grafikte çalışmaların tercih edilen araştırma desenine göre dağılımları incelendiğinde 40 çalışmada nicel araştırma deseninin tercih edildiği, 7 çalışmada hem nitel hem nicel araştırma deseninin birlikte kullanıldığı, 3 çalışmada seçilen araştırma deseninin belirtilmediği, nitel araştırma deseninin ise hiçbir çalışmada tercih edilmediği görülmektedir.

Tablo 9. Çalışmaların Kullanılan Yönteme Göre Dağılımı

Yöntem Adı	Frekans (f)	Yüzde (%)
Deneysel Yöntem	27	% 54
Yarı Deneysel Yöntem	11	% 22
Özel Durum Yöntemi	1	% 2
Kesitsel Tekil Tarama Modeli	1	% 2
Deneme Modeli	5	% 10
Karma Yöntem	2	% 4
Belirtilmemiş	3	% 6
Toplam	**50**	**% 100**

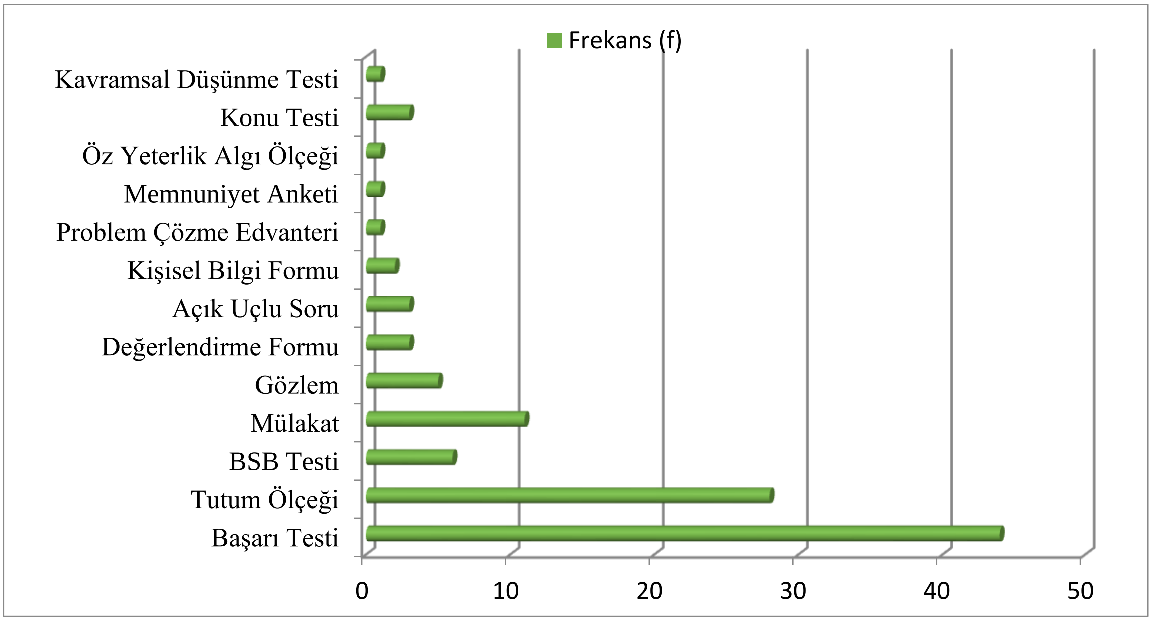


Şekil 9. Çalışmaların Kullanılan Yönteme Göre Dağılımı

Çalışmalarda kullanılan yönteme göre dağılımların verildiği Tablo 9 ve Şekil 9 incelendiğinde en çok tercih edilen yöntemlerin 27 çalışmada kullanılan deneysel yöntemin ve 11 çalışmada kullanılan yarı deneysel yöntemin olduğu görülmektedir. Deneysel yöntemlerin dışında 5 çalışmada deneme modelinin kullanıldığı, 2 çalışmada karma yöntemlerin tercih edildiği, 1'er çalışmada özel durum yönteminin ve kesitsel tekil tarama modelinin seçildiği ve 3 çalışmada kullanılan yöntemin belirtilmediği görülmektedir.

Tablo 10. Çalışmalarda Kullanılan Veri Toplama Araçlarının Dağılımı

Veri Toplama Aracı	Frekans (f)	Yüzde (%)
Başarı Testi	44	% 40,74
Tutum Ölçeği	28	% 25,9
BSB Testi	6	% 5,55
Mülakat	11	% 10,18
Gözlem	5	% 4,62
Değerlendirme Formu	3	% 2,77
Açık Uçlu soru	3	% 2,77
Kişisel Bilgi Formu	2	% 1,85
Problem Çözme Edvanteri	1	% 0,92
Memnuniyet Anketi	1	% 0,92
Öz Yeterlik Algı Ölçeği	1	% 0,92
Konu Testi	3	% 2,77
Kavramsal Düşünme Testi	1	% 0,92
Toplam	**108**	**% 100**

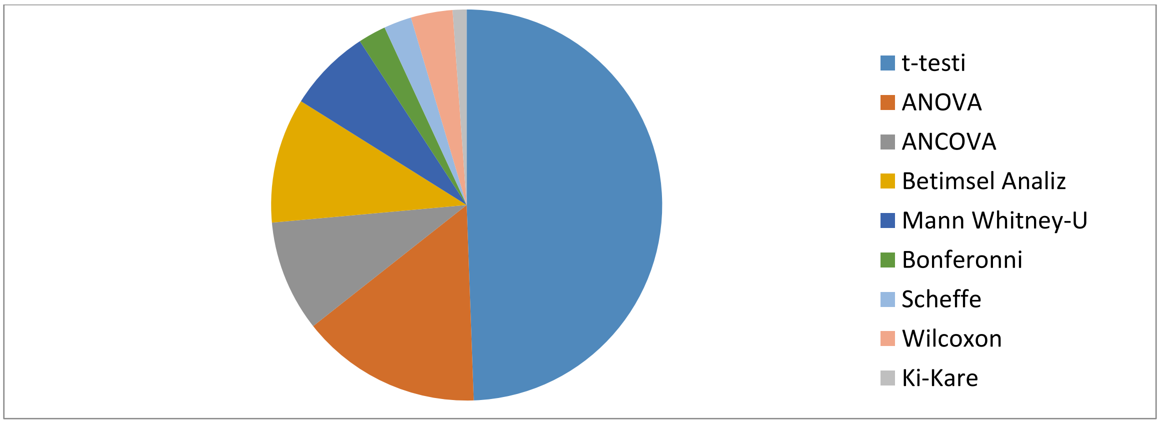


Şekil 10. Çalışmalarda Kullanılan Veri Toplama Araçlarının Dağılımı

Çalışmalarda kullanılan veri toplama araçlarının dağılımının verildiği tablo ve şekilden de anlaşıldığı üzere; büyük oranda (% 40,74) başarı testinden yararlanıldığı görülmektedir. Hemen ardından tutum ölçeği (% 25,9) ve mülakat (% 10,18) tercih edilmiştir. BSB testi (% 5,55), gözlem (% 4,62), değerlendirme formu (% 2,77), açık uçlu soru (% 2,77), kişisel bilgi formu (% 1,85) ve konu testinin (% 2,77) daha az tercih edildiği, problem çözme edvanteri, memnuniyet anketi, öz-yeterlik algı ölçeği ve kavramsal düşünme testinin yalnızca 1'er çalışmada kullanıldığı görülmektedir.

Tablo 11. Çalışmaların Veri Analizlerinde Kullanılan Yöntemlere Göre Dağılımı

Verilerin Analizi İçin Teknikler	Frekans (f)	Yüzde (%)
t-testi	43	% 49,42
ANOVA	13	% 14,92
ANCOVA	8	% 9,19
Betimsel analiz	9	% 10,34
Mann Whitney-U testi	6	% 6,89
Bonferonni	2	% 2,29
Scheffe	2	% 2,29
Wilcoxon	3	% 3,44
Ki-Kare testi	1	% 1,14
Toplam	**87**	**% 100**



Şekil 11. Çalışmaların Veri Analizlerinde Kullanılan Yöntemlere Göre Dağılımı

Çalışmaların veri analizi ile ilgili dağılımların sunulduğu Tablo 11 ve pasta grafiğine bakıldığında en fazla kullanılan veri analiz yönteminin 43 çalışmada kullanılan t-testi olduğu görülmektedir. 13 çalışmada ANOVA, 8 çalışmada ANCOVA kullanılmıştır. Ayrıca 9 çalışmada betimsel analiz, 6 çalışmada Mann Whitney-U testi, 3 çalışmada Wilcoxon testi kullanılmıştır. 2 çalışmada verilerin analizinde Scheffe testi, Bonferonni testi ve diğer bir çalışmada da ki-kare testi kullanılmıştır.

SONUÇ VE TARTIŞMA

Bu çalışmada fen bilimleri eğitiminde teknoloji kullanımı alanında ülkemizde yayınlanan çalışmalar çeşitli açılardan incelenmiştir. İncelemeler yapılırken çalışmaların kimliği hakkında tanımlayıcı bilgi, disiplin alanı, konusu, yöntemi, veri toplama araçları, örneklemi ve veri analiz yöntemleri şeklinde yapılmış ve toplam on bir araştırma sorusuna cevap aranmıştır. Çalışmada her bir araştırma sorusuna yönelik bulgular tek tek ele alınarak tartışılmış ve önerilerde bulunulmuştur.

Türkiye'de fen bilimleri eğitiminde teknoloji kullanımı ile ilgili yapılan çalışmaların uzun yıllar öncesine dayandığı söylenebilir. Çalışmamız kapsamında 2003 yılından itibaren fen bilimleri eğitiminde teknoloji kullanımı alanında yapılan çalışmaların önemli derecede arttığı söylenebilir. Özellikle bazı yıllarda çalışmaların artmasına daha sonra durağanlığa, ardından da önemli derecede azalmasına, dergilerin standartlarının artması ve dolayısıyla yayın yapmanın zorlaşması, yurt dışı çalışmalara daha fazla yönlenilmesinin neden olduğu söylenebilir.

Araştırmada ülkemizde yayınlanan makalelerin incelenmesi sonucu nicel kategorisinde bulunan çalışmaların çoğunlukta olduğu, hiçbir nitel araştırmanın yapılmadığı görülmektedir. Nicel araştırmalarda, araştırmacı değişkenler arasındaki ilişkileri ve bu ilişkilerin sebeplerini araştırırken; nitel araştırmalarda ise durum ve olayları katılımcıların bakış açısıyla anlamaya çalışır (Sarı, 2011). Bu düşünceden dolayı, araştırmaların daha derin olarak ve çoklu şekillerde yapılabilmesi için, fen bilimleri eğitiminde teknoloji kullanımı ile ilgisi nitel çalışmalara da yer verilmesi çalışmanın önerileri arasındadır. Ayrıca nicel ve nitel yöntemlerin bir arada kullanıldığı çalışma sayısı da oldukça azdır (f=7). Verilerin çoklu şekillerde yorumlanması amacıyla karma çalışmalara da öncelik verilmesi önerilebilir. Dolayısıyla nitel ve karma araştırma yöntemleri sorunların altında yatan sebepleri daha derinlemesine inceleme imkânı sağladığından bu araştırma yöntemlerinin daha yaygın olarak kullanılması ülkemizde fen bilimleri eğitimi araştırmalarına derinlik kazandıracaktır.

Analiz sonuçlarına göre, fen bilimleri eğitiminde teknoloji kullanımı ile ilgili en sık araştırılan konular arasında bilgisayar destekli öğretimin öğrenci başarısına etkisi ve animasyonun öğrenci başarısına etkisinin yer aldığı belirlenmiştir. Bununla birlikte web tabanlı öğretim, interaktif öğretim gibi konulara da daha çok ağırlık verilmesinin yararlı olacağı söylenebilir.

Çalışmalarda örneklem grubunun sınıf düzeylerinin daha çok ilköğretimin üst kademelerinden seçildiği görülmektedir. İlköğretimin ilk kademeleriyle de çalışmalar zenginleştirmelidir. Ayrıca sınıf düzeylerinin karma olarak seçildiği çalışmalar da az sayıdadır. Bütün sınıf düzeyleriyle karma örneklem oluşturarak yapılabilecek çalışmaların sayısının arttırılmasının da araştırmaları zenginleştireceği düşünülmektedir.

Çalışmalardaki örneklem büyüklüğü yoğunluklu olarak 50-99 öğrenci arasında belirlenmiştir. Çok küçük ve çok büyük örneklemler çok fazla tercih edilmemiştir. Küçük örneklemlerin tercih edilmemesi isabet olsa da büyük örneklemlerle çalışmalar yapılarak daha kapsamlı araştırmalar yapılabilir.

Çalışmaların çoğunluğunun deneysel yöntemlerle yürütüldüğü sonucuna ulaşılmıştır. Aynı şeklide, Şimşek ve arkadaşlarının (2009), eğitim teknolojileri alanında gerçekleştirdiği araştırmalarında, çalışmalarda çoğunlukla deneysel desenin kullanıldığı sonucuna ulaşmışlardır. Araştırmacıların genellikle deneysel deseni kullanmalarının sebebinin, betimsel desene göre verilere daha hızlı ve kolay bir şekilde ulaşılması ve analizlerinin daha zahmetsiz bir şekilde yapılması olabileceği düşünülmektedir. Bunun yanında verilere ulaşım ve analiz kolaylığı sebebiyle deneysel araştırma modellerinin kullanımının yanında, öğrencilerin deneysel süreçte duygu ve düşüncelerini de tespit etmek amacıyla betimsel modellerin de kullanılması önerilmektedir.

Çalışmada veri toplama aracı olarak başarı testinin ve tutum ölçeğinin çoğunlukla tercih edildiği görülmektedir. Büyük oranda anketlerin kullanılması nicel çalışmaların bir sonucu olarak karşımıza çıkmaktadır. Çalışma bulgularının güvenilirliğini artırmak ve daha geçerli sonuçlara ulaşabilmek için araştırmacıların birden fazla veri toplama aracı kullandıkları görülmektedir. Bu sayede çalışmaların veri setinin daha zengin ve tutarlı olduğu, böylelikle geçerliği ve güvenirliği yüksek çalışmaların yapıldığı düşünülmektedir. Öte yandan mülakata ve gözleme daha az yer verildiği sonucuna varılmıştır. Gözlem ve mülakata daha fazla yer verilerek araştırmalarda daha fazla çeşitliliğe ulaşılabileceği düşünülmektedir.

İncelen çalışmaların veri analizlerinde en çok parametrik istatistiksel analizlerin kullanıldığı görülmektedir. Bu bulgu, Şimşek ve arkadaşlarının (2009) eğitim teknolojisi alanında yapılmış olan tez çalışmaları üzerine gerçekleştirdikleri araştırma sonuçları ile uyum göstermektedir. Araştırmacılar çalışmalarında özellikle parametrik olmayan istatistik tekniklerinin çok sınırlı sayıda kullanıldığına ilişkin bulgular elde etmişlerdir. Kullanılacak istatistiksel analiz türünü belirleyen değişkenler; araştırma modelinin türü, veri toplama araçları ve çalışma grubunun özellikleridir. Parametrik testlerin kullanılmasındaki temel varsayımlar ise; örneklem gruplarının 30'dan büyük ve değişkenlere ilişkin verilerin normal dağılım göstermesi durumudur (Büyüköztürk ve ark, 2009). Bu bilgiler ışığında, parametrik testlerin temel varsayımları göz önünde bulundurularak incelendiğinde; tezlerde çalışılan örneklem gruplarının genellikle 30 dan büyük olduğu ve normal dağılım koşulunun sağlandığı sonucuna ulaşılmaktadır.

Yapılan araştırmada elde edilen bulguların fen bilimleri eğitimi araştırmacılarına, rehber olması beklenmektedir. Fen bilimleri eğitiminde teknoloji kullanımı alanında çalışan ve bu alanda yayın yapan akademisyenler için geçmişten günümüze fen bilimleri eğitiminde teknoloji alanında kullanılan araştırma konularının, yöntemlerin, veri analiz yöntemlerinin bilinmesi yeni yapılacak olan çalışmalara ışık tutacaktır. Ayrıca yapılan içerik analizinin bu alanla ilgilenen tüm araştırmacıları yeniliklere yöneltmesi umulmaktadır. Bu araştırma bulguları sayesinde geçmişten günümüze hangi konuların daha sıklıkla çalışıldığı açıkça görülmektedir. Bu sayede yapılan çalışmanın, araştırmacıların yeni yöntemlere yönelmelerine yardımcı olacağı düşünülmektedir. Ülkemizde yapılan çalışmaların gösterdiği gibi fen bilimleri eğitiminde teknoloji kullanımının öğrencilerin ders başarısı ve tutumunu olumlu etkilediği sonucu göz önünde bulundurularak fen bilimleri eğitiminde teknolojinin ilköğretim kademelerinden başlatılarak eğitimin her alanında yaygınlaştırılması gerekmekte ayrıca ülkenin her yanında teknoloji kullanımını teşvik edici çalışmalara yer verilmelidir.

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AN EXAMINATION OF THE SCIENCE TEACHERS' AND STUDENT TEACHERS' LABORATORY SELF-EFFICACY PERCEPTIONS

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ABSTRACT: Aim of this study is to examine biology teachers' and student teachers' laboratory self-efficacy perceptions. The participants of this study are 30 biology teachers and 139 student teacher studying Recep Tayyip Erdoğan University science teacher department. In this study, to collect the data the Laboratory Self-Efficacy Scale. The resulting data were analyzed using SPSS 22.0 (Statiscal Package for Social Sciences) program package. Frequency, t-test, one-way variance, frequency and percentage distribution is used in evaluation of the data. At the end of the study, it was found out that statically significant differences weren't determined between professional experience levels and laboratory self-efficacy perceptions of teachers, and between genders and laboratory self-efficacy perceptions of teachers. Additionally statically significant differences weren't determined between studying levels and laboratory self-efficacy perceptions of student teachers, and between genders and laboratory self-efficacy perceptions of teachers. But statically significant differences were determined between science teachers and science student teacher.

Keywords: science instruction, science teacher and student teacher, laboratory self-efficacy.

FEN BİLİMLERİ ÖĞRETMENLERİNİN VE ÖĞRETMEN ADAYLARININ LABORATUVAR KULLANIMINA YÖNELİK ÖZ-YETERLİKLERİNİN BELİRLENMESİ

ÖZET: Bu araştırmanın amacı, fen bilimleri öğretmenlerinin ve öğretmen adaylarının laboratuvar kullanımı öz-yeterlik algılarını incelemektir. Araştırma betimsel nitelikte hazırlanmış bir alan araştırmasıdır. Araştırmanın çalışma grubunu 30 fen bilimleri öğretmeni ve RTEÜ Eğitim Fakültesi Fen bilgisi öğretmenliği bölümünde öğrenim gören 139 öğretmen adayı oluşturmuştur. Araştırma verilerini toplamak amacıyla "Laboratuvar Kullanımı Öz-Yeterlik Algı Ölçeği" kullanılmıştır. Elde edilen veriler, SPSS 22.0 (Statiscal Package for Social Sciences) paket programı kullanılarak analiz edilmiştir. Analiz sürecinde bağımsız gruplar t testi, tekyönlü varyans analizi, frekans ve yüzde dağılım kullanılmıştır. Elde edilen bulgulara göre fen bilimleri öğretmenlerinin laboratuvar kullanımı öz-yeterlik algı düzeyleri ile cinsiyetleri ve kıdemleri arasında anlamlı bir farklılık olmadığı saptanmıştır. Öğretmen adaylarının da kendi içinde cinsiyetlerine ve sınıf düzeylerine göre laboratuvar kullanım öz-yeterlikleri arasında anlamlı bir farklılık olmadığı sonucuna ulaşılmıştır. Öte yandan öğretmenlerle öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri arasında anlamlı farklılık olduğu görülmüştür.

Anahtar sözcükler: fen eğitimi, fen bilimleri öğretmenleri ve öğretmen adayları, laboratuvar öz yeterlilik

GİRİŞ

Tüm insanlar içinde yaşadıkları doğayı, doğadaki canlı ve cansız varlıkları, bunlar arasındaki ilişkileri değerlendirerek hâkim olma çabasındadırlar. Doğa ve doğa olaylarını doğru değerlendirebilmek için iyi bir fen eğitimi almış olmak gerekir. Fen eğitiminde laboratuvar uygulamaları derse karşı dikkatin çekilebilmesi, fen konularının daha etkili ve anlamlı öğrenilebilmesi için gereklidir. Laboratuvar, bazı kavram veya konuların öğrenciye bizzat yaptırarak, denenerek veya gösterilerek öğretildiği sınırları belirlenmiş ve kontrol edilebilir bir ortamdır. Bu ortamlar bilginin kullanıldığı, problemin tanımlandığı, el becerileri ve işlem yeteneklerinin geliştirildiği ortamlardır. Laboratuvarlar birçok gözlem veya soyut algılamalar sonucu zihinde oluşan soruların somutlaştırılarak anlam kazandığı, elde edilen bilgilerin yaşamsal değere sahip olduğunun anlaşıldığı ortamlardır (Güneş ve ark., 2013).

İlgili literatürde laboratuvara yönelik öğretmenlerin ve öğretmen adaylarının algılarını ve davranışlarını belirlemeyi amaçlayan ölçeklerin geliştirildiği çalışmalar mevcuttur. Ekici (2002) tarafından geliştirilen ölçek biyoloji öğretmenlerinin laboratuvar dersine yönelik tutumlarını ölçmeye yöneliktir. Fraser, McRobbie ve Giddings (1992) tarafından geliştirilen "Fen Laboratuvarı Sınıf Çevresi Ölçeği"'nin Türkiye'deki üniversitelerin eğitim fakülteleri genel kimya laboratuvarı öğrenme çevresine uyarlama çalışması gerçekleştirilmiştir (Doğan, Atılgan & Demirci, 2003). Diğer bir araştırmada ise Tezcan ve Günay (2003) tarafından lise öğretmenlerinin ve öğrenenlerin laboratuvar ortamındaki rollerini belirlemek amacıyla anket formu geliştirilmiştir. Öğretmenlerin fen deneylerinin amaçlarına yönelik tutumlarını belirlemek amacıyla Yıldız, Akpınar, Aydoğdu ve Ergin (2006) tarafından geliştirilen ölçek, fen deneylerinin günlük yaşamla ne kadar ilişkilendirildiği, laboratuvar uygulamalarının öğrenenlerin bilişsel becerilerine ve akademik başarılarına etkisini belirlemeye yöneliktir. Diğer bir araştırmada Uzal, Erdem, Önen ve Gürdal (2010) tarafından öğretmenlerin basit araç gereçlerle yapılan fen deneylerine ilişkin algılarını belirlemek amacıyla geliştirilen ölçek, basit araçlar sayesinde deneylerin yapılabilirliği, günlük yaşamla ilişkilendirilebilirliği, öğrenenlerin ilgi ve tutumlarındaki değişim üzerinde durmaktadır. Kılıç ve Soran (2011) çalışmalarında biyoloji öğretmen adaylarının laboratuvar uygulamaları yapmaya yönelik davranış niyetlerini saptamak amacıyla anket geliştirmişlerdir. Feyzioğlu ve ark. (2012) yenilenen ortaöğretim kimya ders programını dikkate alarak laboratuvar uygulamalarının amaçları, laboratuvarın etkililiği ve kimya dersinin planlanması açısından öğretmenlerin algılarını belirleyen geçerli, güvenilir ve güncel bir ölçme aracı geliştirmeyi amaçlamışlardır. Çalışma sonucunda, kimya öğretmenlerinin laboratuvar uygulamalarına yönelik algılarını ölçen, üç alt faktörden oluşan güvenilir ve geçerli bir ölçme aracı geliştirmişlerdir. Tanrıverdi ve Demirbaş (2012) ise fen bilgisi öğretmenliği bölümü 1.sınıf öğrencilerinin fizik laboratuvarına yönelik tutumlarını ölçmek amacıyla ölçek geliştirmişlerdir.

Alan yazında laboratuvar uygulamaları hakkında öğrenci tutumlarını belirlemeye, sorun tespit etmeye yönelik çalışmaların da yapıldığı görülmektedir. Milli Eğitim Bakanlığı, Eğitim Araştırma Geliştirme Dairesi [EARGED] (1995) tarafından yapılan çalışmada mekân ve araç-gereç yetersizliği, sınıf mevcutlarının fazla olması, laboratuvar teknisyenlerinin olmayışının yanında programda derse ayrılan sürenin yetersiz olması nedeniyle öğretmenlerin laboratuvar ortamına yönelik olumlu algılara sahip olmadıkları belirlenmiştir. Güzel (2002), fen bilgisi öğretmenlerinin laboratuvar kullanımı ve teknolojik yenilikleri izleme eğilimlerine ilişkin araştırmada öğretmenlerin laboratuvar eğitimi için özel eğitime ihtiyaç duyup duymadıkları ve bu eğitime katılma istekleri ile Fen Bilimlerindeki gelişmelerle ilgili belirli aralıkta yapılan hizmet içi eğitime katılmadaki görüşleri alınmıştır. Uluçınar, Cansaran ve Karaca (2004) Amasya il merkezindeki ilk ve ortaöğretim okullarında fen derslerinin işlenişinde laboratuvar yönteminden ne ölçüde yararlanıldığını, uygulamaların amacını ve öğrenmeye etkileri hakkındaki öğretmen görüşlerini belirlemeye çalışmışlardır. Araştırma sonucunda öğretmenler, laboratuvar uygulamalarından yeterli verimin alınabilmesi için sınıf mevcutlarının azaltılması, haftalık programdaki fen dersi saatlerinin artırılması, laboratuvarların güvenlik konusunda geliştirilmesi ve müfredat yenilikleri konusunda öğretmenlere zaman zaman hizmet içi kurslar verilmesi şeklinde görüş bildirmişlerdir. Aydın (2009) Gazi Üniversitesi Gazi Eğitim Fakültesi'nde öğrenim gören fen bilgisi öğretmen adaylarının, genel biyoloji laboratuvarına yönelik ne tür beklentiler içinde olduklarını tespit etmeyi amaçlamıştır. Araştırmanın sonucunda, öğretmen adaylarının çoğunlukla bireysel çalışmak, deneyleri kendilerinin hazırlayıp yapması, daha kapsamlı deney föyleri kullanmak ve daha çok hayvan diseksiyonu yapmak gibi beklentilere sahip olduklarını belirlemiştir. Böyük, Demir ve Erol (2010) ilköğretim ikinci kademedeki Fen Bilimleri dersi öğretmenlerinin, laboratuvar çalışmalarına yönelik yeterlik görüşlerinin cinsiyet, mezuniyet branşı, mesleki kıdem, okulun bulunduğu yerleşim birimi ve hizmetiçi eğitime katılma durumuna göre farklılık gösterip göstermediğini tespit etmeye çalışmışlar; araştırma sonunda, öğretmenlerin, Fen Bilimleri derslerinde, laboratuvarları kullanmanın öğrencilerin derse ilgisini çekme ve etkili öğrenme sağlamada oldukça önemli olduğu görüşünde birleştikleri sonucuna ulaşmışlar. Kaya ve Bölük (2011) ise fen bilimleri (Fen Bilimleri, fizik, kimya ve biyoloji) öğretmenlerinin cinsiyet, mesleki kıdem, mezuniyet branşı, hizmetiçi eğitime katılma durumu ve laboratuvar çalışmalarına yönelik öz-yeterlik görüşlerini araştırmışlardır. Araştırma sonunda öğretmenlerin laboratuvar uygulamaları bakımından yeterli olduklarını düşündükleri sonucuna ulaşmışlardır. Güneş ve ark. (2013) da Fen Bilimleri derslerinde laboratuvar kullanımına yönelik öğretmenlerin ve öğrencilerin görüşlerini almışlardır. Araştırma sonucunda okulların tamamında laboratuvar bulunmasına rağmen Fen Bilimleri derslerinde laboratuvar etkinliklerine yeterince yer verilmediği; öğretmenlerin önemli bir kısmının laboratuvarlardan yararlanmadığı, günlük yaşamda kullanılan malzemelerle yapılabilecek deneylerin bile uygulama yapılmadan geçiştirildiği sonucuna ulaşılmıştır.

Yukarıda sunulan alan yazın da göz önüne alındığında laboratuvar uygulamalarına yönelik çok sayıda çalışmanın yapılmış olduğu görülmektedir. Çünkü laboratuvar uygulamaları; öğrencilerin bilimsel düşünme ve çalışma becerilerini geliştirerek, zihin becerilerini kullanabilme yolarını görebilmesini, kalıcı ve etkili öğrenmeyi sağlayabilmesi, sistemli, düzenli ve planlı çalışmanın önemini kavratarak yeni çalışmalar planlayabilmeyi kazandırır. Temel fen bilimlerinde öğretim hedeflerinin istenilen düzeyde olabilmesi için, özellikle laboratuvar uygulamalarının, dersin amacına uygun şekilde planlanması gerekir. Bu bağlamda fen bilimleri öğretmen adaylarının üniversiteden mezun olmadan fen laboratuvarlarına yönelik öz-yeterliklerinin tespit edilmesi ve laboratuvar derslerindeki uygulamaların öz-yeterliklerini olumlu yönde arttırılacak şekilde düzenlenmesi, öğretmen adaylarının meslek hayatlarında laboratuvar kullanımının artmasına katkı sağlayacağı düşünülmektedir. Benzer şekilde öğretmenlerin de laboratuvar kullanımına yönelik öz-yeterliklerinin belirlenmesi meslek hayatlarındaki laboratuvar kullanımlarını daha iyi düzeye getireceğine inanılmaktadır. Alan yazında hem öğretmenlerin hem de öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterliklerini belirlemeye yönelik bir çalışmanın yapılmamış olması da bu çalışmanın alan yazına katkıda bulunacağını düşündürmektedir.

Araştırmanın Amacı

Bu çalışmanın temel amacı Fen Bilimleri öğretmenlerinin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterliklerinin belirlenmesidir. Bu temel amaç çerçevesinde aşağıdaki sorulara yanıt aranmıştır:

- Fen Bilimleri öğretmenlerinin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlik düzeylerinin dağılımı nasıldır?
- Fen Bilimleri öğretmenleri ile öğretmen adaylarının laboratuvar kullanımı öz-yeterlikleri arasında anlamlı bir farklılık var mıdır?
- Fen Bilimleri öğretmenlerinin laboratuvar kullanımına yönelik öz-yeterlikleri cinsiyete göre anlamlı bir farklılık göstermekte midir?
- Fen Bilimleri öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri cinsiyete göre anlamlı bir farklılık göstermekte midir?
- Fen Bilimleri öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri sınıf düzeylerine göre anlamlı bir farklılık göstermekte midir?
- Fen Bilimleri öğretmenlerinin laboratuvar kullanımına yönelik öz-yeterlikleri mesleki kıdemlerine göre anlamlı bir farklılık göstermekte midir?
- Fen Bilimleri öğretmenlerinin laboratuvar kullanımına yönelik öz-yeterlikleri laboratuvar kullanma sıklıklarına göre anlamlı bir farklılık göstermekte midir?

YÖNTEM

Fen Bilimleri öğretmenlerinin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterliklerini belirlemeyi amaçlayan bu araştırmada, deneysel olmayan nicel araştırma yöntemlerinden tarama(survey) metodu kullanılmıştır. Tarama metodu, geçmişte ya da halen var olan bir durumu var olduğu şekliyle betimlemeyi amaçlayan araştırma yaklaşımıdır. Tarama modelinde araştırmaya konu olan olay, birey ya da nesne, kendi koşulları içinde ve olduğu gibi tanımlanmaya çalışılır. Onları herhangi bir şekilde değiştirme, etkileme çabası gösterilmez (Karasar, 2010). Bu sebeple araştırma konusu, içinde bulunduğu durumla tanımlanmaya çalışılacaktır.

Evren-Örneklem

Bu araştırmanın evrenini; 2014-2015 eğitim-öğretim yılında Rize il merkezindeki ortaokullarda görev yapmakta olan Fen Bilimleri öğretmenleri ve Recep Tayyip Erdoğan Üniversitesi Eğitim Fakültesi İlköğretim Bölümü Fen Bilgisi Öğretmenliği programı öğrencileri oluşturmaktadır. Araştırmada, veri toplama sürecinde evrenin tamamına ulaşılmaya çalışılmıştır. Bu süreçte araştırmanın örneklemini basit seçkisiz yöntemle ulaşılan, Rize ilinde görev yapmakta olan 30 Fen Bilimleri Öğretmeni ve Recep Tayyip Erdoğan Üniversitesi Eğitim Fakültesi İlköğretim Bölümü Fen Bilgisi Öğretmenliği programının 1., 2., 3. ve 4. sınıflarında öğrenimine devam eden 139 öğretmen adayı oluşturmuştur. Araştırmaya katılan öğretmenlerin ve öğretmen adaylarının demografik özelliklerine göre dağılımları Tablo 1'de sunulmuştur.

Tablo 1. Çalışma Grubunda Yer Alan Öğretmenlerin ve Öğretmen Adaylarının Demografik Özelliklerine Göre Frekans ve Yüzde Dağılımı

Öğretmenler				Öğretmen Adayları			
Kıdem	**Cinsiyet**	**Frekans**	**Yüzde**	**Sınıf**	**Cinsiyet**	**Frekans**	**Yüzde**
	Kız	6	3.52		Kız	30	17.78
0-5 Yıl	Erkek	3	1.76	**1.Sınıf**	Erkek	12	7.11
	Toplam	9	5.3		Toplam	42	24.9
	Kız	4	2.36		Kız	14	8.3
6-10 Yıl	Erkek	8	4.72	**2.Sınıf**	Erkek	16	9.49
	Toplam	12	7.1		Toplam	30	17.8
	Kız	2	1.2		Kız	28	16.57
11-15 Yıl	Erkek	4	2.4	**3.Sınıf**	Erkek	9	5.32
	Toplam	6	3.6		Toplam	37	21.9
	Kız	1	0.6		Kız	18	10.68
16-20 Yıl	Erkek	2	1.2	**4.Sınıf**	Erkek	12	7.12
	Toplam	3	1.8		Toplam	30	17.8

Tablo 1 incelendiğinde; araştırmaya katılan 30 öğretmenden 9'unun 0-5 yıl arasında, 12'sinin 6-10 yıl arasında, 6'sının 11-15 yıl arasında ve 3'ünün 16-20 yıl arasında mesleki kıdeme sahip olduğu görülmektedir. 0-5 yıl arası mesleki kıdeme sahip olan öğretmenlerin 6'sının kız, 3'ünün erkek; 6-10 yıl arası mesleki kıdeme sahip olan öğretmenlerin 4'ünün kız, 8'inin erkek; 11-15 yıl arası mesleki kıdeme sahip olan öğretmenlerin 2'sinin kız, 4'ünün erkek ve son olarak 16-20 yıl arası mesleki kıdeme sahip olan öğretmenlerin 1'inin kız, 2'sinin erkek olduğu görülmektedir. Araştırmaya katılan 139 öğretmen adayından 42'sinin 1.sınıfta, 30'unun 2.sınıfta, 37'sinin 3.sınıfta ve 30'unun 4.sınıfta öğrenim görmektedir. Ayrıca 1.sınıfta öğrenim gören öğretmen adaylarının 30'u kız, 12'si erkek; 2.sınıftaki adaylarının 14'ü kız, 16'sı erkek; 3.sınıftaki adayların 28'i kız, 9'u erkek ve son olarak 4.sınıftaki adayların 18'i kız, 12'si erkekten oluşmaktadır.

Veri Toplama Araçları

Araştırmada öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterliklerini belirlemek için Ekici (2009) tarafından geliştirilen 5'li likert türündeki "Laboratuvar Kullanımı Öz-Yeterlik Ölçeği" kullanılmıştır. Bu ölçek, 2 boyuta ait 18 maddeden oluşmaktadır. Birinci boyutta 8 maddeden oluşan kişisel faktörler, ikinci boyutta ise 10 maddeden oluşan dış faktörler (öğrenci ve ortamdan kaynaklanan faktörler) yer almaktadır. Ekici (2009), ölçeğin geneli için Cronbach Alpha güvenirlik katsayısını .90 olarak, kişisel faktörlerinin yer aldığı birinci boyutunun Cronbach Alpha güvenirlik katsayısını .90 ve dış faktörlerin yer aldığı ikinci boyutunun Cronbach Alpha güvenirlik katsayısını .85 olarak hesaplmıştır. Cronbach-alpha güvenirlik katsayısının .90 olması anketin, alfa katsayısı değerlendirme ölçütlerine göre yüksek derecede güvenilir bir ölçme aracı olduğunu göstermektedir (Kalaycı, 2005).

Ekici (2009) tarafından geliştirilen ölçeğe öğretmenler için, cinsiyet, kıdem, laboratuvar kullanma sıklıkları; öğretmen adayları için de cinsiyet ve sınıf düzeyi olarak demografik özellikler eklenmiştir. Ankette yer alan 18 maddenin 15'inde ifadeler olumlu olduğundan, seçenekler "Kesinlikle Katılmıyorum'' (1), "Katılmıyorum" (2), "Kararsızım" (3), "Katılıyorum" (4) ve "Kesinlikle Katılıyorum" (5) şeklinde; geriye kalan 3 maddede ifadeler olumsuz olduğundan seçenekler tam tersi şekilde puanlanmıştır.

Verilerin Analizi

Araştırmada elde edilen verilerden öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımı öz-yeterlikleri ile cinsiyetleri arasındaki ilişkinin incelenmesinde ve öğretmenlerin laboratuvar kullanımı öz-yeterlikleri ile laboratuvar kullanım sıklıkları arasındaki ilişkinin incelenmesinde bağımsız t-testi analizi kullanılmıştır. Öğretmenlerin laboratuvar kullanımı öz-yeterlikleri ile kıdemleri arasındaki ilişkinin incelenmesinde ve öğretmen adaylarının laboratuvar kullanımı öz-yeterlikleri ile sınıf düzeyleri arasındaki ilişkinin incelenmesinde tek yönlü varyans (ANOVA) analizi kullanılmıştır. Yapılan istatistiksel işlemlerde SPSS 22.0 programı kullanılmıştır.

BULGULAR

Bu bölümde, anket ile toplanan veriler, uygun istatistiksel teknikler kullanılarak analiz edilmiş, elde edilen bulgular tablolar haline getirilerek yorumlanmıştır.

Öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlik düzeylerinin dağılımı, frekans ve yüzde dağılım olarak Tablo 2'de verilmiştir. Asıl ölçekte yer alan "Kesinlikle Katılmıyorum" ve

"Katılmıyorum" seçenekleri olumsuz; "Kesinlikle Katılıyorum" ve "Katılıyorum" seçenekleri olumlu şeklinde birleştirilmiş, birer seçenek haline getirilerek sunulmuştur.

Tablo 2. Öğretmenlerin ve Öğretmen Adaylarının Laboratuvar Kullanımına Yönelik Öz-yeterlik Düzeylerinin Dağılımı

İfadeler	Olumsuz		Kararsız		Olumlu	
	N	%	N	%	N	%
1. Laboratuvarda etkili bir öğretim ortamı sağlamak için sınıf disiplini ile ilgili kurallar geliştirmede kendimi yeterli hissederim.	16	9.4	25	14.8	128	75.7
2. Tüm derslerimi laboratuvarda planladığımda kendimi daha verimli hissederim.	44	30	41	24.3	84	49.7
3. Laboratuvarda uygun çalışma ortamı olduğunda kendimi daha iyi hissederim.	13	7.7	11	6.5	145	**85.8**
4. Laboratuvarda bulunması gereken fiziki koşulların ve araç-gereçlerin oluşturulabilmesinde kendimi yeterli hissederim.	21	12.5	43	25.4	105	62.1
5. Laboratuvarda karşılaşabileceğim tüm problemleri çözebilmekte yetenekli olduğumu hissederim.	27	16	60	35.5	82	48.5
6. Laboratuvarda çalışmaktan gerginlik hissederim	108	63.9	35	20.7	26	15.4
7. Laboratuvarda ders anlatırken kendimi çok rahat hissederim.	21	12.4	51	30.2	97	57.4
8. Laboratuvarda öğrencilerle ve diğer öğretmenlerle becerilerimi kullanabileceğim projeler hazırlayabilmekte kendimi yeterli hissederim.	21	12.5	49	30	99	58.6
9. Öğrencilerin laboratuvarda yapılan çalışmaya olan ilgisi kendime olan güvenimi arttırıyor.	21	12.4	14	8.3	134	79.3
10. Laboratuvarda çalışmak konusunda kendimi yetersiz hissederim.	122	**72.2**	21	12.4	26	15.4
11. Laboratuvarda yeterli araç-gereç olması her zaman beni rahatlatır.	16	9.5	8	4.7	145	**85.8**
12. Laboratuvarda bilgi ve yeteneğimi rahatlıkla gösterebildiğimi hissederim.	18	10.6	41	24.3	110	65
13. Öğrenciler-diğer öğretmenler-okul idaresi tarafından laboratuvarda ders yapmamın teşvik edilmesi kendimi iyi hissetmemi sağlar.	12	7.2	31	18.3	126	74.6
14. Laboratuvar dersinde nitelikli bir öğretmen olduğumu daha iyi hissederim.	14	8.2	21	12.4	134	79.3
15. Laboratuvarda ders yapmakta özel bir yeteneğim olduğuna İnanıyorum.	25	14.8	60	35.5	84	49.7
16. Laboratuvarda öğrenci sayısı fazla olduğunda endişe hissederim.	43	25.5	34	20.1	92	54.4
17. Laboratuvar dersine karsı ilgisi olmayan öğrencileri derse motive etmekte kendimi yeterli hissederim.	24	14.2	49	29	96	56.8
18. Laboratuvarda diğer öğretmenlerin ortaya çıkardıkları problemleri çözmek konusunda kendimi yeterli hissederim.	17	10.1	71	**42**	81	47.9

Tablo 2'ye göre, genel olarak öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterliklerinin olumlu olduğu görülmektedir. Öğretmenlerin ve öğretmen adaylarının en yüksek oranda (%72.2) olumsuz düşünceye sahip oldukları ifade, "Laboratuvarda çalışmak konusunda kendimi yetersiz hissederim." şeklindeki 10. ifade; olumlu düşüncenin en fazla (%85.8) olduğu ifadeler, "Laboratuvarda uygun çalışma ortamı olduğunda kendimi daha iyi hissederim." şeklindeki 3. ifade ve "Laboratuvarda yeterli araç-gereç olması her zaman beni rahatlatır." şeklindeki 11. ifadelerdir. Ayrıca en fazla (%42) kararsızlık gösterilen ifadenin, "Laboratuvarda diğer öğretmenlerin ortaya çıkardıkları problemleri çözmek konusunda kendimi yeterli hissederim." şeklindeki 18. İfade olduğu görülmektedir.

Öğretmenlerin cinsiyetleri ile laboratuvar kullanımına yönelik öz-yeterlikleri arasındaki ilişki, bağımsız gruplar t testi ile analiz edilmiş ve bulgular Tablo 3'te verilmiştir.

Tablo 3. Çalışma Grubundaki Öğretmenlerin Cinsiyetlerine Göre Laboratuvar Kullanımına Yönelik Öz-yeterlik Düzeylerinin Karşılaştırılması İçin t-testi

Cinsiyet	N	$\overline{X}$	ss	t	sd	p
Kız	13	76.69	6.99	-1.724	28	.096
Erkek	17	69.70	13.22			

Tablo 3'e göre, öğretmenlerin laboratuvar kullanımına yönelik öz-yeterlik düzeylerine ait puanları, cinsiyete göre anlamlı bir farklılık göstermemektedir [t(28) = -1.724, p>.05]. Ayrıca kız ve erkeklerin puan ortalamalarında da farklılık görülmemiştir [$\overline{X}$ kız= 76.69; $\overline{X}$ erkek= 69.70].

Tablo 4. Çalışma Grubundaki Öğretmen Adaylarının Cinsiyetlerine Göre Laboratuvar Kullanımına Yönelik Öz-yeterlik Ortalamalarının Karşılaştırılması İçin t-testi

Cinsiyet	N	$\overline{X}$	ss	t	sd	p
Kız	90	64.43	11.79	.463	137	.644
Erkek	49	65.42	12.36			

Tablo 4'e göre, öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterliklerine ait puanları, cinsiyete göre anlamlı bir farklılık göstermemektedir [t(137) = .463, p>.05]. Ayrıca kız ve erkeklerin puan ortalamalarında da farklılık görülmemiştir [$\overline{X}$ kız= 64.43; $\overline{X}$ erkek= 65.42].

Öğretmenlerin laboratuvar kullanım sıklıkları ile laboratuvar kullanımına yönelik öz-yeterlikleri arasındaki ilişki, bağımsız gruplar t testi ile analiz edilmiş ve bulgular Tablo 5'te sunulmuştur.

Tablo 5. Çalışma Grubundaki Öğretmenlerin Laboratuvar Kullanım Sıklıklarına Göre Laboratuvar Kullanımına Yönelik Öz-yeterlik Ortalamalarının Karşılaştırılması İçin t-testi

Laboratuvar Kullanım Sıklığı	N	$\overline{X}$	ss	t	sd	p
Ara sıra	15	68.80	12.70	-1.99	28	.056
Çoğunlukla	15	76.66	8.54			

Tablo 5 incelendiğinde, laboratuvarı ara sıra kullanan öğretmenlerin ortalaması $\overline{X}$= 68.80 laboratuvarı çoğunlukla kullanan öğretmenlerin ortalaması ise $\overline{X}$= 76.66 olarak bulunmuştur. İki grubun ortalamaları arasında fark bulunsa da [t(28) = -1.99, p>.05] olduğu görülmektedir. Buna göre, öğretmenlerin laboratuvar kullanım sıklıkları ile laboratuvar kullanımına yönelik öz-yeterlikleri arasında anlamlı bir farklılık olmadığı görülmektedir.

Çalışma grubunun laboratuvar kullanımına yönelik öz-yeterlikleri ile meslekleri arasındaki ilişki, bağımsız gruplar t testi ile analiz edilmiş ve bulgular Tablo 6'da sunulmuştur.

Tablo 6. Çalışma Grubunun Laboratuvar Kullanımına Yönelik Öz-yeterliklerinin Mesleklere Göre Karşılaştırması İçin t-testi

Meslek	N	$\overline{X}$	ss	t	sd	p
Öğretmen	30	72.73	11.36	-3.33	167	.001*
Öğretmen Adayı	139	64.78	11.96			

*****p< 0.05

Tablo 6' da görüldüğü üzere öğretmenlerin ortalaması $\overline{X}$= 72.73; öğretmen adaylarının ortalaması $\overline{X}$= 64.78 olarak bulunmuştur. Ayrıca [t(167) = -3.33, p<.05] olduğu görülmektedir. Buna göre öğretmen adayları ile öğretmenlerin laboratuvar kullanımına yönelik öz-yeterlikleri arasında öğretmenlerin lehine anlamlı bir fark bulunmuştur.

Öğretmen adaylarının sınıf düzeyi ile laboratuvar kullanımına yönelik öz-yeterlikleri arasında anlamlı bir farklılık olup olmadığı, tek yönlü varyans analizi ile test edilmiş, bulgular Tablo 7 ve Tablo 8'de verilmiştir.

Tablo 7. Öğretmen Adaylarının Laboratuvar Kullanımına Yönelik Öz-yeterliklerine Ait Puanlarının Sınıf Düzeyine Göre Aritmetik Ortalama ve Standart Sapmaları

Sınıf Düzeyi	N	$\overline{X}$	ss
1.Sınıf	42	3.69	.555
2.Sınıf	30	3.66	.649
3.Sınıf	37	3.33	.747
4.Sınıf	30	3.70	.660
Toplam	**139**	**3.59**	**.664**

Tablo 7'ye göre öğretmen adaylarının sınıf düzeylerine göre aritmetik ortalamalarında farklılık görülmemekle birlikte laboratuvar kullanım öz-yeterliklerinin Katılıyorum= 4 puan ile Kararsızım=3 puan aralığına düşmektedir ve bu puan değeri öz-yeterliklerinin orta düzeyde olduğunu ifade etmektedir.

Tablo 8. Öğretmen Adaylarının Laboratuvar Kullanımına Yönelik Öz-yeterliklerine Ait Puanlarının Sınıf Düzeyine Göre ANOVA Sonuçları

Varyansın Kaynağı	Kareler Toplamı	sd	Kareler Ortalaması	F	p
Gruplar arası	3.28	3	1.094	2.561	.058
Gruplar içi	57.64	135	.427		

Tablo 8'de verilen analiz sonuçları; öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri ile sınıf düzeyleri arasında anlamlı bir fark olmadığını göstermektedir [F(3-135)= 2.561 , p> .05].

Öğretmenlerin mesleki kıdemleri ile laboratuvar kullanımına yönelik öz-yeterlikleri arasındaki farklılığın istatistiksel olarak anlamlı olup olmadığına dair yapılan tek yönlü varyans analizi sonuçları Tablo 9 ve Tablo 10'da verilmiştir.

Tablo 9. Öğretmenlerin Laboratuvar Kullanımına Yönelik Öz-yeterliklerine Ait Puanlarının Mesleki Kıdemlerine Göre Aritmetik Ortalama ve Standart Sapmaları

Mesleki Kıdem	N	$\overline{X}$	ss
0-5 Yıl	9	3.70	.932
6-10 Yıl	12	4.06	.296
11-15 Yıl	6	4.23	.521
16-20 Yıl	3	4.55	.364
Toplam	**30**	**4.04**	**.631**

Tablo 9'a göre öğretmenlerin mesleki kıdemleri arttıkça laboratuvar kullanımına yönelik öz-yeterliklerinin de arttığı düşünülmektedir. Ancak aritmetik ortalamaları arasında görülen bu farklılığın istatistiksel olarak anlamlı olup olmadığına dair yapılan varyans analizi sonuçları Tablo 10'da verilmiştir.

Tablo 10. Öğretmenlerin Laboratuvar Kullanımına Yönelik Öz-yeterliklerine Ait Puanlarının Mesleki Kıdemlerine Göre ANOVA Sonuçları

Varyansın Kaynağı	Kareler Toplamı	sd	Kareler Ortalaması	F	p
Gruplar arası	2.006	3	.669	1.819	.168
Gruplar içi	9.556	26	.368		

Tablo 10'da verilen analiz sonuçları; öğretmenlerin laboratuvar kullanımına yönelik öz-yeterlikleri ile mesleki kıdemleri arasında anlamlı bir fark olmadığını göstermektedir [F(3-26)= 1.819 , p> .05].

TARTIŞMA VE SONUÇLAR

Bu araştırmada, Fen Bilimleri öğretmenlerinin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri tespit edilmiş ve bu yeterliklerine cinsiyet, mesleki kıdem, sınıf düzeyi ve laboratuvar kullanma sıklığı gibi değişkenlerin etkisi araştırılmıştır. Çalışma, Fen Bilimleri öğretmenleri ve Fen Bilgisi Öğretmenliği programına devam eden 1., 2., 3. ve 4. sınıf öğrencileri üzerinde yürütülmüştür. Veriler anket yoluyla toplanarak, uygun istatistiksel yöntemler ile analiz edilmiştir.

Elde edilen verilerden, öğretmenlerin ve öğretmen adaylarının genel olarak laboratuvar kullanımına yönelik öz-yeterliklerinin olumlu olduğu söylenebilir. Öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımına yönelik, hakkında en fazla olumlu düşündükleri ifadeler "Laboratuvarda uygun çalışma ortamı olduğunda kendimi daha iyi hissederim." ve "Laboratuvarda yeterli araç-gereç olması her zaman beni rahatlatır." ifadeleri olmuştur. Bu ifadelerin ikisinin de laboratuvar ortamı ile ilgili olduğu görülmektedir. Bu bağlamda laboratuvar uygulamalarının önemli bir öğesi olan laboratuvar ortamının çalışma yapmak için uygun olması, öğretmenlerin ve öğretmen adaylarının yapılan uygulamalardan endişe duymadan daha verim almalarını sağlayacağı düşünülmektedir.

Öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımına yönelik, en olumsuz düşündükleri ifade "Laboratuvarda çalışmak konusunda kendimi yetersiz hissederim" ifadesi olmuştur. Bu ifadede olumsuz düşünceye sahip olmaları, maddenin olumsuz olmasından dolayı öğretmenlerin ve öğretmen adaylarının laboratuvarda çalışmak konusunda kendilerini yeterli hissettikleri anlamına gelmektedir.

Öğretmenlerin ve öğretmen adaylarının en fazla kararsızlık gösterdikleri ifade "Laboratuvarda diğer öğretmenlerin ortaya çıkardıkları problemleri çözmek konusunda kendimi yeterli hissederim" ifadesidir.

Öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri, cinsiyete göre farklılık göstermemiştir. Dolayısıyla cinsiyetin, öğretmenlerin ve öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri üzerinde herhangi bir etkiye sahip olmadığı şeklinde yorumlanabilir. Benzer şekilde Ekici (2002) tarafından Ankara ili merkez ilçelerinde görev yapan Biyoloji öğretmenlerinin laboratuvar dersine yönelik tutum puanlarının farklı değişkenlere göre analizinin yapıldığı çalışmada, öğretmenlerin laboratuvar dersine yönelik tutumları arasında cinsiyete göre anlamlı fark bulunmamıştır. Ancak yapılan başka bir çalışmada ise, öğretmen adaylarının yeterlik inançları üzerinde, cinsiyet değişkeninin anlamlı bir etkisinin bulunduğu görülmüştür (Çapri ve Çelikkaleli, 2008). Buna göre, farklı örneklemi oluşturan öğretmen adaylarının öz-yeterlik inançlarının değişkenlere göre farklılık gösterdiği söylenebilir.

Öğretmenlerin laboratuvar kullanım sıklıklarının, laboratuvar kullanımına yönelik öz-yeterlikleri üzerindeki etkisi araştırılmış ve laboratuvar kullanım sıklıklarının da öz-yeterlikleri üzerinde herhangi bir etkiye sahip olmadığı sonucuna ulaşılmıştır.

Öğretmenlerin laboratuvar kullanımına yönelik öz-yeterlikleri mesleki kıdemlerine göre de anlamlı farklılık göstermemiştir. Benzer şekilde Feyzioğlu ve ark. (2011) yaptıkları çalışmada kıdeme bağlı olarak yapılan t testi sonuçlarına göre laboratuvarın amaçlarına ilişkin algılar boyutunda kıdeme bağlı olarak öğretmenlerin algılarında anlamlı bir farklılaşma olmadığı sonucuna ulaşmışlardır. Kaya ve Böyük (2011) ise yaptıkları araştırmada mesleki kıdemi 1 yıldan fazla olan öğretmenlerin laboratuvar yeterliklerinin kıdemi 1 yıldan az olan öğretmenlere göre daha yüksek olduğu sonucuna ulaşmışlardır.

Öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri ile sınıf düzeyleri arasında da anlamlı farklılık ortaya çıkmamıştır. Elde edilen bulgu Gerçek ve ark. (2006) tarafından biyoloji öğretmen adaylarının öz-yeterlik inançlarının belirlendiği çalışmada, cinsiyetin etkisinin olmadığının ancak sınıf değişkeninin etkisinin olduğu sonucu ile örtüşmektedir. Benzer bir çalışmada da, fen eğitimi alan öğretmen adaylarının sınıf seviyeleri artıkça öz-yeterlik inanç düzeylerinin yükseldiği tespit edilmiştir (Yaman vd., 2004).

Öte yandan öğretmenlerle öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri karşılaştırıldığında ise öğretmenlerin laboratuvar kullanımına yönelik öz-yeterliklerinin daha olumlu olduğu bulunmuştur. Bu durum, öğretmenlerin öğretmen adaylarına göre dış etkenlerden daha az etkilendikleri ve laboratuvar uygulamalarına yönelik daha olumlu düşünceye sahip oldukları şeklinde yorumlanabilir.

ÖNERİLER

Bu araştırmanın genel sonucu olarak; öğretmenlerin cinsiyetlerine, laboratuvar kullanım sıklıklarına ve mesleki kıdemlerine göre laboratuvar kullanım öz-yeterlikleri arasında anlamlı bir farklılık olmadığı; öğretmen adaylarının da cinsiyetlerine ve sınıf düzeylerine göre laboratuvar kullanım öz-yeterlikleri arasında anlamlı bir farklılık olmadığı; öte yandan öğretmenlerle öğretmen adaylarının laboratuvar kullanımına yönelik öz-yeterlikleri arasında anlamlı farklılık olduğu ortaya çıkmıştır. Araştırma sonuçlarına bağlı olarak aşağıdaki öneriler sunulabilir:

- Fen Bilimleri dersinin olmazsa olmazı olan laboratuvarın etkili kullanımı için öğretmenlerin öz-yeterlikleri dikkate alınarak gerek Fen Bilimleri programında gerekse okullarda koşullar düzeltilebilir.
- Fen Bilimleri dersi öğretmenlerine verilen hizmet içi kurslar belirli aralıklarla sürekli hale getirilmeli ve bu eğitimler teorik bilgi sunumundan çıkarılıp uygulamalı mesleki eğitime dönüştürülebilir.
- İlköğretim okullarında laboratuvar uygulamaları için ayrı bir ders saati belirlenebilir.
- Öğrencilerin deney yapma konusunda daha istekli olmaları da dikkate alınarak laboratuvar uygulamalarının artırılması için okullar araç-gereç yönünden desteklenerek öğretmenlerin deneysel uygulamalara daha fazla önem vermeleri sağlanabilir.
- Öğretmenlere deneysel uygulamalardan kaçınma nedenleri göz önüne alınarak düzenlemeler yapılabilir, eksiklikler giderilebilir ve gerekirse öğretmenler deneysel uygulamalar için proje bazında ödüllendirilebilir.
- Öğretmen adaylarının öz-yeterlik inançlarını güçlendirecek uygulamalara yer verilebilir ve sınıf içinde gerçekleştirdikleri Fen Bilimleri öğretimi uygulamalarına ilişkin öz değerlendirmeler yapmalarına imkân tanınabilir.
- Geliştirilecek Fen programları Fen Bilimleri dersinin pratik uygulamalı yönüne ağırlık verilerek hazırlanabilir.
- Geliştirilmiş deney kılavuzları ve ilgili araç-gereçler okullara dağıtılabilir.
- Laboratuar uygulamalarına normal ders saati ücreti üzerinde bir ücret verilerek öğretmenler özendirilebilir. Bu, laboratuarın öğretmenler tarafından benimsenmesini kolaylaştırıcı ve özendirici bir ücretlendirme yöntemi olabilir.

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TEACHER VIEWS ABOUT USE OF MUSICAL ANIMATION IN MIDDLE SCHOOL SCIENCE AND TECHNOLOGY COURSE

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ABSTRACT: Some subjects of science and technology course (electricity, atoms and so on.) create learning difficulties for middle school students who have not passed or are newly passing on formal operations period. Animations with music are produced alternatively to overcome these difficulties by utilizing information and communication technologies. The related studies reported that animations used in science lessons make a positive contribution to students' academic achievement and to retention of learned information. Animations are used as Musical Animation which combines an animation with a subject related song for some of the subjects of middle school science and technology course.

The purpose of this study is to analyse teachers' opinions about the impact of animations with music on students' learning of science and technology course at middle school. This research was done with 10 science and technology teachers working in various regions of Turkey in 2014-2015 academic year. Phenomenology, which is one of the qualitative research designs, was used in this in this study. The document that used as a data collection instrument was consisted of open-ended questions and constructed by experts. Data analysis was done by the formation of codes and distinction of themes. The results showed that Musical Animations have a positive impact on students. According to the results, the findings obtained from literature were discussed in terms of similarities and differences and suggestions were made.

Keywords: animation, science and technology, teacher opinion, qualitative study, phenomenology

ORTAOKUL FEN VE TEKNOLOJİ DERSİNDE MÜZİKLİ FEN ANİMASYONU KULLANIMI HAKKINDA ÖĞRETMEN GÖRÜŞLERİ

ÖZET: Fen ve Teknoloji dersine ait bazı konular (elektrik, atom vb.), soyut işlemler dönemine geçmemiş ya da yeni yeni geçmekte olan ortaokul öğrencileri için öğrenme güçlüğü oluşturmaktadır. Bu güçlüklerin üstesinden gelmek için, alternatif bir yöntem olarak, bilgi ve iletişim teknolojilerinden faydalanıp animasyonlar üretilmiştir. Fen derslerinde kullanılan animasyonların öğrencilerin akademik başarılarına, öğrenilen bilgilerin kalıcılığına olumlu katkı sağladığı yapılan çalışmalarda belirtilmiştir. Animasyonlar, ortaokul Fen ve Teknoloji dersine ait bazı konular için, konu içerikli bir müzikle birleştirilerek, müzikli fen animasyonu (MFA), şeklinde de kullanılmaktadır. Bu araştırmanın amacı; ortaokul Fen ve Teknoloji dersinde kullanılan müzikli fen animasyonlarının öğrencilerin fen konularını öğrenmelerine nasıl bir katkı sunduğunu, öğretmen görüşleriyle analiz etmektir. Araştırma 2014-2015 eğitim öğretim yılında, Türkiye' nin çeşitli bölgelerinde görev yapan ve derslerinde müzikli fen animasyonları kullanan 10 Fen ve Teknoloji öğretmeni ile yapılmıştır. Araştırmada nitel araştırma desenlerinden olgu bilim (fenomenoloji) çalışması kullanılmıştır. Veri toplama aracı olarak kullanılan doküman, açık uçlu sorulardan oluşturulmuş ve uzman kontrolü ile son hali verilmiştir. Verilerin analizi kodlar oluşturma ve temalara ayırma ile yapılmıştır. Araştırma bulguları, müzikli animasyonların öğrencilerin fen konularını öğrenmeleri üzerinde, pozitif yönde etkiye sahip olduğunu göstermektedir. Analizler sonucunda, alanyazın çalışmaları ile elde edilen bulgular, benzerlikler ve farklılıklar yönünden tartışılmış ve önerilerde bulunulmuştur.

Anahtar sözcükler: animasyon, fen ve teknoloji, öğretmen görüşü, nitel araştırma, olgu-bilim

GİRİŞ

Öğrenme bireyin zihninde önceden var olan bilgilerin üzerine yeni bilgileri eklemesidir (Özmen, 2007). Fen bilimleri öğrenimi ise gözlenen doğayı ve doğal olayları sistemli bir şekilde inceleme ve gözlemlenmemiş olayları öncesinden tahmin etme olarak tanımlanabilir (Zaman, 2006).

Eğitim ortamlarındaki öğrenciler ve öğretmenler fen ve teknoloji derslerinin öğrenilmesinde ve öğretilmesinde zorlandıklarını belirtmektedirler. Bunun sebepleri arasında, fen ve teknoloji kavramlarının çoğunun soyut yapıda olması ve günlük yaşamda kullanılan kelimelerin fen öğretiminde farklı anlamlarda kullanılması gösterilmektedir (Taber, 2002). Fen ve teknoloji dersinde gerçekleşen olayların öğrencilerin zihninde canlandırılabilmesi için somut öğretim yardımcılarıyla desteklenerek öğretilmesi, soyut bilgilerin somut kavramlar olarak şekillenmesine yardımcı olabilir (Atılboz, 2004). Animasyon bu şekilde kullanılabilecek teknolojik seçenekler arasındadır (Saka ve Akdeniz, 2006).

Animasyon; latince bir kelime olup, canlandırmak manasındadır (Foley et al; 1990). Burke et al.(1998)'e göre animasyon, çizilen veya canlandırılan nesnenin hareketini anlatan, canlandırılmış hareketli resimlerdir. Eğitimde kullanılan animasyonların öğrencilerin derse karşı tutum ve akademik başarılarında kayda değer artış sağlamasının yanı sıra güvenlik, zamanı hızlandırılıp yavaşlatabilme, çok seyrek görülen olayları incelenebilme, karmaşık sistemleri basitleştirilme, kullanışlı ve ucuz olma, motivasyon gibi bir çok katkı sağladığı ortaya konulmuştur (Güvercin, 2010; Tekdal, 2002).Bu sebeple dünyanın çeşitli ülkelerindeki okullarda animasyonlar yaygın olarak kullanılmaktadır. Yine yurt dışında yapılan birçok araştırma, animasyon destekli öğretimin özellikle biyoloji, kimya, fizik, yabancı dil ve elektrik-elektronik eğitiminde diğer yöntemlerden daha fazla etkili olduğunu, öğrencilerin motivasyonlarını artırdığını, öğrenmelerine olumlu katkı sağladığını ve bilimsel süreç becerilerinin gelişmesine yardımcı olduğunu saptamıştır (Bosco 1986; Fletcher1989, 1990; Kuliket al. 1980; Kuliket al. 1983; Kuliket al. 1985; Kuliket al. 1986). Bununla beraber, ülkemizde özellikle ilköğretim fen ve teknoloji derslerinde animasyon kullanımının yetersiz olduğu dikkat çekmektedir (Güvercin, 2010).

Ülkemizde çeşitli internet sitelerinde öğretmenler tarafından geliştirilen ya da yabancı kaynaklardan alınıp çevirisi yapılan fen animasyonları bulunmaktadır *(http://www.fenci.gen.tr ,http://www.egitimevi.net).* Bu animasyonların arasında müzikle birleştirilmiş olanlara da rastlanmaktadır (*http://www.fatihgizligider.com).*

Uçan (1996) müziğin, özü itibarıyla eğitsel bir nitelik taşıdığından, herkesin müzikle ilişkisinin biçimine, yönüne, kapsamına ve derecesine göre ondan bir şey aldığından, bir şey edindiğinden; bir şey kazandığından bahseder. Müziğin ve dansın öğrenme üzerindeki etkisini inceleyen Mphanty ve Hejmadi (1992),Uçan' ın yaklaşımını destekler nitelikteki çalışmalarında, 5-6 yaşlarındaki çocukların vücutlarındaki bölümlerin adlarını öğrenmesi için çeşitli öğretim metotlarını incelemiş, resim yapısını ve tamamlanmasını içeren 'Torrence Test of Creativity' ile çeşitli ölçümler yapmış ve sonuç olarak, müziğin yaratıcılık ve öğrenme üzerinde olumlu etkisi olduğunu belirtmişlerdir.

Müzik veya animasyon kullanarak hazırlanan ders materyallerinin öğrenmeye olan katkıları ayrı ayrı incelendiğinde her ikisinin de öğrenmeyi desteklediği görülmektedir. Animasyonlar, ortaokul Fen ve Teknoloji dersine ait bazı konular için, konu içerikli bir müzikle birleştirilerek, müzikli fen animasyonu (MFA), şeklinde de kullanılmaktadır. MFA'ların öğrencilerin öğrenmelerine nasıl bir katkı sağladığı tespit edilmesiyle, öğretmen görüşlerinin, geliştirilecek müzikli fen animasyonlarına içerik ve teknik anlamında yol gösterici olmasında, MFA hazırlamak isteyen öğretmenlerin teknik anlamdaki ihtiyaçlarının belirlenmesinde alan yazına katkı sağlayacağı düşünülmektedir.
Bu çalışmanın araştırma sorusu; 'Ortaokul Fen ve Teknoloji dersinde kullanılan MFA' lar öğrencilerin fen konularını öğrenmelerine nasıl bir katkı sağlamaktadır?' şeklindedir.

Araştırmanın esas problemine bağlı olarak alt problemler aşağıdaki gibi belirlenmiştir;

MFA kullanan öğretmenlerin, MFA' yı kullanma amaçları nelerdir?

Öğretmenler, MFA' ya ulaşma ve MFA' yı kullanma aşamalarında sıkıntı yaşıyor mu? Yaşıyorlarsa bu sıkıntılar ve nedenleri nelerdir?

Öğrencinin MFA' ya olan ilgisinde, öğrenci ve MFA özelliklerinin belirleyici rolü nedir?

MFA hazırlamak isteyen öğretmenlerin ihtiyaçları nelerdir?

YÖNTEM

Araştırmada nitel araştırma desenlerinden araştırmanın doğasına uygun olan olgu bilimi (fenomenoloji) deseni kullanılmıştır. Bu desen, aynı dünya ve kültürde yaşayıp-yetişen bireylerin aynı olayları farklı şekillerde algılayabiliyor ve yorumlayabiliyor olmasından dolayı öğrenimde bireysel farklılıkları ortaya koyması yönünden etkilidir (Morton, 1986).

Çalışma Grubu

Bu çalışmaya 2014-2015 bahar döneminde 10 Fen ve Teknoloji öğretmeni katılmıştır. Örneklemde yer alacak öğretmenlerin belirlenmesinde araştırmanın amacına uygun olarak amaçlı örneklem seçim yöntemlerinden olan ölçüt örnekleme yöntemi kullanılmıştır. Ölçüt örnekleme yöntemindeki temel anlayış, önceden belirlenmiş bir dizi ölçütü karşılayan bütün durumların çalışılmasıdır. Burada önceden hazırlanmış bir dizi ölçüt kullanılabileceği gibi ölçütler araştırmacı tarafından da geliştirilebilir (Yıldırım & Şimşek, 2011). Örneklem seçiminde, 'Dersinde müzikli fen animasyonları kullanma' kriter olarak belirlenmiştir. Araştırma için hazırlanan doküman formu Türkiye'nin tüm bölgelerinde, derslerinde müzikli fen animasyonu kullandığını belirten fen öğretmenlerine e-posta yoluyla gönderilmiş, İç Anadolu, Doğu Anadolu, Güney Doğu Anadolu, Karadeniz ve Marmara bölgelerindeki öğretmenlerden veri toplanabilmiştir. Her bölgeden yeterli sayıda kişi ile çalışılamaması bu çalışmanın sınırlığı arasında yer almaktadır.

Bu öğretmenlerin mesleki tecrübeleri ve en son mezun oldukları programlar ve cinsiyetlerine ait bilgiler Tablo 1'de sunulmuştur.

Tablo 1. Fen ve Teknoloji Öğretmenlerinin Mesleki kıdemleri, En Son Mezun Oldukları Programlar

		Öğretmen Sayısı
Mesleki tecrübe	10 Yıl ve Altı	6
	10 Yıl Üstü	4
En son mezun olunan program	Lisans	7
	Yüksek lisans	3
Cinsiyet	Kadın	5
	Erkek	5

Veri Toplama Araçları

Bu çalışmada veri toplama aracı olarak, doküman analizi formu kullanılmıştır. Dokümanlar, araştırmacının gözlem veya görüşme yapmaya gerek kalmadan veriyi toplayabildiği ve genelde nitel araştırmalarda etkili bir şekilde kullanılan bilgi kaynaklarıdır (Yıldırım & Şimşek, 2011).

Alan yazın araştırması sonunda iki bölümden oluşan yirmi dört soruluk doküman analiz formu hazırlanmıştır. İlk gurupta öğretmeni tanımak amaçlı hazırlanmış dört soru (çalışma grubunda verilmiştir), ikinci gurupta konuyu araştırmak (bulgular kısmında verilecektir) için yirmi soru bulunmaktadır. Sorular uzmanların kontrolüne sunulmuş, üzerinde gerekli düzenlemeler yapılmış ve son haline getirilip kapsam geçerliği sağlanarak yukarıda belirtilen 10 katılımcıya uygulanmıştır. Doküman analizindeki sorular, bulgular kısmında verilmiştir.

Verilerin Analizi

Araştırmacılardan birisi verileri incelemiş ve kodlamalar oluşturmuştur. Bu kodlamalar belirli başlıklar altında toplanarak temalara ulaşılmıştır. Araştırmacılar fikir birliğine vararak bu temalar altında bulguları incelemiştir.
Temalar sırasıyla; MFA kullanan öğretmenlerin; MFA' yı kullanma amaçları, MFA' ya ulaşma ve MFA' yı kullanma aşamalarında yaşadıkları sıkıntı/lar, MFA hazırlamak isteyen öğretmenlerin ihtiyaçları ve öğrencinin MFA' ya olan ilgisinde, öğrenci ve MFA özelliklerinin neler olduğu başlıkları altında irdelenmiştir.

Geçerlik güvenirlik

Bu çalışmanın iç geçerliğini arttırmak amacıyla doküman analizi formu alan yazın incelemesi sonucunda hazırlanmış ve uzman kontrolü ile çalışma son haline ulaştırılmıştır. İçerik analizi, önceden belirlenmiş temalar ışığında, analiz sırasında oluşturulan kodlar yoluyla belirlenmiştir. İlgisiz kodlar ya da cümleler dışarıda tutulmuştur. Araştırmanın dış geçerliğini sağlayabilmek için araştırmaya katılan öğretmenlerin isimleri değiştirilerek doğrudan alıntılar kullanılmış ve öğretmenlerden elde edilen nitel bulguların hamlığı korunmuştur. Ayrıca çalışmanın amaca hizmet edebilmesi için araştırma formatına uygun öğretmenler seçilerek amaçlı örnekleme yöntemi kullanılmıştır. Araştırmanın iç güvenirliğini arttırmak amacıyla bulgular yorum yapılmadan okuyucuya sunulmuştur. Araştırmanın dış güvenirliğini arttırmak amacıyla bir alan uzmanı da araştırmanın ham verilerini, yöntemini, bulgularını tutarlık bakımından incelemiştir

BULGULAR

Bu bölümde araştırmaya katılan Fen ve Teknoloji öğretmenlerine yöneltilen sorular, oluşturulan temalara göre incelenmiş ve tablolar halinde sunulmuştur.

Müzikli Fen Animasyonu (MFA) kullanım amacınız nedir?

Öğretmenler MFA'ları ilgi/dikkat çekmek, kalıcılığı sağlamak, dersi sevdirmek, sınıf yönetimini kolaylaştırmak ve dersi eğlenceli hale getirmek için kullandıkların belirtmişlerdir. Tablo 2'de görüleceği üzere MFA'lar çoğunlukla öğrencilerin derse ilgisini dikkatini çekmek ve öğrenilenlerin kalıcılığını artırmak için kullanılmaktadır. MFA'lar ayrıca dersi sevdirmek, eğlenceli hale getirmek ve sınıf yönetimini kolaylaştırmak için de kullanılmaktadır.

Tablo 2. MFA Kullanım Amacı

Amaç	Frekans
İlgi-dikkat çekme	5
Kalıcılık	4
Dersi sevdirme	2
Dersi eğlenceli kılma	2
Sınıf yönetimi(Zaman tasarrufu)	1

Görüşülen öğretmenler MFA' ların amacı konusunda tek amaç (örneğin sadece ilgi çekmek veya sadece kalıcılığı sağlamak) ileri sürdükleri gibi birden fazla amaç için de kullandıklarını ifade etmişlerdir:

'*Çünkü öğrencilerimin ilgisini çekiyor.' (Hayat)*
'Her ünite için kullanıyorum, kalıcılık- ilgi-istek-dersi sevme- zaman yönetimi hatta sınıf yönetiminde dahi faydasını gördüğüm için.' (Tülay)

MFA'ların, öğrencileriniz açısından, etkili olduğunu düşünüyor musunuz? Neden?

Öğretmenlerin dokuz tanesi MFA' ların öğrenciler açısından etkili olduğunu düşünürken bir tanesi, öğrenciler tarafından hazırlananların daha etkili olduğunu belirtmiştir.
Görüşülen öğretmenler, MFA'ların öğrenciler açısından etkilik nedenlerini Tablo 3'de belirtildiği şekilde ifade etmişlerdir.

Tablo 3. Öğretmenlerin MFA' yı kullanma nedenleri

Kullanma nedeni	Frekans
Kalıcılık	4
Dersi eğlenceli kılma	3
İlgi-dikkat çekme-merak uyandırma	2
Müziksel ve görsel zekâya hitap etme	2
Sınıf yönetimi(zaman tasarrufu)	1
Derse katılım	1
Bakış açısı geliştirme	1
Öğrenmeyi kolaylaştırma	1

Görüşülen öğretmenler içinde MFA' ların etkililiği konusunda neden belirtmeyen (bir kişi) olduğu gibi, tek neden (örneğin öğrenmeyi kolaylaştırma veya sadece kalıcılığı sağlama) veya birden fazla neden belirtenler de olmuştur.

'Çünkü anlatılan konuyu açıklayan bir şarkı ile konu daha kolay pekiştiriliyor, öğreniliyor' (Fikret)
'Çünkü eğlenceli, müziksel ve görsel zekâya hitap ediyor ve öğrencilerin bakış açılarını geliştiriyor' (Betül)

MFA' ları;

Kullanım şeklinizi ve amacınızı açıklar mısınız?

Öğretmenlere soru yeterince açık ifade edilemediği için ya da öğretmenler tarafından açıkça anlaşılamadığı için bu soruya iki türde cevap alınmıştır. Bir öğretmen kullanım şekliyle kast edilenin, kullanılan sunum materyali olduğunu algılamış ve ekrana yansıtarak kullandığını ifade etmiştir.

‘*Projeksiyonla laboratuvarda’* (İsmail)

Bir öğretmen ise sadece amacını açıklamış kullanım şeklini cevaplamamıştır. Görüşülen öğretmenler, MFA’ların kullanım amacını Tablo 4’de belirtildiği şekilde ifade etmişlerdir

Tablo 4. MFA’ ların Kullanım Amacı

Amaç	Frekans
Dersi işlevsel kılma	5
İlgi-dikkat çekme	3
Dersin değerlendirilmesi	2
Dersi eğlenceli kılma	2
Kalıcılık	1

Öğretmenler derslerinde kullandıkları MFA’ların kullanım amaçlarını şu şekilde belirtmişlerdir.

‘Amacım ise dersi daha işlevsel hale getirmek. Arada müziği durdurup anlatmam gerekiyor. Sonra bir kaç defa dinleyince sözler oturmuş ve konuyu anlamış oluyorlar.’(Fatma)
‘İlgi çekme amacıyla ve dersi daha eğlenceli hale getirme amacıyla.’ (Mahmut)

MFA’lara hangi kaynak ya da kaynaklardan ulaşıyorsunuz?

Katılımcı öğretmenler arasında MFA hazırlayanlar olduğu gibi, MFA’ ya internetteki fen ile ilgili internet sitelerinden, sosyal medyadan veya internetteki fen guruplarından ulaşanlarda bulunmaktadır. Kaynaklara ulaşımla ilgili sonuçlar Tablo 5’ de verilmiştir.

Tablo 5. MFA’ ya Ulaşılan Kaynaklar

Kaynaklar	Frekans
Fen ile ilgili internet siteleri	7
Sosyal medyadan	4
Kendi hazırlayan	3
İnternetteki fen gurupları	2

MFA’ ya ulaşmak için kullandığınız bu kaynak ya da kaynaklar hakkında bilgiyi nereden aldınız?

Katılımcılardan üç kişi kaynağı kendisinin oluşturduğunu, iki kişi kaynağı oluşturan kişileri tanıdığı için kendilerinden direk aldıklarını, iki kişi sosyal medyadan aldığını, dört kişi internetteki fen sitelerinden, bir kişi internetteki fen guruplarından ve iki kişide okuldaki zümrelerinden aldıklarını belirtmişlerdir.

MFA içerikli kaynak ya da kaynaklara ulaşırken herhangi bir zorlukla karşılaşıyor musunuz? Evet, ise açıklar mısınız?

Bu soruya katılımcı öğretmenlerin dokuzu hayır cevabını verirken bir öğretmen evet diyerek cevaplamıştır. Evet diyerek cevaplayan öğretmenin açıklaması şu şekildedir:

‘Sosyal medya üzerinden videoları izletme imkânı olmadığı için büyük güçlük çekiyoruz. Kliplerimizi eba (eğitim bilişim ağı)’ ya yükledik okulda açılabilsin diye. Maalesef oradan da sildiler.’
Kaynak ya da kaynaklardaki MFA’ lar içerik ve sayı anlamında yeterli mi?

Bu soruya katılımcı öğretmenlerin ikisi evet cevabını verirken sekiz öğretmen hayır cevabını vermiştir.

Yetersiz buluyorsanız, yeterli hale getirilebilmesi için neler yapılabilir?

Kaynaklardaki MFA’ ları yetersiz bulan sekiz öğretmenin cevapları iki tema altında toplamıştır.
Birinci tema öğretmenlere bu konuda seminerler verilmesi ve hazırlayan öğretmenlerin teşvik edilmesi yönündedir.

‘*Sayı anlamında yeterli değil bazıları çok amatörce çekilmiş veya yapılmış oluyor. Fen bilimleri öğretmenlerine yönelik daha fazla teknolojiyle ilgili seminerler verilmeli ve üretkenlik artmalı.’ (Fatma)*

İkinci tema Milli Eğitim Bakanlığı bünyesinde birim kurulmalı ve bu materyal için profesyonelce çalışılması gerektiği yönünde olmuştur.

'Elbette yeterli değil. Bakanlık bu konu ile ilgili bir birim kurmalı ve bu işin başına da M:A yapmış tecrübeli öğretmenleri getirmeli. İşi daha da profesyonelce yapmak için sözlerini fen öğretmenlerinin yazdığı profesyonel ses sanatçıları ve aranjörlerin desteklediği klipler yapılmalı' (Fikret)

MFA' yı kullanım sırasında karşılaştığınız zorluklar varsa belirtir misiniz?

MFA kullanan öğretmenlerden beşi, kullanım sırasında herhangi bir zorlukla karşılaşmadığını belirtirken; beşi, çeşitli zorluklarla karşılaştığını belirtmiştir. Zorlukla karşılaştığını ifade eden kişilerin karşılaştığı zorluklar şu şekilde temalandırılmıştır: animasyonda sözlerin iyi anlaşılamadığı (iki kişi), internet olmadığı zaman okulda kullanılamadığı (bir kişi), okul bilgisayarlarının kapasitelerinin yetersiz olduğu (iki kişi).

MFA' ya olan ilgi açısından

Öğrenci cinsiyeti etkili midir? Neden?

Bu soruya üç katılımcı evet cevabı vermiş, bunlardan ikisi kızların daha ilgili olduğunu belirtmiş, diğeri ise erkeklerin daha hareketli kızların ise daha çekingen olduğunu ifade etmiştir. Diğer katılımcılar cinsiyetin etkili olmadığını belirtmişlerdir.

MFA' da ki şarkının hareketli ya da yavaş olması etkili midir? Neden?

Katılımcılardan bir kişi MFA' da kullanılan şarkının hareketli ya da yavaş olmasının MFA' ya olan ilgi açısından önemli olmadığını ifade ederken, yedisi bu ilginin hareketli şarkılardan yöne olduğunu, bununla beraber iki kişi de orta hızda şarkıların daha etkili olduğunu belirtmiştir. Bu soruya ait nedeni cevaplayan bir kişi olmuştur. Cevabı şu şekildedir:

'Çok etkili. Kesinlikle hareketli şarkılar coşku ve sevinç duygusunu tetikliyor ve daha çok seviliyor. Amacımıza da daha etkili ulaştırıyor.' (Tülay)

MFA' daki şarkıların, kadın ya da erkek tarafından seslendiriliyor olması etkili midir? Neden?

Dokuz katılımcı bu soruya hayır cevabı vermiş. Bunlardan ikisi, önemli olanın sesin etkileyici olması ikisi de etkileyici sesin yanında şarkı sözünün de önemli olduğunu belirtirken diğer beşi nedenini açıklamamıştır.
Evet cevabı veren bir kişi de neden olarak, erkek söylediğinde daha çok beğenildiğini ifade etmiştir.

MFA'da kullanılan şarkının, öğrencinin bildiği (aşina olduğu) ya da daha önce hiç duymadığı şarkılardan seçilmiş olması etkili midir? Neden?

Öğretmenlerden biri, öğrencilerin şarkıya aşina olup olmamasının MFA' ya olan ilgileri açısından önemli olmadığını, daha çok şarkının ilgi çekiciliğinin önemli olduğunu ifade etmiştir. Geri kalan dokuz öğretmen ise bilindik şarkıların daha etkili olduklarını belirtmişlerdir. İki öğretmen nedenini katılımı kolaylaştırdığını söyleyerek açıklamışlardır. Yedi öğretmen ise nedenini belirtmemişlerdir.

Eklemek istediğiniz başka etki ya da etkiler varsa nedenleriyle birlikte belirtiniz

Katılımcıların dokuzu eklemek istedikleri bir şey olmadığını ifade etmiştir. Bir katılımcı ise

'*Sadece şunu söylemek isterim teknoloji çağında ders kitaplarına test kitaplarına hapsolmuşuz. Bir an önce bu teknoloji çağında bu tür M.A ların sayısı arttırılmalı.' (Zeynep)* şeklinde açıklama yapmıştır.

Siz de MFA hazırladınız mı?

Dört katılımcı bu soruya hayır cevabını verirken altı katılımcı evet cevabını vermiştir. Evet, cevabını veren katılımcılar;

Hazırladıysanız; içeriğiniz belirtir misiniz?

Katılımcılar, ortaokul Fen ve Teknoloji dersi kazanımlarını içeren, şarkı ve klipler ayrıca müzikli ders videoları (solunum sistemi, boşaltım sistemi, ampul parlaklığı etkileyen etmenler, iyonlar, kaldırma kuvveti, yoğunluk, ampullerin seri paralel bağlanması, sindirim sistemi, kulak ve işitme, göz ve görme, yaylar konularında) hazırladıklarını belirtmişlerdir.

'kulak ve işitme, göz ve görme ile ilgili ve yaylar konusunda teşebbüslerim olmuştur.'(Serhat)

Hazırlama aşamasında ne gibi zorluklarla karşılaştınız? Neden?

MFA hazırlayan altı katılımcıdan üçü zorlukla karşılaşmadığını belirtirken, diğer üç katılımcı teknoloji kullanma ve görselleri elde etme konularında zorluklarla karşılaştıklarını belirtmiştir. Ayrıca MFA hazırlayan bir katılımcı klip aşamasında profesyonel yardım aldığını ifade etmiştir.

Hazırlamak için kurs/ seminer/ eğitim aldınız mı?

MFA hazırlayan altı katılımcıdan beşi bu alanda herhangi bir eğitim almadığını ifade ederken bir katılımcı karşılaştığı zorlukları aşabilmek için eğitim aldığını belirtmiştir.
'*Fen bilimleri öğretmenlerine yönelik - tpab(teknolojik pedogojik alan bilgisi (tübitak projesi olarak verilen 10 günlük bir eğitimdi)' (Tülay)*

Hazırlamadıysanız;

Hazırlamak isteseydiniz hangi konuları seçerdiniz?

MFA hazırlamayan üç katılımcıdan biri fenle ilgili her konuda, ikisi de asit ve bazlar, sürat, periyodik tablo, denklem denkleştirme, ısı sıcaklık, elektrik (dirençler),kaldırma kuvveti, ışık(yansıma ve kırılma) konularında MFA hazırlamak istediklerini belirtmişlerdir. Bir katılımcı ise hazırlamak istemediğini ifade etmiştir.

Hazırlamak için kurs/ seminer/ eğitim almak ister miydiniz? Bu eğitimin nasıl verilmesini isterdiniz?

MFA hazırlamayan üç katılımcı, hazırlamak için eğitim almak istediğini ifade etmiştir. Bu eğitimin teknik içerikli, uygulamalı ve ürün odaklı olacak şekilde verilmesini istemişlerdir. Bir katılımcı ise bu konuda fikir belirtmemiştir.

SONUÇ

Araştırmaya katılan öğretmenler, derslerinin her aşamasında (giriş, gelişme ve sonuç),MFA'ları ilgi çekici, dersi eğlenceli hale getiren, müziksel ve görsel zekâya hitap eden, öğrencilerin derse katılımını arttıran ve sınıf yönetimini kolaylaştıran bir materyal olarak kullanmaktadırlar. Arıcı ve Dalkılıç (2006)' a göre de animasyonların derslerde kullanılması öğrenci ilgisini artırmaktadır.

Derslerde kullandıkları MFA'ları, katılımcı öğretmenler kendileri hazırladıkları gibi, MFA'ya internetteki fen ile ilgili internet sitelerinden, sosyal medyadan veya internetteki fen gruplarından da temin edebilmektedirler. MFA'ları kullanan öğretmenler MFA'ların sayısının yeterli olmadığını ve içeriklerinin zenginleştirilmesi gerektiğini söylemişlerdir. Araştırmaya katılan öğretmenlere göre MFA'ya ilgi açısından öğrenci cinsiyeti, kullanılan şarkının kadın ya da erkek tarafından seslendiriliyor olması etkili olmazken, kullanılan şarkının hareketli, öğrenci tarafından bilindik, sözlerinin açık ve anlaşılır olması etkilidir. Araştırmaya katılan öğretmenler arasında MFA hazırlayanlar olmakla birlikte, hazırlamayıp ulaşabildikleri kaynaklardan MFA kullananlar da bulunmaktadır. Katılımcılar genel olarak bu alanda uygulamalı eğitim almak istediklerini belirtmişlerdir.

ÖNERİLER

MFA'ların içerik ve sayı anlamında zenginleştirilmesi için bu alanda gönüllü olarak çalışmak isteyen öğretmenlere MEB'nın belirlediği bir birim tarafından eğitim verilmesi, ürünlerin bu birim tarafından toplanıp bütün öğretmenlere yaygınlaştırılması ve ürün oluşturan öğretmenlerin motive edilmesi önerilebilir.

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ANALYSIS OF SECONDARY STUDENTS' CONCEPTUAL UNDERSTANDINGS ON THE TOPIC OF MIRRORS

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ABSTRACT: The purpose of this study was to analyze the conceptual understandings of secondary students on the topic of "mirrors". Within this context, the answer of the question "How process of conceptual change occurs in students" has been clarified. The sample of the study consists of 46 students from 9th grade students. Data of the research were collected through a "Conceptual Test", "Interviews", "Video Records", "Student Guidelines" and "Semantic Feature Analysis". The data was analyzed with Thorley's (1990) "Status Analysis Categories, which was also conducted in the studies of Hewson and Lemberger. With regard to the results obtained from the analysis of the conceptual change status; it can be inferred that while students were displeased with the existing concepts learnt through previous teaching strategies, the concepts and explanations which were acquired with the help of experiments and activities were "comprehensible", "conceivable" and "beneficial" for them. And therefore, it can be deduced that students internalized new (scientific) concepts resulting in meaningful and permanent learning.

Key words: conceptual change, status analysis categories, meaningful learning, student guidelines.

ORTAÖĞRETİM ÖĞRENCİLERİNİN AYNALAR KONUSUNDAKİ KAVRAMSAL DURUMLARININ ANALİZİ

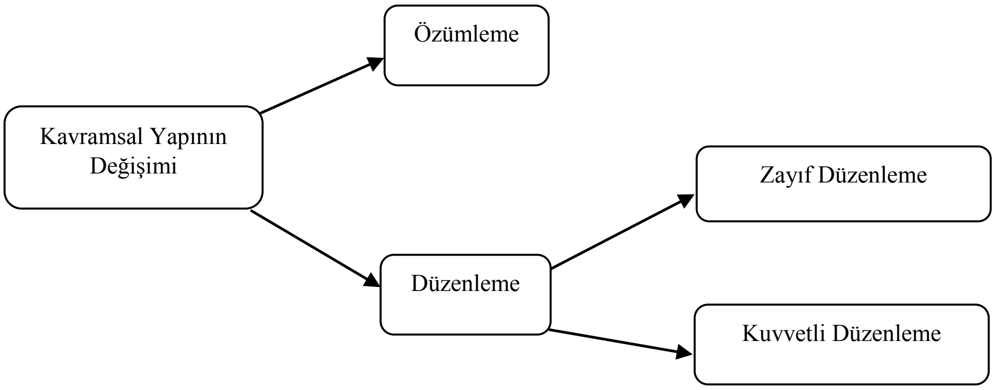
ÖZET: Araştırmanın amacı, ortaöğretim öğrencilerinin aynalar konusundaki kavramsal durumlarının analizini yapabilmektir. Bu kapsamda; "Öğrencilerin kavramsal değişim süreci nasıl gerçeklemektedir?" sorusuna yanıt aranmıştır. Araştırmanın örneklemini, 9. sınıfta eğitim gören toplam 46 öğrenci oluşturmaktadır. Veri toplama sürecinde; "Kavram Testi", "Görüşmeler", "Kamera Kayıtları", "Öğrenci Kılavuzları" ve "Anlam Çözümleme Tabloları" kullanılmıştır. Verilerin analizi sürecinde; Thorley tarafından geliştirilen Hewson ve Lemberger'in çalışmalarında kullandığı, "Durum Analiz Kategorileri"nden yararlanılmıştır. Kavramsal değişim durumlarının analizinden elde edilen sonuçlar değerlendirildiğinde; öğrencilerin öğretim sürecine taşıdıkları mevcut kavramlar ile ilgili hoşnutsuzluk duydukları, gerçekleştirdikleri deney ve etkinlikler yardımıyla ulaştıkları yeni kavram ve açıklamaları "anlaşılır", "akla yatkın" ve "yararlı" buldukları için olası yeni (bilimsel) kavramları içselleştirerek anlamlı ve kalıcı bir öğrenme gerçekleştirdikleri söylenebilir.

Anahtar sözcükler: kavramsal değişim, durum analiz kategorileri, anlamlı öğrenme, öğrenci kılavuzları.

GİRİŞ

Günümüzde eğitimin yeni hedefi; bilgiyi nasıl ve nerede kullanacağını bilen, öğrenme yöntemlerini tanıyıp etkili bir biçimde kullanan ve yeni bilgiler üretmede önceki bilgilerinden yararlanan insan modeli oluşturmaktır (Abbott ve Ryan, 1999). Bu aşamada, anlamlı bir öğrenme gerçekleştirebilmek için öğrencilerin öğretim ortamına getirdikleri kavram yanılgılarını saptamak ve kavramsal değişim sürecine hizmet eden bir öğretim ortamı tasarlamak gerekir (Aydoğan, Güneş ve Gülçiçek, 2003). Bu nedenle günümüzde, kavram yanılgılarını belirlemeye yönelik çalışmaların yerini kavramsal değişim süreci ve yapısına ilişkin çalışmalar almaktadır.

Kavramsal değişim süreci ile ilgili olarak ortaya atılan en önemli model Posner ve arkadaşları (1982) tarafından geliştirilen *kavramsal değişim teorisi* (CCM)'dir. Söz konusu teoride iki olgu ön plandadır; özümleme ve düzenleme. Özümleme; yeni bilgilere ulaşmada mevcut bilgilerden yararlanmayı ifade etmektedir. Düzenleme; öğrencilerin var olan kavramları yeni bir olayı açıklamakta yetersiz kaldığında, bu kavramların öğrenci tarafından yeniden organize edilmesi şeklinde açıklanmaktadır. Zayıf düzenleme; mevcut kavram ve düşünceler üzerinde gerçekleştirilen sınırlı bir düzenlemeyi, kuvvetli düzenleme ise mevcut kavram ve düşüncelerin yapısında gerçekleştirilebilecek kapsamlı ve radikal bir düzenlemeyi ifade edilmektedir (Cooper, 1993). Kavramsal değişim aşamaları Şekil 1'de sunulmuştur (Asan ve Gönül, 2000).



Şekil 1. Kavramsal Değişim Aşamaları

Kavramsal değişim aşamalarını kuramcılar farklı biçimlerde yorumlamışlardır. Vosniadou (1994) özümleme sürecini, mevcut kavramların ilave bilgilerle zenginleştirilmesi olarak görmektedir. Thagard (1992) özümleme sürecinde öğrencilerin düşüncelerinin yenilenmesi gerektiğini savunmakta; bu aşamada mevcut kavramın gelişmesine imkan sağlayan örnek olaylar ile kurallar bütününden yararlanmayı önermektedir. Chi ve arkadaşları (1994) ise özümleme aşamasında mevcut kavramın varoluşsal yapısında bir değişiklik olmayacağını ileri sürmektedirler.

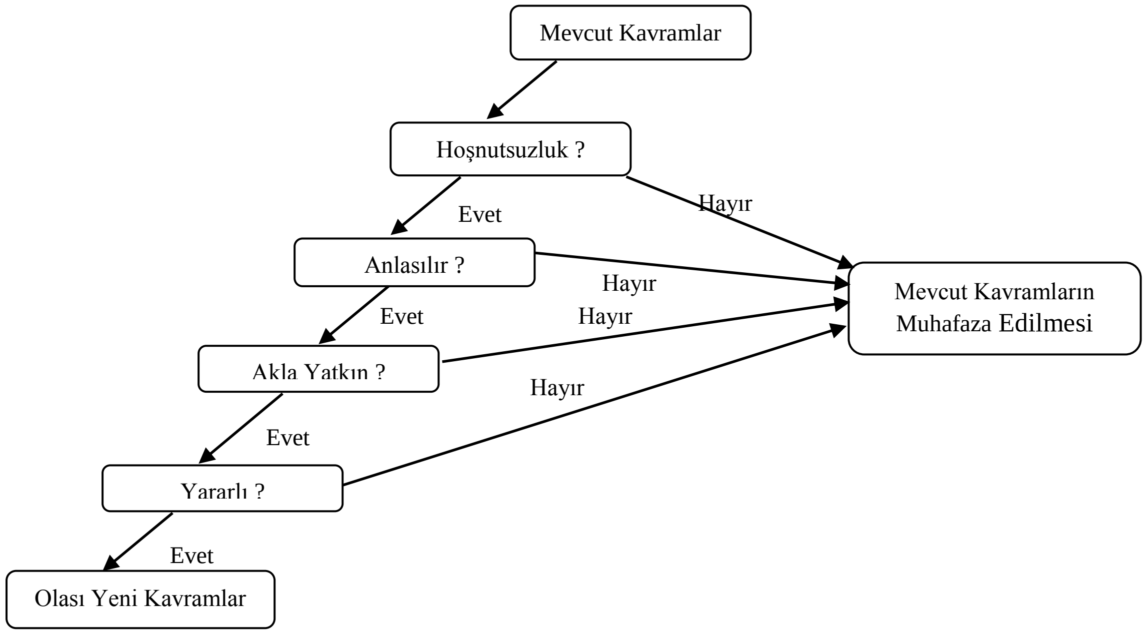
Schwedes ve Schmidth (1992) özümleme sürecinin kurallar ve fikirler rehberliğinde ana kavram çerçevesinde gerçekleşen bir değişim süreci olduğunu düşünmektedir. Tibergien (1994) kavramsal değişimin özümleme aşamasını kavramların deneysel kazanımlarında (deneysel veriler, ölçümler vb.) gerçekleşen bir değişim süreci olarak görmektedir.

Kuramcıların düzenleme sürecine ilişkin görüşlerini şu şekilde özetlemek mümkündür. Hewson ve Hewson (1992) zayıf düzenleme sürecini, "kavramsal ele geçirme" bir başka ifadeyle "kavramı genişleterek yeniden yorumlama" olarak, kuvvetli düzenleme sürecini ise kavramlar arası değişim aşaması olarak isimlendirmiştir. Vosniadou (1994) zayıf düzenleme aşamasını; mevcut kuram ve düşüncelerin bilimsel seviyelerinde gerçekleştirilecek yeniden yapılandırma süreci olarak ifade etmektedir. Kuvvetli düzenleme aşamasını ise mevcut kavram ve düşüncelerin yapısında gerçekleştirilebilecek kapsamlı ve radikal bir yeniden yapılandırma süreci olarak tanımlamaktadır.

Thagard (1992) zayıf düzenleme aşamasında mevcut kavrama kısmi eklemelerde bulunulmasını, mevcut kavramın ilişkili olan yeni kavramlarla desteklenmesini önermektedir. Thagard kuvvetli düzenleme sürecini ise iki aşama olarak değerlendirmiştir. İlk aşamada, birbiriyle ilişkili olan kavramlar arasındaki bilgi geçişlerinin (daldan dala atlama) kavramsal değişimi gerçekleştirme sürecinde etkili olacağını ifade etmektedir.

Kuvvetli düzenleme sürecinde kullanılabilecek ikinci aşama ise farklı kavramlar arasında gerçekleştirilen kapsamlı bir değişim sürecini (ağaç değiştirme) içermektedir. Chi ve arkadaşları (1994); zayıf düzenleme aşamasında, mevcut kavramın yapısının benzer özellikler gösteren varoluşsal kavram kategorileri içerisinde değişime uğradığını ve bu sürecin bir ağacın dallarında dolaşmaya benzediğini düşünmektedirler. Kuvvetli düzenleme sürecinin ise kavramın farklı yapısal özelliklere sahip varoluşsal kavram kategorileri arasında değişime uğramasına imkan sağladığını söylemekte ve bu süreci "bir ağaçtan başka bir ağaca geçiş" olarak isimlendirmektedirler. Chi ve arkadaşlarının kavramsal değişim sürecine yönelik çıkarımları Thagard'ın düşünceleri ile paralellik göstermektedir.

Schwedes ve Schmidth (1992) zayıf düzenleme sürecini; ana kavramın çevresinde yer alan kurallar ve fikirlerde gerçekleşen değişiklikler veya bu kural ve fikirlerin ana kavram ile ilişkilendirilme süreci olarak ifade etmektedir. Kuvvetli düzenleme sürecini "ana kavramın bütünüyle başka bir kavram ile değiştirilmesi" şeklinde yorumlamaktadır. Tibergien'e göre (1994) zayıf düzenleme süreci anlamsal bir kavramsal değişimi ifade etmektedir. Bu süreçte; nesnelerin ve olayların yapısında derinlemesine bir değişim olmasına rağmen kuramda radikal bir değişikliğe rastlanmamaktadır. Kuvvetli düzenleme sürecinde ise kuramsal bir kavramsal değişim gerçekleşmektedir. Kuramın yapısındaki bu değişim özellikle nedensellik ilkesi bağlamında gerçekleşmektedir. Kavramsal değişim sürecinde mevcut kavramlarda gerçekleşmesi olası değişimler Şekil 2'de sunulmuştur (Posner, Strike, Hewson ve Gertzog, 1982).



Şekil 2. Kavramsal Değişim Teorisi

Kavramsal değişim teorisine ilişkin bu aşamalı süreç kavramsal değişim için gerekli koşulları şu şekilde ifade etmektedir (Posner, Strike, Hewson ve Gertzog, 1982).

Öğrenci mevcut bilgilerine karşı *hoşnutsuzluk* içerisinde olmalıdır ve bu hoşnutsuzluğun neden olduğu sorunları bilimsel kavramların çözebileceğini düşünmelidir.

Yeni kavram *anlaşılır* olmalıdır. Anlaşılır olmayan kavram öğrenci tarafından içselleştirilememekte ve doğru anlamlandırılamamaktadır.

Yeni kavram *akla yatkın* olmalıdır.

Yeni kavram *yararlı* olmalıdır. Yeni kavramın problemleri çözmedeki verimliliği öğrencinin eski bilgiyi terk etmesini çabuklaştırmaktadır. Bir başka ifadeyle yeni kavramın işgörüsü olmalıdır.

Kavramsal değişim sürecinin koşullarına yönelik birçok çalışma mevcuttur (Strike ve Posner (1992); Wandersee, Mintzes ve Novak, 1994; Vosniadou ve Ionnides, 1998; Hubber, 2005). Bu çalışmalar; "bilginin yeniden yapılandırılması" ve "bilimsel anlayışa ulaşabilme" süreçlerine odaklanmakta, kavramsal değişimin öğrencilerin bilişsel farkındalık düzeyi ile ilişkili olduğunu ifade etmektedir.

Kavram yanılgılarının giderilmesi ve kavramsal değişimin sağlanması amacıyla; bilgisayar destekli öğretim, kavramsal değişim etkinlikleri, kavramsal çatışma aktiviteleri, kavram haritaları ve yapılandırmacı kurama dayalı öğretim stratejilerinin kullanıldığı ve öğrencilerin bilimsel kavramları öğrenebilme kapasitelerinin, mevcut bilişsel yapılarının farkına varabilmeleri ile ilişkili olduğunu ifade eden çalışmalarda mevcuttur (Fetherstonhaugh ve Treagust, 1992; Pintrich, Marx ve Boyle, 1993; Nievas ve Perales, 1995; Galili, 1996; Galili ve Hazan, 2000).

Öğrencilerin kavramsal değişim süreci değerlendirilirken; "ontolojik", "bilişsel" ve "sosyal" olarak üç farklı alandan oluşan "Çok Boyutlu Kavramsal Değişim Yapısı"nı temele alan çalışma sayısı ise oldukça sınırlıdır. (Chi, 1992; Chinn ve Brewer, 1993; Duit, (1995); Hewson ve Lemberger, 2000).

Bu çerçevede araştırmada, öğrencilerin aynalar konusundaki kavramsal durumlarının analizini yapabilmek amacıyla "Öğrencilerin kavramsal değişim süreci nasıl gerçeklemektedir?" sorusuna yanıt aranmıştır. Süreç; çok boyutlu kavramsal değişim yapısının bilişsel bakış açısını temele alan ve Thorley (1990) tarafından geliştirilen "Durum Analiz Kategorileri"nden yararlanarak yapılandırılmıştır.

YÖNTEM

Çalışmanın bu bölümünde; araştırma modeli, örneklem ve veri toplama araçlarına ilişkin bilgilere yer verilmiştir.

Araştırma Modeli

Araştırmada örnek olay yönteminin bütüncül tek durum deseni kullanılmıştır. Yin (1984) örnek olay yöntemini; güncel bir olguyu kendi gerçek yaşam çerçevesi içinde çalışan, olgu ve içinde bulunduğu içerik arasındaki sınırların kesin hatlarıyla belirgin olmadığı, birden fazla kanıt veya veri kaynağının mevcut olduğu durumlarda kullanılan bir yöntem olarak ifade etmektedir. Bütüncül tek durum deseni ise örnek olay yönteminin desenleri arasında yer alan ve tek bir durumu (bir okul, bir program, bir kurum vb.) ayrıntılı olarak incelemeye fırsat tanıyan bir desendir. Eğer ortada iyi formüle edilmiş bir kuram varsa, bunun teyit edilmesi veya çürütülmesi amacıyla bu desen kullanılabilir (Galili ve Hazan, 2000).

Araştırmada; öğrenme sarmalına uygun olarak tasarımlanan 5E öğretim modelinin kavramsal değişim sürecine olan etkisini, tek bir durum (9. sınıf) üzerinden deneysel olarak incelemeye fırsat tanıdığı için "bütüncül tek durum deseni" tercih edilmiştir. Test edilecek özellikler araştırmanın amacına uygun olarak belirlenmiş; öğrencilerin ön bilgileri ve öğretim sürecinde kazandırılması gereken hedef davranışlar dikkate alınarak öğrenme ortamı tasarlanmıştır. Öğretim süreci; uygulama öncesi, deneysel işlem (uygulama) ve uygulama sonrası olarak üç farklı aşamadan oluşmaktadır. Uygulama öncesi süreç, öğrencilerin konuya ilişkin ön bilgilerinin ve kavram yanılgılarının belirlendiği aşamadır. Deneysel işlem süreci; 5E Öğretim Modeli çerçevesinde yapılandırılan ve kavramsal değişimi gerçekleştirmeye yönelik öğretim uygulamalarını kapsayan bir aşamadır.

Deneysel desenin son aşaması olan uygulama sonrası süreç ise öğrencilerin kavramsal değişimlerinin incelendiği değerlendirmeye yönelik bir aşamadır. Araştırmada; "durum analiz kategorileri" temele alınarak, "uygulama sonrası" sürece ilişkin veriler değerlendirilmiştir.

Örneklem

Çalışmanın örneklemi; Balıkesir il merkezinde bulunan bir lisenin 9. sınıfları arasından küme örnekleme yöntemi yardımı ile seçilen iki şubeden oluşmaktadır. Lisede hali hazırda oluşmuş sınıflar kümeler olarak kabul edilmiş, araştırma için gerekli iki sınıf seçkisiz örnekleme yöntemi ile belirlenmiştir. Örnekleme dahil edilen öğrencilerin bir seçme sınavı ile alınması ve bu nedenle seviyelerinin birbirine yakın olması, seçilen örneklemin rastgele alınmasından kaynaklanabilecek olumsuzlukları en aza indirmiştir. Örneklemde yer alan öğrencilerin dağılımı Tablo 1'de verilmiştir.

Tablo 1. Öğrencilerin Dağılımı

Şube	Öğrenci Sayısı (n)	Kız	Erkek
9-A	22	13	9
9-C	24	11	13

Veri Toplama Araçları

Veri toplama sürecinde ölçme aracı olarak "Kavram Testi", "Görüşmeler", "Kamera Kayıtları", "Öğrenci Kılavuzları" ve "Anlam Çözümleme Tabloları"ndan yararlanılmıştır.

Kavram Testi

Bu çalışmada kullanılan kavram testinin amacı; kavram yanılgılarının giderilmesinde uygulanan öğretim sürecinin öğrencilerin kavramsal değişimlerini nasıl etkilediğini ortaya çıkarmaktır. Driver ve Erickson (1983), öğrencilerin düşünce biçimlerini ortaya koymada kullanılan yaklaşımları kavramsal (conceptual) ve olaysal (phenomenologically) çerçeve olarak iki farklı boyutta ele almıştır. Kavramsal çerçevenin kullanıldığı yaklaşımlarda; öğrencilerden, verilen herhangi bir kavram ile ilgili açıklama yapmaları veya bunu herhangi bir yazılı testte bir ya da birden fazla cümle içinde kullanmaları istenmektedir. Olaysal çerçeve temelli yaklaşımlarda ise öğrencilere, incelenen kavramla ilgili fiziksel bir sistem ya da bir olay sunularak bir sonuca ulaşmaları ve bu sonucu doğrulamaları istenmektedir.

Kavramsal çerçeve temelli sorular; önceden öğretilmiş ya da öğretilmekte olan belli konuların öğrenciler tarafından ne derece iyi kullanıldığını ortaya çıkarmayı amaçlamaktadır. Olaysal çerçevede yazılan sorularda ise öğrencilerin okulda öğrendikleri ve günlük deneyimler ile kazandıkları bilgilerden hangilerini nasıl kullandıklarını keşfetmek ve günlük deneyimleri içeren bilgilerin ne derece uygun kullanıldığını belirlemek amaçlanmaktadır (Kocakülah, 2006). Araştırmada; görsel olması, öğrencilerin ilgisini çekmesi ve daha kapsamlı veriler elde edilmesine imkân vermesi nedeniyle olaysal temelli sorular tercih edilmiştir.

Testte düzlem aynalara yönelik 5, çukur aynalara yönelik 2, tümsek aynalara yönelik 2 ve görüntü çeşitleri ile ilgili 1 adet olmak üzere toplam 10 adet olaysal temelli soru yer almaktadır (EK – A). Düzlem ayna konusu ile ilgili soruların daha fazla olmasının nedeni, daha önce yapılan çalışmalarda düzlem ayna konusu ile ilgili olarak öğrencilerde belirlenen kavram yanılgılarının diğer konular ile karşılaştırıldığında daha fazla olmasıdır. Ayrıca düzlem ayna konusunun içeriğinde; "Görüş Alanı", "Kesişen Aynalar" ve "Paralel Aynalar" konularının da yer alması düzlem ayna konusu ile ilgili daha fazla sorunun kavram testinde yer almasının bir başka nedenidir. Soruların 9 tanesi açık uçlu, 1 tanesi ise çoktan seçmeli soru tipindedir. Çoktan seçmeli soruda, öğrencilerden işaretledikleri yanıtların nedenini de yazmalarının istendiği ayrı bir bölüm yer almaktadır.

Kavram testi; konu ile ilgili olarak yapılan çalışmalardan, üniversitelerin internet sayfalarında yer alan optik konusuna ait sorulardan ve kaynak kitaplardan faydalanılarak oluşturulan soru bankası içerisinden kapsama uygun olaysal temelli soruların seçilmesi ile oluşturulmuştur. Kavram testinde yer alan soruların seçiminde, konu ile ilgili olarak daha önce yapılan çalışmalarda kullanılan sorulardan faydalanılması, kavram testinin iç geçerliğinin sağlanmasına olumlu katkıda bulunmuştur.

Kavram testlerinde yer alan soruların açık uçlu kısımlarının analizinde araştırmacıdan kaynaklanabilecek bir takım yanılgıların giderilmesi maksadıyla aynı alanda çalışan bir başka araştırmacı tarafından elde edilen verilerin kodlanması gerekmektedir (Kabapınar, 2003). Bu süreçte öncelikle ikincil araştırmacı ile birlikte kavram testinde yer alan sorular ile ilgili kategori tabloları (görüntü oluşumu, görüş alanı, görüntü özellikleri vb.) oluşturulmuştur. Çalışma grubunun ortalama % 50'lik kısmı (23 öğrenci) rastgele seçilmiş ve teste verdikleri yanıtlar Tablo 2'de verilen sayısal değerlendirme ölçütü yardımıyla değerlendirilmiştir (Kocakülah, 1999).

Tablo 2. Dereceli Puanlama Anahtarı

Sayısal Değer veya Kavramın Öğrenilmiş Olma Derecesi		Değerlendirmede Kullanılan Ölçüt
Yanıt yok	0 Puan	Kavram hiç yok.
Kodlanamaz Yanıt	1 Puan	Verilmesi istenen yanıtın tamamen tersi cevaplar veya yanlış kavramlar var.
Bilimsel Olarak Kabul Edilemez Yanıt	2 Puan	Hatalar ve kavram yanılgıları var.
Kısmi Yanıt	3 Puan	Kavram kısmen öğrenilmiş.
Tam Yanıt	4 Puan	Kavramın tüm parçaları var, cevap bilimsel olarak kabul edilebilir.

Son aşamada araştırmacının ve uzmanın değerlendirmeleri karşılaştırılmış ve her bir soru için tutarlılık yüzdesi aşağıdaki bağıntıya göre hesaplanmıştır (Yurdakul, 2008).

$$p = \frac{N_a\, x100}{N_t}$$

p: Tutarlılık yüzdesi

N_a : İki kodlamada aynı şekilde kodlanan öğrenci sayısı

Kavram testinde yer alan soruların araştırmacı ve ikincil araştırmacı tarafından değerlendirilmesi sonucu elde edilen tutarlılık yüzde sonuçları Tablo 3'de verilmiştir.

Tablo 3. Araştırmacı ve İkincil Araştırmacı Tarafından Yapılan Değerlendirmelere İlişkin Tutarlılık Yüzdeleri

Soru Numarası	p (Tutarlılık Yüzdesi)	Ortalama p
1	0,92	0,889
2	0,85	
3	0,90	
4	0,96	
5	0,82	
6	0,80	
7	0,94	
8	0,92	
9	0,86	
10	0,92	

Tablo 3'de görüldüğü gibi sorulara ilişkin tutarlılık yüzdelerinin ortalaması % 88,9'dur. Bu durumda; kavram testinden elde edilen sonuçların araştırmacının kendi görüşlerinden ziyade elde edilen verilere dayandığı söylenebilir.

Görüşmeler

Görüşme sürecinin öğrencilerin verdikleri yanıtlar doğrultusunda daha esnek bir biçimde yapılandırılmasına ve öğrencilerle gerçekleştirilen tartışmalar doğrultusunda görüşmeye yeni bir yön verilebilmesine imkân sağladığı için bu aşamada yarı yapılandırılmış görüşme tekniği tercih edilmiştir. Öğretim sürecinin sonunda uygulanan bu görüşme ile öğrencilerin aynalar konusuna ilişkin düşünce biçimleri ve kavramsal değişim sürecine olarak daha detaylı ve derinlemesine bilgi edinebilmek amaçlanmıştır.

Araştırmanın iç geçerliğini sağlamak anlamında, görüşülen bireylerden doğrudan alıntılara yer verilmiş ve daha sonra bu veriler yorumlanmıştır. Görüşme formunda yer alan sorular; öğrencilerin kavram testinin ilk ve son uygulamasına vermiş oldukları yanıtlar incelenerek her öğrenci için ayrı ayrı belirlenen sorulardan oluşmaktadır. Görüşme formları, "düzlem ayna, tümsek ayna, çukur ayna" alt başlıklarında toplanmış sorulardan oluşmaktadır. Görüşmede yer alan soruların bir bölümü araştırmacı tarafından geliştirilmiş, bir bölümü ise Kocakülah'ın (2006) çalışmasından alınarak yeniden düzenlenmiştir (EK – B).

Kamera Kaydı

Kamera kayıtlarından, öğrencilerin kavramsal değişim sürecini takip edebilmek ve bu süreçteki düşünce biçimlerini net olarak ortaya koymak amacıyla yararlanılmıştır. Araştırma sürecinde; 3 öğrenciden oluşan iki farklı öğrenci grubunu (2 adet) ve tüm sınıfı kayıt altına alan (1 adet) toplam 3 kamera kullanılmıştır. Toplam kayıt süresi 300 dakika sürmüştür. Elde edilen tüm kamera kayıtları araştırmacılar ve eğitim uzmanları tarafından izlenmiş ve kavramsal değişim sürecinde yararlanılabileceği düşünülen öğrenci ifadeleri yazılı dokümana dönüştürülmüştür. Elde edilen verilerden ve öğrencilerin diğer veri toplama araçlarına (kavram testi, görüşmelere vb.) verdikleri yanıtlardan yararlanılarak kavramsal değişim sürecine ilişkin sonuçlara ulaşılmıştır.

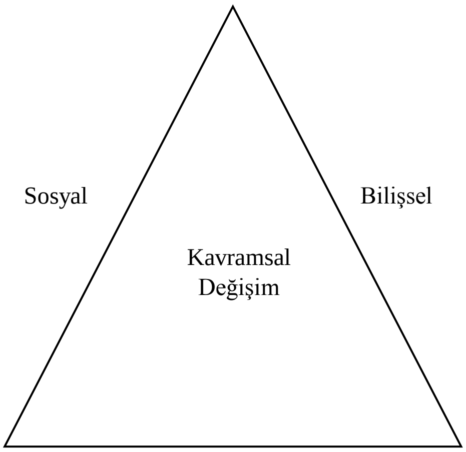
Öğrenci Kılavuzları ve Anlam Çözümleme Tabloları

Öğretim sürecinde yer alan etkinliklerin aşamalılık ilişkisini ayrıntılı olarak ifade edebilmek ve öğrenciler tarafından anlaşılmasını kolaylaştırmak amacıyla öğrenci kılavuzları oluşturulmuştur. Öğrenci kılavuzlarında; öğretim modelinin farklı aşamalarında kullanılmak üzere hazırlanan, toplam 20 etkinlik yer almaktadır. Öğrenciler etkinlikler ile ilgili düşüncelerini, elde ettikleri değerleri ve çözümlerini bu kılavuzlara aktarmışlardır. Öğrenci kılavuzları; öğrencinin derste aktif olmasına, bilgiyi yapılandırabilmesine ve grup arkadaşları ile etkileşmesine de yardımcı olmaktadır.

Öğrenci kılavuzlarında, öğretim sürecinde gerçekleştirilen uygulamaların yeterliliğini ölçmek ve öğrencilerin kavramsal değişim düzeylerini belirleyebilmek amacıyla anlam çözümleme tablolarına yer verilmiştir. Anlam çözümleme tablolarında yer alan soruların seçiminde, konu ile ilgili olarak daha önce yapılan çalışmalarda kullanılan sorulardan faydalanılarak, iç geçerliğinin sağlanmasına katkıda bulunulmuştur. Kavramların analizine yönelik olarak iki boyutlu bir tablo şeklinde geliştirilen bu aracın; bir boyutunda özellikleri çözümlenecek kavramlar, diğer boyutunda ise özellikler yer almaktadır.

Verilerin Analizi:

Kavramsal değişim süreci değerlendirilirken "Çok Boyutlu Kavramsal Değişim Yapısı"ndan yararlanılmıştır. "Ontolojik", "bilişsel" ve "sosyal" olarak üç farklı alandan oluşan yapı şekil 3'de verilmiştir (Tyson, Venville, Harrison ve Treagust, 1997).



Şekil 3. Çok Boyutlu Kavramsal Değişim Yapısı

Ontolojik bakış açısı öğrencilerin dış dünyayı nasıl algıladıkları ile ilgilenir. Bilişsel bakış açısı; öğrencilerin dış dünyaya ait algılarını nasıl ifade ettikleri, kavramlara ilişkin ne tür teoriler, düşünceler ve yargılar geliştirdikleri ile ilgilidir. Sosyal bakış açısı ise kavramsal değişim için gerekli olan sosyal koşullar ile ilgilenir.

Araştırmada, çok boyutlu kavramsal değişim yapısının "bilişsel bakış açısı" ön plana çıkmaktadır. Bu bakış açısı; Posner ve arkadaşları (1982) tarafından geliştirilen "Kavramsal Değişim Teorisi"ni temele almaktadır. Kavramsal değişim için gerekli koşulları dikkate alarak Thorley (1990) tarafından geliştirilen "Durum Analiz Kategorileri" ise elde edilen verilerin değerlendirilmesi sürecinde kullanılmıştır.

Tablo 4. Durum Analiz Kategorileri.

Kavramların Durumları	Alt Kategoriler (Üst Aşama)
Anlaşılırlık	Anlatımsal Modlar
	- Görüntü (Kavramların sunumunda grafik ve resimlerden yararlanabilme.)
	- Örnek Verme (Günlük yaşama ilişkin örnekler verebilme.)
	- Dil (Sözle veya semboller yardımıyla kavramı ifade edebilme.)
Akla Yatkınlık	Tutarlılık Faktörleri
(Makul Olma)	- Diğer Bilgi (Diğer bilgi ve kavramlar ile tutarlılık)
	- Laboratuar Deneyimi (Laboratuar deneyimleri ve gözlemler ile olan tutarlılık)
	- Geçmiş Deneyimler (Kavram ile ilgili geçmişte yaşanan özel olaylar)
	- Bilişsel Yapı (Bilişsel veriler ile olan tutarlılık)
	- Doğa Ötesi (Nesne ve düşüncelerin ontolojik durumlarına başvurmak)
	- Akla Yatkın Benzetmeler (Diğer kavramların yardımına başvurmak)
	- Gerçek İşleyiş (Nedensel işleyişin yardımına başvurmak.)

Yararlılık	- Güç (Kavramın geniş bir uygulama alanına sahip oluşu)
(Verimlilik)	- Umut Verici İfadeler (Kavram ile ilgili beklentiler, yeni kavram ile neler yapılabileceği.)
	- Rekabet (Kavramları yarıştırmak, karşılaştırmak.)

Durum analiz kategorileri yardımıyla gerçekleştirilen veri analizi sürecinde; öğrencilerin görüşmelere ve kavram testine verdikleri yanıtlardan, öğrenci kılavuzlarında ve anlam çözümleme tablolarında yer alan öğrenci ifadelerinden ve kamera kayıtlarından yararlanılmıştır.

BULGULAR

Bu bölümde; öğrencilerin kavramsal değişim süreçleri; "*Anlaşılırlık", "Akla Yatkınlık"* ve *"Yararlılık"* boyutları çerçevesinde analiz edilmiştir.

Anlaşılırlık

Kavramsal değişim sürecinde; bilimsel olmayan kavramların yerini bilimsel kavramların alabilmesi için sağlanması gereken koşullardan birisi yeni kavramın "*anlaşılır"* olmasıdır. Anlaşılır olmayan kavram öğrenci tarafından içselleştirilemez ve doğru anlamlandırılamaz (Bransford, Brown, ve Cocking, 2000).

Kavramsal değişim süreci "anlaşılırlık" kategorisi kapsamında değerlendirilirken 3 farklı alt kategoriden yararlanılmıştır. Tablo 5'de bilimsel kavramların *"anlaşılırlık"* düzeyi ile ilgili alt kategorilerin (görüntü, örnek verme, dil) gözlemlenme derecelerine ait veriler sunulmuştur. Tablodaki veriler; yanıtlarında "anlaşılırlık" düzeyinin alt kategorilerinden yararlanan 7 farklı öğrenciye aittir.

Tablo 5. "Anlaşılırlık" Düzeyinin Alt Kategorilerine ait Veriler

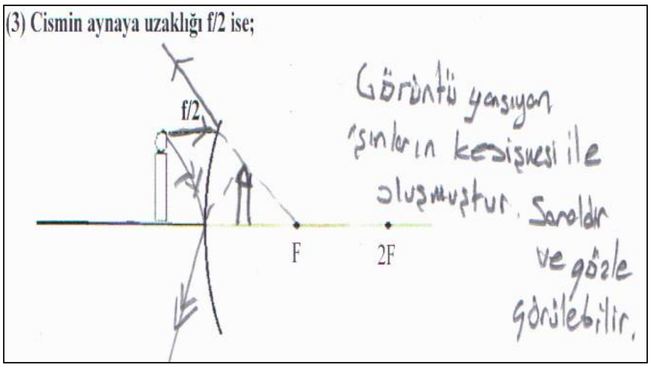
Alt Kategoriler	**Kavramların Anlaşılırlığı**						
	Öğ. 1	Öğ. 2	Öğ. 4	Öğ. 5	Öğ.8	Öğ. 9	Öğ.11
Görüntü	+	+		+			+*
Örnek Verme		+*	+		+	+	
Dil	+*	+*	+	+	+	+	+*

\+ *: Alt kategoriye ait davranışın öğretim süreci sonunda gözlemlendiğini ifade etmektedir.*
+* *: Alt kategoriye ait davranışın öğretim sürecinin öncesinde ve sonrasında gözlemlendiğini ifade etmektedir.*

Görüntü

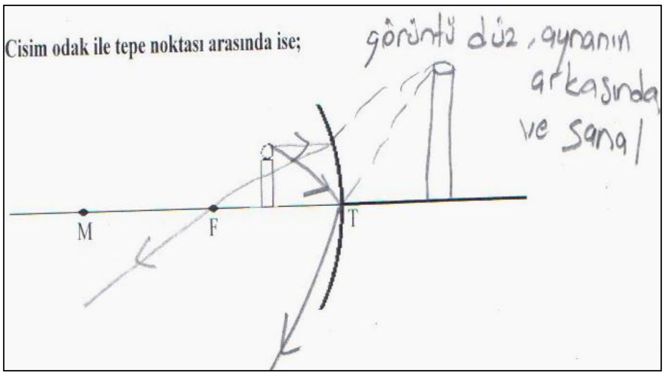
Öğrenciler bilimsel kavramların sunumu sürecinde grafik ve resimlerden yararlanmaktadırlar. Yeni kavrama ilişkin olarak grafik ve resimler yardımıyla yaptıkları açıklamalar yeni kavramı anlaşılır bulduklarını ortaya koymaktadır. Bu alt kategoriye örnek olarak öğrenci 2'nin öğretim öncesinde ve öğretim sonrasında sahip olduğu düşünceler aşağıda sunulmuştur.

Öğrenci 2 öğretim süreci öncesinde sanal kavramı ile ilgili olarak; *"Sanal görüntü düzdür ve cisimle aynı boydadır. Görüntünün gerçek olduğunu ise ters olmasından anlarız"* düşüncesine sahiptir. Öğretim süreci sonunda sanal kavramı ile ilgili olarak; *"Görüntü türleri aynadan yansıyan ışınların kesiştiği yer ile ilgilidir. Örneğin gerçek görüntü yansıyan ışınların aynanın önünde kesişmesi ile oluşmaktadır. Sanal görüntü ise yansıyan ışınların uzantılarının aynanın arkasında kesişmesi ile oluşur, gözle görülebilir"* şeklinde bir açıklama getirmiştir. Bu düşüncesini; öğrenci kılavuzunda yer alan ve şekil 4'de verilen tümsek aynada görüntü oluşumu ile ilgili çizimi ile desteklemektedir.



Şekil 4. Öğrenci 2'ye Ait Tümsek Aynada Görüntü Çizimi.

Öğrenci 5 ise öğretim süreci öncesinde; *"Çukur aynalarda oluşan görüntüler gerçektir"* düşüncesine sahiptir. Öğretim süreci sonunda ise çukur aynalarda oluşan görüntülerin türleri ile ilgili olarak; *"Çukur aynalarda gerçek ve sanal görüntüler oluşabilir. Görüntünün aynanın önünde oluştuğu durumlarda görüntü gerçektir. Görüntü aynanın arkasında oluşması durumunda ise görüntü sanaldır."* şeklinde bir açıklama getirmiştir. Bu düşüncesini; öğrenci kılavuzunda yer alan ve şekil 5'de verilen çukur aynada görüntü oluşumu ile ilgili çizimi ile desteklemektedir.



Şekil 5. Öğrenci 5'e Ait Çukur Aynada Görüntü Çizimi.

Görüldüğü gibi öğrenciler kavramsal değişim sürecinde bilimsel kavram ve açıklamaların *"anlaşılabilirliğini"* çizimleri ile desteklemektedirler.

Örnek Verme

Öğrenciler bilimsel kavramların sunumu sürecinde günlük yaşama ilişkin örneklerden yararlanmaktadırlar. Bu aşamada öğrenciler; arkadaşları, aileleri ve çevreleriyle olan etkileşimleri sonucunda ortaya çıkan günlük yaşama ilişkin deneyimlerini aktararak bilimsel kavram ve düşünceleri *"anlaşılır"* bulduklarını ifade etmektedirler.

Öğrenci 9 görüşme sorusuna; *"Bu derslerden sonra çevremde gördüğüm aynaları daha fazla inceledim. Örneğin; alışveriş merkezinde gördüğüm bir ayna vardı. Bu aynada görüntümün nasıl oluştuğunu kendim açıklamaya çalıştım. Tümsek bir aynaydı, çünkü oluşan görüntüler düz ve küçüktü"* yanıtını vermiştir.

Öğrenci 4 ise aynalar konusu ile ilgili bir görüşme sorusuna; *"Günlük yaşamda birçok alanda küresel aynaları kullanıyoruz. Örneğin; çukur aynalar var makyaj yapmak için kullanılan. Yollarda göremediğimiz bölgeleri gösteren büyük tümsek aynalar var. Önceden bu kadar dikkat etmiyordum bu tür şeylere; derste öğrendiklerimden sonra daha çok dikkatimi çekiyor"* yanıtını vermiştir. Görüldüğü gibi öğrenciler yeniden yapılandırdıkları kavramlara ilişkin olarak günlük yaşam ile ilgili birçok örnek verebilmektedir. Bu açıklamalar öğrencilerin bilimsel kavram ve düşünceleri *"anlaşılır"* bulduklarına ilişkin veriler sunmaktadır.

Dil

Öğrenciler bilimsel kavramların sunumu sürecinde söz ve sembollerden yararlanmaktadırlar. Bu aşamada öğrenciler; bilimsel kavram ve düşünceleri kendi ifadeleri ile açıklamaya çalışmışlardır.

Öğrenci 8 aynalar konusu ile ilgili görüşme sorusuna ise; *"Çukur aynalarda birçok görüntü oluşur. Bazı görüntüler cisimden büyüktür, bazıları ise küçüktür. Örneğin; cisim F (odak) ile T (tepe noktası) arasında ise görüntü cisimden büyüktür. Cisim M'nin (merkez) dışında ise oluşan görüntü cisimden küçüktür"* yanıtını vermiştir. Görüldüğü gibi öğrenci 8 kavramları açıklama sürecinde sözlü ifadelerin yanı sıra sembollerden de yararlanmıştır.

Öğrenci 11 ise görüşme sorusuna; *"Tümsek aynalara ne kadar uzaktan bakarsak bakalım görüntü cisimden küçüktür. Görüntü her zaman aynanın arkasında ve F (odak) ile T (tepe noktası) arasında oluşur. Büyük alışveriş merkezlerinde de bu tür aynalardan gördüm. Onlarda cisimleri olduğundan daha küçük gösteriyordu"* şeklinde yanıt vermiştir. Öğrenci 11; bilimsel kavram ve düşünceleri kendi ifadeleri ile açıklamış, bu açıklamada sembollerden ve günlük yaşama ilişkin deneyimlerden de yararlanmıştır.

Akla Yatkınlık

Kavramsal değişim sürecinde; bilimsel olmayan kavramların yerini bilimsel kavramların alabilmesi için sağlanması gereken koşullardan birisi yeni kavramın *"akla yatkın"* olmasıdır. Kavramsal değişim süreci "akla yatkınlık" kategorisi kapsamında değerlendirilirken 7 farklı alt kategoriden yararlanılmıştır. Tablo 6'da bilimsel kavramların *"akla yatkınlık"* düzeyi ile ilgili alt kategorilerin (diğer bilgi, laboratuar deneyimi, geçmiş deneyimler, bilişsel yapı, doğa ötesi, akla yatkın benzetmeler) gözlemlenme derecelerine ait veriler sunulmuştur. Tablodaki veriler; yanıtlarında *"akla yatkınlık"* düzeyinin alt kategorilerinden yararlanan 9 farklı öğrenciye aittir.

Tablo 6. "Akla Yatkınlık" Düzeyinin Alt Kategorilerine ait Veriler

Alt Kategoriler	**Kavramların Akla Yatkınlığı**								
	Öğ. 2	Öğ. 3	Öğ. 5	Öğ. 6	Öğ.8	Öğ. 9	Öğ.11	Öğ.14	Öğ.16
Diğer Bilgi	+			+	+		+	+*	+*
Lab. Deneyimi		+*	+		+	+			
Geçmiş Deneyimler	+				+		+*		+*
Bilişsel Yapı		+	+*	+				+	
Doğa Ötesi				+		+			
Akla Yatkın Benzetmeler	+	+*	+*			+			+
Gerçek İşleyiş	+*		+	+	+*		+*	+	

+ *: Alt kategoriye ait davranışın öğretim süreci sonunda gözlemlendiğini ifade etmektedir.*
+* *: Alt kategoriye ait davranışın öğretim sürecinin öncesinde ve sonrasında gözlemlendiğini ifade etmektedir.*

Diğer Bilgi:

Öğrenciler bilimsel kavramların sunumu sürecinde; yeniden yapılandırılan kavramın diğer bilgi ve kavramlar ile olan tutarlılığından yararlanmaktadırlar. Bilimsel kavramın diğer kavramlarla olan ilişkisini ifade ederek, yeni kavramı akla yatkın bulduklarını vurgulamışlardır.

Öğrenci 6 görüşme sorusuna; *"Görüntü türü, yansıyan ışınların aynanın önünde veya arkasında kesişmesi ile ilişkilidir. Görüntülerin düz veya ters olması ile görüntü türü arasında ilişki yoktur. Bu durum aynanın çeşidine bağlıdır. Örneğin çukur aynalarda görüntünün yönü ile cismin yönü farklı olabilir. Tümsek ve düzlem aynalarda ise cisim düz ise görüntü düz, cisim ters ise görüntü ters olarak oluşur"* şeklinde yanıt vermiştir. Öğrenci 6 yanıtında; "görüntünün yönü", "aynanın türü" ve "görüntünün türü" kavramları arasındaki ilişkiye değinerek, kavramlar arasındaki tutarlılık durumunu etkili bir biçimde vurgulamıştır.

Öğrenci 11 ise görüşme sorusuna; *"Aynaya baktığımda görüntüyü aynanın arkasında görebiliyorsam o görüntü sanaldır. Tümsek aynalara baktığımda da görüntüyü aynanın arkasında görebildiğim için görüntü sanal bir görüntüdür. Çukur aynalarda oluşan görüntüleri aynanın önünde gözlemleyebiliyorum. Bu tür görüntüler ise gerçek görüntüdür"* şeklinde yanıt vermiştir. Görüldüğü gibi öğrenci 11; görüntü çeşidi ile aynanın türü arasında ilişkiyi açıklamış ve bu kavramlar arasında bağlantı kurarak bilgiler arasındaki tutarlılığı vurgulamıştır.

Laboratuar Deneyimi

Öğrenciler bilimsel kavramların sunumu sürecinde laboratuar deneyimlerinden ve gözlemlerinden yararlanmışlardır. Bilimsel kavrama ilişkin olarak deney ve gözlemler yardımıyla elde edilen veriler; öğrenilen bilginin akla yatkınlığını açıklamak amacıyla kullanılmıştır.

Öğrenci 9 görüşme sorusuna; *"Çukur ayna ile ilgili yaptığımız etkinlikte (etkinlik 11) cismin ve görüntünün yerini değiştirebiliyorduk, bu çok eğlenceliydi. Bundan hoşlandım. Daha önce bu görüntüleri kitaplarda görüyordum, fakat laboratuarda görüntüleri ben oluşturdum. Bence bu şekilde öğrenmek daha iyi."* şeklinde yanıt vermiştir. Öğrencinin yanıtında da açık bir şekilde vurgulandığı gibi laboratuar deneyimleri öğrencilerin bilimsel kavramı akla yatkın bulmalarında etkin bir role sahiptir.

Öğrenci 5 ise görüşme sorusuna; *"Laboratuarda yaptığımız bir uygulama (etkinlik 6) vardı. Aynalar arasındaki açı değerlerini değiştirerek, oluşan görüntülerin sayısını buluyorduk. Daha önce görüntü sayısını formülle buluyordum, ezberliyordum yani. Bu etkinlikte ise farklı açı değerleri için aynalarda oluşan görüntüleri gözlemleyebildim"* şeklinde yanıt vermiştir. Görüldüğü gibi öğrenci 5 kavramların akla yatkınlığını açıklarken, laboratuarda gerçekleştirilen deney ve etkinliklerin önemine vurguda bulunmuştur.

Geçmiş Deneyimler

Öğrenciler bilimsel kavramların sunumu sürecinde geçmiş deneyimlerinden yararlanmışlardır. Bilimsel kavrama ilişkin olarak öğretim öncesinde ve sonrasında sahip oldukları düşünceleri; kavramın akla yatkınlığını açıklamak amacıyla kullanmışlardır.

Öğrenci 2 görüşme sorusuna; "Daha önce bazı şeyleri ezbere biliyordum. Mesela odak noktasının yerini, ışınların nasıl yansıdığını… Bu derslerde; odak noktasının nasıl bulunduğunu, yansıma kurallarını kendim deneyler yaparak daha iyi öğrendim. Örneğin; "sanal görüntü"yü daha iyi anlayabildim, önceden bu kavrama tam olarak anlam veremiyordum" şeklinde yanıt vermiştir. Görüldüğü gibi öğrenci; geçmiş deneyimlerinde doğru bir şekilde anlamlandıramadığı kavramları öğretim sürecinde akla yatkın bulmaya başlamıştır. Öğrenci 2'nin yer aldığı grubun kamera kayıtları incelendiğinde ise öğrencinin grupta yer alan arkadaşı ile ışınların yansıması ve odak noktasının belirlenmesi ile ilgili konuştuğu görülmektedir.

Öğrenci 2: Işınlar hep aynı noktadan geçiyor.
Öğrenci 4: Evet.
Öğrenci 2: Bu nokta odak noktası değil mi?
Öğrenci 4: Paralel ışınlar odaktan geçecek şekilde yansır.
Öğrenci 2: Sende bir paralel bir ışın göndersene… İkimizin ışınları nerede kesişecek bakalım?
Öğrenci 4: Bak bu noktada kesişiyor.
Öğrenci 2: Bu nokta odak noktası değil mi?
Öğrenci 4: Evet.
Öğrenci 2: Aynaya paralel gelen ışınların toplandığı yer aynanın odak noktası oluyor, değil mi?
Öğrenci 4: Evet
Öğrenci 2: Bak bunu bilmiyordum, şimdi anladım.

Kamera kayıtlarında yer alan açıklamalarında öğrenci 2; geçmiş deneyimlerinde doğru bir şekilde anlamlandıramadığı odak noktası kavramını arkadaşı ile birlikte gerçekleştirdiği etkinlik sonunda anlayabildiğini ifade etmektedir. Öğrenci; bilimsel kavrama ilişkin olarak öğretim öncesinde ve sonrasında sahip olduğu düşüncelerini ifade ederek kavramın *akla yatkınlığına*, bilimsel kavram ve düşünceleri kendi ifadeleri ile açıklayarak *(dil alt kategorisi)* kavramın *anlaşılırlığına* vurguda bulunmaktadır.

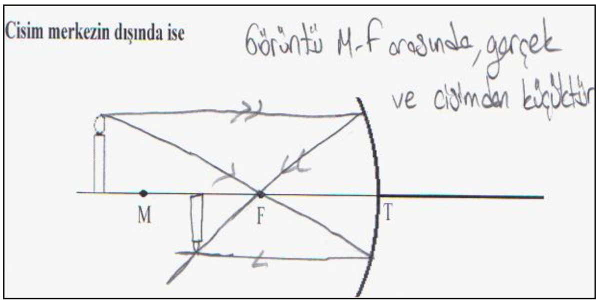
Öğrenci 8 ise görüşme sorusuna; *"Ortaokulda aynalar konusunu görmüştük. O zaman tahtaya yazılanlar ve formüller aklıma yatmıyordu. Öğrendiklerimin nasıl gerçekleşebileceğini zihnimde canlandıramıyordum. Ama laboratuarda yaptığım deneylerden ve etkinliklerden sonra aynalar ile ilgili bir şey söylendiğinde, öğrendiğim bilgiler gözümde canlanıyor. Öğrendiklerim aklıma daha çok yatıyor"* şeklinde yanıt vermiştir. Öğrenci geçmiş deneyimleri ile şimdiki deneyimlerini karşılaştırmış; laboratuar sürecinde gerçekleştirdiği uygulamalar yardımıyla bilimsel kavramları "akla yatkın" bulduğunu vurgulamıştır.

Bilişsel Yapı

Thorley (1990) bilişsel yapı kavramı ile bilimsel veriler ile olan tutarlılığı ifade etmeye çalışmaktadır. Bu süreçte çoğu kez bilimsel teorilerin deneysel kanıtlarının önemi vurgulanmaktadır.

Öğrenci 14 görüşme sorusuna; *"Derste; kendimiz gözlem yaptığımız için daha iyi anlıyoruz. Daha önce öğretmen anlatıyordu, biz dinliyorduk. Şimdi bilgiye biz ulaşıyoruz. Örneğin; lazerleri kullanarak yaptığım deneyde, çukur aynalardaki özel ışınların yansımalarını gözlemleyebildim"* yanıtını vermiştir. Öğrenci; bilimsel kavramların deneysel kanıtları yardımıyla kavramın akla yatkınlığına vurguda bulunmaktadır. Öğrenci, derste ulaştığı bilginin bilimsel veriler (çukur aynalarda özel ışınların yansıma kuralları) ile olan tutarlılığını deneysel süreç içerisinde kendisi ispatlamıştır.

Öğrenci 3 ise ulaştığı bilginin bilimsel veriler ile olan tutarlılığını öğrenci kılavuzunda yer alan çizimi ile desteklemektedir. Şekil 6'da yer alan çizimde, öğrencinin çukur aynalarda görüntü oluşumu sürecine ilişkin deneysel veriler yer almaktadır.



Şekil 6. Öğrenci 3'e Ait Çukur Aynada Görüntü Çizimi.

Öğrencinin öğretim sürecinde gerçekleştirdiği uygulamalar yardımıyla öğrenci kılavuzuna yapmış olduğu çizim; çukur aynalarda "görüntü oluşumu", "görüntü türü" ve "görüntü özellikleri"ne ilişkin olarak elde edilen deneysel verilerin, bilimsel gerçekler ile olan tutarlılığını ispatlar niteliktedir. Bu durum; öğrencinin bilimsel kavramların akla yatkınlığını açıklayabilmesi sürecine olumlu katkı sağlamaktadır.

Doğa Ötesi

Doğa ötesi kavramı; nesne ve inanışların ontolojik (öğrenciler tarafından algılanma şekli) konumları ile ilişkilidir (Thorley, 1990). Çok az görüşmecide "doğa ötesi" alt kategorisinde değerlendirebileceğimiz ifadelere rastlanmıştır.

Öğrenci 6 görüşme sorusuna; *"Görüntü aynaya gelen ışınların yansıması ile oluşur. Yansıyan ışınlar kesişmek isterler. Aynanın önünde kesişebilirlerse görüntü gerçek olur. Aynanın önünde kesişemezlerse arkasında kesişmeye çalışırlar. Arkada kesişirlerse bu görüntü de sanal olur"* şeklinde yanıt vermiştir. Görüldüğü gibi öğrenci; ışınları düşünen ve bazı istekleri olan varlıklar gibi betimlemektedir. Öğrenci 2 ışınları bu şekilde algılamakta ve bu düşünüş şekli bilimsel kavramları "akla yatkın" bulmasına yardımcı olmaktadır.

Öğrenci 9 ise görüşme sorusuna; *"Çukur aynada cisim sonsuz ile odak arasında hareket ederken görüntüde odak ile sonsuz arasında hareket eder. Görüntü ve cismin buluşma noktası merkezdir. Burada ikisinin büyüklüğü birbirine eşit olur. Görüntü ve cisim buluşma noktası (merkez) dışında birbirlerinden ayrıldıklarında aynaya uzak olanın büyüklüğü diğerinden fazla olmaktadır"* yanıtını vermiştir. Öğrenci; cisim ve görüntüyü ontolojik konumları ile değerlendirmekte ve onlara anlamlar yüklemektedir. Cisim ve görüntüye yüklemiş olduğu roller; bilimsel kavramların akla yatkınlığını desteklemekte ve öğrencinin çukur aynada görüntü oluşumu sürecini daha kolay anlamlandırabilmesine yardımcı olmaktadır.

Akla Yatkın Benzetmeler

Öğrenciler bilimsel kavramların sunumu sürecinde benzetmelerden yararlanmışlardır. Bilimsel kavrama ilişkin olarak yaptıkları benzetmeleri kavramın akla yatkınlığını açıklamak amacıyla kullanmışlardır.

Öğrenci 2 görüşme sorusuna; *"Ortaokulda mercekleri görmüştük. Çukur aynada oluşan görüntüler ince kenarlı merceğe çok benziyor. Örneğin; çukur aynada cisim merkezin dışında ise görüntü merkez ile odak arasındadır. Cisim merkeze doğru yaklaştıkça görüntü aynadan uzaklaşır. Aynı ince kenarlı merceklerde olduğu gibi..."* şeklinde yanıt vermiştir. Burada öğrenci; çukur aynalarda oluşan görüntülerin özelliklerini sıralarken, çukur ayna ile ince kenarlı mercek arasında benzetme yapmıştır. Bu benzetme çukur ayna konusuna ilişkin görüntü özelliklerinin akla yatkınlığını destekler niteliktedir.

Öğrenci 16 ise görüşme sorusuna; *"Tümsek aynalarda görüntü her zaman ayna ile odak arasındadır. Cisimden küçüktür. Kalın kenarlı merceklerde de bu şekilde olduğunu hatırlıyorum. Görüntü her zaman mercek ile F arasındaydı. Ama mercek ışınları kırıyordu, aynalar ise yansıtır"* şeklinde yanıt vermiştir. Burada kalın kenarlı mercek ile tümsek ayna arasında bir benzetme yapılmıştır. Öğrencinin yapmış olduğu benzetme bilimsel kavramların akla yatkınlığını destekler niteliktedir.

Öğrenci 2 ve öğrenci 16; "ışığın ince ve kalın kenarlı merceklerde kırılması", "yansıma ve kırılma olaylarının benzerlik ve farklılıkları", "merceklerin yapısı", "merceklerde görüntü oluşumu" ve "ince ve kalın kenarlı merceklerin kullanım alanları" konularına yönelik olarak ilköğretim sürecinde aldıkları konu içeriklerine atıfta bulunarak açıklamalar yapmışlardır. Öğrenci 2 ve öğrenci 16'nın görüşme sorularına verdiği yanıtlarda görüldüğü gibi; öğrenciler ilköğretim sürecinde merceklere ilişkin olarak edindikleri bilgileri ortaöğretim sürecine taşımışlar, aynalar ve mercekler arasında "ışınlar" ve "görüntü oluşumu" konularında göze çarpan ortak noktaları "mercekler" ile "aynalar" arasında benzetme yapabilmek amacıyla kullanmışlardır. Öğrencilerin aynalar ve mercekler arasında yaptıkları benzetmeler, aynalar konusunda kazandıkları bilimsel kavramların "akla yatkınlığına" vurguda bulunmaktadır.

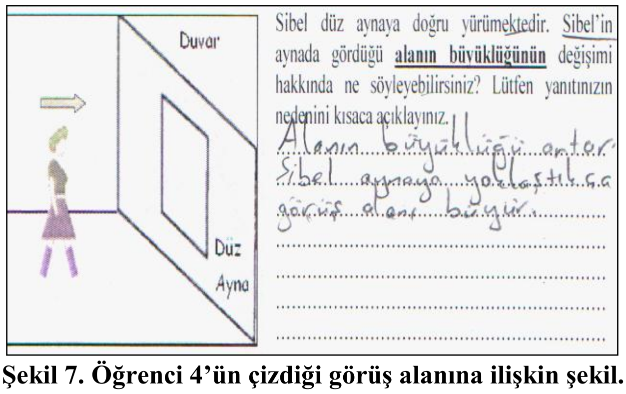
Gerçek İşleyiş

Bu kavram; bir olgu için nedensel işleyişi ifade eder. Gerçeklik boyutunda bir bakış açısıdır (Thorley, 1990). Çalışmada; bu alt kategori ile ilgili olarak öğrencilerin gerçeğe çok yakın açıklamalarına ve çizimlerine yer verilmiştir. Bu açıklamalar ve çizimler küçük eksiklikler dâhilinde bilimsel açıklamaları içermekte ve bilimsel kavramların akla yatkınlığını desteklemektedir.

Öğrenci 14 görüşme sorusuna; *"Derste bir deney yapmıştık. Üçgen bir cismi çukur aynaya çok fazla yaklaştırdığımda neredeyse görüntünün cisimle aynı büyüklüğe ulaştığını gördüm. Fakat uzaklaştırmaya başladığımda cismin aynadaki görüntüsünün büyümeye başladığını gördüm. Cismi çukur aynadan uzaklaştırmaya devam ettiğimde görüntüde bir bulanıklık oldu. Daha sonra ters ve büyük bir görüntü gördüm. Daha da uzaklaştırdığımda görüntünün ters olduğunu, fakat cismin görüntüsünün küçülmeye başladığını fark ettim"* şeklinde yanıt vermiştir. Öğrenci yanıtında; çukur aynada oluşan görüntülerin özelliklerini cismin çukur aynaya olan uzaklığı çerçevesinde açıklamaya çalışmıştır. Bu açıklamalar, bilimsel kavramların akla yatkınlığını öğrencinin gözlemleri ile desteklemektedir.

Öğrenci 4 kavram testinde (ön test) yer alan açıklamasında; "görüş alanının büyüklüğünün gözlemcinin konumuna bağlı olmadığını" ifade etmiştir. Öğrenci 4'ün yer aldığı grubun kamera kayıtları incelendiğinde ise öğrencinin gözlemcinin aynaya yaklaşması durumunda görüş alanında gerçekleşen değişimi; *"Gözlemci aynaya yaklaştıkça görüş alanı büyür. Bunun nedeni; cisimden çıkarak aynadan yansıyan ışınların gözümüze ulaşırken ayna ile yaptığı açının büyümesidir. Cisimden gözümüze ulaşan ışınların ayna ile yaptığı açı ne kadar büyürse görüş alanı da o oranda artar."* şeklinde açıkladığı görülmektedir. Öğrencinin ifadeleri bilimsel açıklamaları içermekte ve bilimsel kavramların akla yatkınlığını *gerçek işleyiş* boyutunda desteklemektedir.

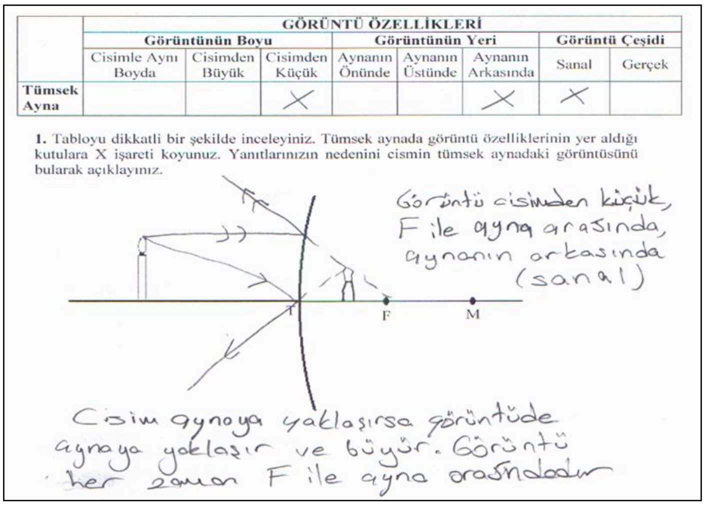
Öğrenci 4'ün düzlem aynada görüş alanının bağlı olduğu değişkenlere ilişkin olarak sahip olduğu düşünceler; aşağıda verilen görüşme alıntıları ve öğrencinin kavram testine (son test) vermiş olduğu yanıtlar (şekil 7) yardımıyla sunulmuştur.



Şekil 7. Öğrenci 4'ün çizdiği görüş alanına ilişkin şekil.

Görüşmeci: Düzlem aynalarda görüş alanı ile gözlemcinin aynaya olan uzaklığı arasında nasıl bir ilişki vardır?
Öğrenci 4: Görüş alanı aynaya olan uzaklığımıza bağlı olarak değişir.
Görüşmeci: Bu düşünceye nasıl ulaştın?

Öğrenci 4: Bir alışveriş merkezinde görmüştüm. İçeride büyük bir ayna vardı. Aynaya baktığımda dükkânın bir bölümü görebiliyordum. Aynaya doğru yürüdüğümde alışveriş yapan diğer insanları da görmeye başladım.
Görüşmeci: Bu durumda görüş alanı ile gözlemcinin aynaya olan uzaklığı arasında nasıl bir ilişki vardır?
Öğrenci 4: Aynaya yaklaştıkça görüş alanımız artar, uzaklaşırsak daha az alan görürüz.
Öğrenci 4'ün görüşme sorularına ve kavram testine (son test) verdiği yanıtlar incelendiğinde; öğrencinin görüş alanı ile gözlemcinin konumu arasındaki ilişkiye yönelik olarak yaptığı açıklamalarının kamera kayıtlarında yer alan ifadeler ile paralellik gösterdiği görülmektedir.
Öğrenci 5 ise bilimsel açıklamalarını anlam çözümleme tablosunda yer alan çizimleri ile desteklemektedir. Şekil 8'de yer alan tablo ve çizimde, tümsek aynalarda görüntü oluşumu ve görüntü özelliklerine ilişkin bilimsel açıklamaların yer aldığı görülmektedir.



	GÖRÜNTÜ ÖZELLİKLERİ							
	Görüntünün Boyu			Görüntünün Yeri			Görüntü Çeşidi	
	Cisimle Aynı Boyda	Cisimden Büyük	Cisimden Küçük	Aynanın Önünde	Aynanın Üstünde	Aynanın Arkasında	Sanal	Gerçek
Tümsek Ayna			X			X	X	

Şekil 8. Öğrenci 5'e ait Tümsek Aynada Görüntü Çizimi.

Öğrenci tarafından yapılan açıklamalar ve çizimler öğrenci tarafından ulaşılan bilimsel kavramların akla yatkınlığını "gerçek işleyiş" boyutunda desteklemektedir.

Yararlılık

Kavramsal değişim sürecinde; bilimsel olmayan kavramların yerini bilimsel kavramların alabilmesi için öğrencinin yeni kavramı *"yararlı"* bulması gerekir. Yeni kavramın problemleri çözmedeki verimliliği öğrencinin eski bilgiyi terk etmesini çabuklaştıracaktır. Bir başka ifadeyle yeni kavramın "işgörüsü" olmalıdır (Bransford, Brown, ve Cocking, 2000).

Kavramsal değişim sürecini "yararlılık" kategorisi kapsamında değerlendirilirken 3 farklı alt kategoriden yararlanılmıştır. Tablo 6'da bilimsel kavramların *"yararlılık"* düzeyi ile ilgili alt kategorilerinin (güç, umut verici ifadeler, rekabet) gözlemlenme derecelerine ait veriler sunulmuştur. Tablodaki veriler; yanıtlarında *"yararlılık"* düzeyinin alt kategorilerinden yararlanan 8 farklı öğrenciye aittir.

Tablo 6. "Yararlılık" Düzeyinin Alt Kategorilerine ait Veriler

Alt Kategoriler	Kavramın Yararlılığı							
	Öğ. 1	Öğ. 4	Öğ. 5	Öğ. 7	Öğ.8	Öğ. 10	Öğ.12	Öğ.15
Güç	+		+		+	+*	+	
Umut Verici İfadeler	+*	+		-		+		+
Rekabet		+*	+		+		+*	

+ : *Alt kategoriye ait davranışın öğretim süreci sonunda gözlemlendiğini ifade etmektedir.*
+* : *Alt kategoriye ait davranışın öğretim sürecinin öncesinde ve sonrasında gözlemlendiğini ifade etmektedir.*

Güç

Bu alt kategoride; yeni kavramın geniş bir uygulama alanına sahip olduğu vurgulanmaktadır. Öğrencilerin bu yönde yaptığı açıklamalar yeni kavramın yararlılığını destekler niteliktedir. Öğrenci 8 görüşme sorusuna; *"Gazetede çukur aynalar ile ilgili bir haber vardı. Çukur aynalar kullanılarak yapılan bir fırından bahsediyordu. Fırındaki ısının aynanın odağında toplanan ışınlar yardımıyla elde edildiğini yazıyordu. Yazının* *tamamını okuduğumda çukur aynalar ile ilgili birçok şeyi anladığımı fark ettim"* şeklinde yanıt vermiştir. Öğrenci yanıtında; öğrenilen bilgilerin gücünü günlük yaşamda elde ettiği deneyimleri yardımıyla desteklemektedir.

Öğrenci 12 ise görüşme sorusuna; *"Öğretmen görüntü türlerinden (sanal ve gerçek) bahsederken daha çok şey anlıyorum. Çünkü aynalarda ışınların yansıması ile ilgili birçok etkinlik yaptım. Bu etkinlikler görüntülerin nasıl oluştuğunu ve görüntü türlerini anlamama yardımcı oldu."* Görüldüğü gibi öğrenci tarafından yapılan açıklamalar; yeni kavramın (ışığın aynalardan yansıma kuralları) geniş bir uygulama alanına (görüntü oluşumu ve görüntü türlerinin belirlenmesi) sahip olduğunu vurgulamaktadır.

Umut Verici İfadeler

Öğrenciler bilimsel kavramların sunumu sürecinde; yeni kavram ile neler yapılabileceğini ve kavrama ilişkin beklentilerini vurgulamışlardır. Bu açıklamalar yeni kavramın yararlılığını destekler niteliktedir. Öğrenci 10 görüşme sorusuna; *"Özellikle, çukur ve tümsek aynalarda yaptığımız etkinlikler çok eğlenceliydi. Derste deneyler yaparak bilgiye ulaştığım için öğrendiklerim ilgimi çekti. Örneğin; aynalarda ışınların yansımasını çok iyi anladım. Artık aynalardaki görüntüleri kendim bulabiliyorum. Çevremdeki aynalarda oluşan görüntüleri daha iyi anlayabiliyorum."* şeklinde yanıt vermiştir. Burada öğrenci; yeni kavram ile neler yapabileceğini aynalar konusuna ilişkin örnekler yardımı ile açıklamaktadır.

Öğrenci 4 ise görüşme sorusuna; *"Aynalar konusunu hiç sevmiyordum, şimdi seviyorum. Dersi daha iyi anladığımı fark ettim. Özellikle lazer ile yaptığımız etkinlikte (etkinlik 12) özel ışınları çok iyi anladım. Bu ışınların mercekler konusunda bana yardımcı olacağını düşünüyorum."* şeklinde yanıt vermiştir. Görüldüğü gibi öğrenci; kavrama (özel ışınlar) ilişkin beklentilerini mercekler konusuna yönelik olarak ifade etmektedir.

Öğrenci 15; *"Dersten sonra aklıma şu geldi; mesela odamızdan çeşitli aynalar yardımıyla başka bir odayı görebiliriz. Birçok aynadan yararlanarak, yansıma kanunları yardımıyla bunun gerçekleşebileceğini düşünüyorum. Böyle bir araştırma yapmayı çok isterdim"* şeklinde bir düşünceye sahiptir. Öğrenci yanıtında, yeni kavramlar ile neler yapabileceğini vurgulamaktadır. Görüşme yanıtlarında yer alan bu tür umut verici ifadeler yeni kavramların yararlılığını destekler niteliktedir.

Öğrenci 7 ise "aynalar" konusunu yararlı bulmadığını ifade etmiştir. Bu doğrultuda görüşme sorusuna; "*Sınavdan sonra aynalar bana fayda sağlamaz. Belki başkaları için faydalı olabilir. Örneğin; öğrenci 15 ayna ve merceklerle ilgilenmeyi çok seviyor. Bu bilgiler ona faydalı olabilir"* şeklinde yanıt vermiştir. Açıklamada da görüldüğü gibi öğrenci yeni kavramlara ilişkin bir beklentiye sahip değildir.

Rekabet

Öğrenciler kavramların yararlılığı boyutunda; farklı kavramları birbirleri ile karşılaştırmaktadırlar. Bu kıyaslamalara ilişkin açıklamalar yeni kavramın yararlılığını destekler niteliktedir. Öğrenci 5 görüşme sorusuna; *"Işınların çukur aynalardan nasıl yansıdığını ezberliyordum. Soruları çözerken bu ışınları (özel ışınlar) kullanıyordum. Ama lazer ile yaptığımız etkinlikte (etkinlik 12) çukur aynalarda "merkez" noktasının "normal" olarak kullanılabileceğini öğrendim. Artık ışınları ezberlemiyorum"* şeklinde yanıt vermiştir. Öğrenci; çukur aynalarda ışınların yansıması sürecine ilişkin olarak "özel ışınlar" ile "normal" kavramını karşılaştırmakta ve yeni kavramı (normal) daha yararlı bulduğunu ifade etmektedir.

Öğrenci 8 ise görüşme sorusuna; *"Düzlem aynada sağ-sol değişimi olduğunu düşünüyordum. Fakat derste farklı cisimlerin aynadaki görüntülerini incelediğimde aynada ön-arka değişimi olduğunu gördüm. Örneğin bize bir etkinlikte (etkinlik 9) ambulans ve itfaiye yazılarının araçlar üzerine ne şekilde yazıldığı sorulmuştu. Kâğıda yazdığım ambulans yazısına kâğıdın arka yüzünden baktığımda araçların üzerinde yazan ifadeyi elde ettim. Saatin aynadaki görüntüsünün verildiği ve saatin kaç olduğunun sorulduğu soruda da (kavram testi – soru 8) ön-arka değişimini kullandım."* şeklinde yanıt vermiştir. Görüldüğü gibi öğrenci; "ön-arka değişimi" kavramını "sağ-sol değişimi" kavramı ile karşılaştırmakta ve yeni kavramı (ön-arka değişimi) daha yararlılığı bulduğunu ifade etmektedir.

SONUÇ

Sonuçlar; öğrencilerin görüşmelere ve kavram testine verdikleri yanıtlardan, öğrenci kılavuzlarında ve anlam çözümleme tablolarında yer alan öğrenci ifadelerinden ve kamera kayıtlarından yararlanarak, durum analiz kategorileri (*anlaşılırlık, akla yatkınlık* ve *yararlılık)* çerçevesinde analiz edilmiştir.

Kavramsal Değişim Durumlarının "Anlaşılırlık" Kategorisine İlişkin Sonuçlar

Kavramsal değişimin sağlanabilmesi için yeni kavramın öncelikle *anlaşılır* olması gerekir. Anlaşılır olmayan kavram öğrenci tarafından içselleştirilemez ve doğru anlamlandırılamaz (Posner, Strike, Hewson ve Gertzog, 1982). Bu kapsamda, öğrencilerin kavramsal değişim sürecine yönelik olarak elde edilen sonuçlar; *"anlaşılırlık"* kategorisinin *"görüntü", "örnek verme"* ve *"dil"* alt kategorileri çerçevesinde sunulmuştur.

Görüntü

Öğrenciler yeni kavramı "anlaşılır" bulduklarını grafik ve resimler yardımıyla vurgulamaktadırlar. Öğrencilerin anlam çözümleme tablolarında, görüşmelerde ve kavram testlerinde yer alan açıklama ve çizimleri incelendiğinde; öğretim sonrasında öğrencilerin büyük çoğunluğunun yeniden yapılandırılan kavramların anlaşılırlığını desteklediği söylenebilir.

Örnek Verme

Öğrenciler yeni kavramı "anlaşılır" bulduklarını günlük yaşama ilişkin örnekler yardımıyla vurgulamaktadırlar. Öğrencilerin anlam çözümleme tablolarında, görüşmelerde ve kavram testlerinde yer alan günlük yaşama ilişkin ifadeleri; kavramsal değişim sürecinin "anlaşılırlık" boyutunda gerçekleştiğini destekler niteliktedir.

Öğrencilerin; bilimsel kavramlara ulaşma aşamasında günlük yaşamda karşılaştıkları olaylardan yararlandıkları ve öğretim sürecinde yapılandırdığı bilimsel bilgiyi karşılaştığı problemlerin çözümünde etkin bir biçimde kullandıkları söylenebilir.

Dil

Öğrenciler, yeni kavramı "anlaşılır" bulduklarını bilimsel kavramların sunumu sürecinde söz ve sembollerden yararlanarak vurgulamaktadırlar. Derinleştirme etkinliklerinde, görüşmelerde, anlam çözümleme tablolarında ve kavram testinde yer alan, öğrencilerin bilimsel kavramları açıklamaya çalışırken kullandıkları söz ve semboller dikkate alındığında; kavramsal değişim sürecinin "anlaşılırlık" boyutunda gerçekleştiği görülmektedir.

Sonuç olarak; öğretim sürecinde kalıcı ve anlamlı bir öğrenmenin gerçekleşmiş olduğu ve bilimsel kavramların *"anlaşılabilirliğinin"* öğrencilerin yaptıkları çizimler (görüntü), günlük yaşama ilişkin olarak verdikleri örnekler (örnek verme), kullandıkları semboller ve kendilerine ait sözlü ifadeler (dil) yardımıyla desteklendiği söylenebilir

Kavramsal Değişim Durumlarının "Akla Yatkınlık" Kategorisine İlişkin Sonuçlar

Bilimsel olmayan kavramların yerini bilimsel kavramların alabilmesi için sağlanması gereken koşullardan ikincisi yeni kavramın *"akla yatkın"* olmasıdır. Araştırmada, öğrencilerin kavramsal değişim sürecine yönelik olarak elde edilen sonuçlar; *"akla yatkınlık"* kategorisinin *"diğer bilgi", "laboratuvar deneyimi", "geçmiş deneyimler", "bilişsel yapı", "doğa ötesi", "akla yatkın benzetmeler"* ve *"gerçek işleyiş"* alt kategorileri çerçevesinde sunulmuştur.

Diğer Bilgi

Öğrenciler yeni kavramı "akla yatkın" bulduklarını yeniden yapılandırılan kavramın diğer bilgi ve kavramlar ile olan tutarlılığından yararlanarak vurgulamaktadırlar. Öğrenciler yeniden yapılandırdıkları kavramlara ilişkin olarak kavramsal değişim sürecinin "akla yatkınlık" boyutunda gerçekleştiğini, kavram testinde, görüşmelerde ve öğrenci kılavuzlarında yer alan açıklamaları ile desteklemektedirler.

Laboratuvar Deneyimi

Öğrenciler yeni kavramı "akla yatkın" bulduklarını bilimsel kavramların sunumu sürecinde laboratuar deneyimlerinden ve gözlemlerinden yararlanarak vurgulamaktadırlar. Öğrenciler yeniden yapılandırdıkları kavramlara ilişkin olarak kavramsal değişim sürecinin "akla yatkınlık" boyutunda gerçekleştiğini; özellikle etkinliklere ve derinleştirme etkinliklerine yönelik gözlem ve deneyimlerini vurgulayarak ifade etmektedirler. Bu doğrultuda; öğrencilerin bilimsel gerçeklere ulaşarak kalıcı ve anlamlı bir öğrenme gerçekleştirebilmelerine yardımcı olmak amacıyla geliştirilen etkinlik ve etkinliklerin kavramsal değişim sürecine olumlu katkı sağladığı söylenebilir.

Geçmiş Deneyimler:

Öğrenciler yeni kavramı "akla yatkın" bulduklarını bilimsel kavramların sunumu sürecinde geçmiş deneyimlerinden yararlanarak açıklamaktadırlar. Geçmiş deneyimleri ile öğretim sürecinde edindikleri tecrübeleri karşılaştırarak; yeniden yapılandırdıkları kavramlara ilişkin olarak kavramsal değişim sürecinin "akla yatkınlık" boyutunda gerçekleştiğini vurgulamaktadırlar. Özellikle görüşme sorularına verdikleri yanıtlarda; önceki deneyimlerinden farklı olarak bilimsel kavramları akla yakın bulduklarını, sorgulayarak ve araştırarak anlamlı bir öğrenme gerçekleştirdiklerini ifade etmektedirler.

Bilişsel Yapı

Öğrenciler yeni kavramları "akla yatkın" bulduklarını; bilimsel kavramların sunumu sürecinde bilimsel teorilerin deneysel kanıtlarının önemine vurguda bulunarak ifade etmektedirler. Öğrencilerin etkinliklerde, derinleştirme etkinliklerinde ve problem çözme uygulamalarında kavramların deneysel kanıtlarına ilişkin olarak verdiği örnekler, kavramsal değişim sürecinin "akla yatkınlık" boyutunda gerçekleştiğini destekler niteliktedir.

Doğa Ötesi

Öğrenciler yeni kavramları "akla yatkın" bulduklarını; bilimsel kavramların sunumu sürecinde nesne ve inanışların ontolojik (öğrenciler tarafından algılanma şekli) konumlarından yararlanarak vurgulamaktadırlar. Öğrenciler bu süreçte; kavramları düşünen, hareket edebilen ve istekleri olan varlıklar gibi betimlemişlerdir. Bu düşünüş şeklinin; öğrencilerin bilimsel kavramları "akla yatkın" bulmasına yardımcı olduğu ve kavramsal değişim sürecinin gerçekleşmesine olumlu katkıda bulunduğu söylenebilir.

Akla Yatkın Benzetmeler

Öğrenciler yeni kavramları "akla yatkın" bulduklarını; bilimsel kavramların sunumu sürecinde benzetmelerden yararlanarak vurgulamaktadırlar. Öğrencilerin görüşme sorularına verdikleri yanıtlar ve öğrenci kılavuzlarında yer alan ifadeleri incelendiğinde; öğrencilerin kavramların ortak yanlarının farkına vardıkları ve bilimsel kavramların farklı içeriklere genellenebilirliğini onayladıkları görülmektedir. Öğrencilerin bilimsel kavramları açıklamaya çalışırken kullandıkları benzetmeler, kavramsal değişim sürecinin "akla yatkınlık" boyutunda gerçekleştiğini destekler niteliktedir.

Gerçek İşleyiş

Öğrenciler yeni kavramları "akla yatkın" bulduklarını; bilimsel kavramların sunumu sürecinde gerçeğe çok yakın açıklamalardan ve çizimlerden yararlanarak vurgulamaktadırlar. Bu açıklamalar ve çizimler küçük eksiklikler dâhilinde bilimsel açıklamaları içermektedir. Öğrencilerin kavram testlerinde, öğrenci kılavuzlarında ve problem çözme uygulamalarında yer alan ve bilimsel gerçekler ile örtüşen açıklama ve çizimleri dikkate alındığında; kavramsal değişim sürecinin "akla yatkınlık" boyutunda gerçekleştiği söylenebilir.

Sonuç olarak; öğretim aşamasında etkin bir şekilde kullanılan derinleştirme etkinlikleri, anlam çözümleme tabloları ve problem çözme uygulamaları; içerikten bağımsız ve tutarlı bir kavramsal değişimin gerçekleşmesi sürecine destek sağlamaktadır. Kavramsal değişim sürecinde bilimsel kavramların *"akla yatkınlığının"*; laboratuar deneyimleri, bilimsel bilgi ve kavramların deneysel kanıtları, nedensel işleyişe ilişkin açıklama ve çizimler, akla yatkın benzetmeler, doğa ötesi açıklamalar ve geçmiş deneyimler yardımı ile desteklendiği ve öğretim sürecinde kalıcı bir öğrenmenin gerçekleşmiş olduğu söylenebilir.

Kavramsal Değişim Durumlarının "Yararlılık" Kategorisine İlişkin Sonuçlar

Kavramsal değişimin sağlanabilmesi için yeni kavramın *yararlı* olması gerekir. Yeni kavramın problemleri çözmedeki verimliliği öğrencinin eski bilgiyi terk etmesini çabuklaştıracaktır. Bir başka ifadeyle yeni kavramın işgörüsü olmalıdır (Bransford, Brown, ve Cocking, 2000). Bu kapsamda; öğrencilerin kavramsal değişim sürecine yönelik olarak elde edilen sonuçlar, *"yararlılık"* kategorisinin *"güç", "umut verici ifadeler"* ve *"rekabet"* alt kategorileri çerçevesinde sunulmuştur.

Güç

Öğrenciler yeni kavramları "yararlı" bulduklarını; bilimsel kavramların sunumu sürecinde yeni kavramın geniş bir uygulama alanına sahip olduğunu vurgulayarak ifade etmişlerdir. Öğrencilerin özellikle görüşme sorularına verdikleri yanıtlarda; günlük yaşamda karşılaştıkları olayları bilimsel kavramlardan yararlanarak yorumlayabildikleri ve kavramların uygulama alanlarına ilişkin çıkarımlarda bulunabildikleri görülmektedir. Öğrenme sürecinde yararlanılan günlük yaşam ile ilgili etkinliklerin; öğrencilerin yeni kavramın uygulama alanlarına ilişkin bilgi sahibi olmasına yardımcı olduğu ve bu doğrultuda kavramsal değişimin "yararlılık" boyutunda gerçekleşmesine katkı sağladığı söylenebilir.

Rekabet

Öğrenciler yeni kavramları "yararlı" bulduklarını; bilimsel kavramların sunumu sürecinde farklı kavramları birbirleri ile karşılaştırarak vurgulamışlardır. Kavram testlerinde, görüşmelerde ve öğrenci kılavuzunda yer alan açıklamalar dikkate alındığında; öğrencilerin kavramları "problem çözme sürecindeki etkinliği" boyutunda karşılaştırdıkları görülmektedir. Öğrencilerin derinleştirme etkinliklerinde, anlam çözümleme tablolarında ve problem çözme uygulamalarında; diğer kavramlara göre daha yararlı olduğunu düşündükleri bilimsel kavramları etkin olarak kullanmaları, kavramsal değişimin "yararlılık" boyutunda gerçekleştiği düşüncesini desteklemektedir.

Umut Verici İfadeler

Öğrenciler yeni kavramları "yararlı" bulduklarını; bilimsel kavramların sunumu sürecinde kavrama ilişkin beklentilerini ve yeni kavram ile neler yapılabileceğini vurgulayarak ifade etmişlerdir. Öğrencilerin görüşmelerde ve yansıtıcı günlüklerde yer alan ifadeleri incelendiğinde; öğrenme sürecine olan ilgilerinin ve konuya ilişkin beklentilerinin üst düzeyde olduğu görülmektedir. Öğrenciler sorgulayarak, araştırarak ve deneyimlerini bir araya getirerek ulaştıkları kavramları bilginin yeniden yapılandırılması sürecinde etkin bir şekilde kullanmaktadır. Yapılandırdıkları bilgileri karşılaştıkları problemlere uygulayarak bilimsel kavramların farklı içeriklere genellenebilirliğini onaylayan öğrencilerin kavramsal değişimi "yararlılık" boyutunda gerçekleştirdikleri söylenebilir.

Sonuç olarak bilimsel kavramların *"yararlılığının"* öğrenciler tarafından*;* yeni kavramın diğer kavramlar ile karşılaştırılması (rekabet), kavram ile neler yapılabileceğinin ve kavrama ilişkin beklentilerin sunulması (umut verici ifadeler) ve kavramın uygulama alanları hakkında bilgiler verilmesi (güç) biçiminde vurgulandığı görülmektedir.

Kavramsal değişim durumlarının analizinden elde edilen sonuçlar değerlendirildiğinde; öğrencilerin öğretim sürecine taşıdıkları mevcut kavramlar ile ilgili hoşnutsuzluk duydukları, gerçekleştirdikleri deney ve etkinlikler yardımıyla ulaştıkları yeni kavram ve açıklamaları "anlaşılır", "akla yatkın" ve "yararlı" buldukları için olası yeni (bilimsel) kavramları içselleştirerek anlamlı ve kalıcı bir öğrenme gerçekleştirdikleri söylenebilir.

ÖNERİLER

Bu bölümde, kavramsal değişim sürecinin yapılandırılmasına ilişkin önerilere yer verilmiştir. Öneriler ağırlıklı olarak; öğretim modelinin seçimi, veri toplama araçları ve öğrenme ortamında kullanılan stratejiler konuları ile ilişkilidir.

Kavramsal değişim sürecinin planlanmasından önce öğrencilerin mevcut bilgi yapıları belirlenmeli ve bu yapıların doğruluğu ya da yanlışlığı konusunda yargıda bulunulmadan, öğrencilerin bu yapıları hangi bağlamda kurduğu ve dayanaklarını nasıl oluşturduğu sorgulanmalı ve araştırılmalıdır (Yurdakul, 2005). Elde edilen sorgulama ve araştırma sonuçları ile konunun amaçları ve öğrencilerin elde etmesi beklenen kazanımlar doğrultusunda, anlamlı öğrenme sürecine katkı sağlayacak bir kavramsal değişim stratejisi belirlenmelidir. Kavramsal değişim stratejisinin; "bireyi sorgulamaya ve zihinsel süreç becerileri yardımıyla bilgiyi yapılandırmaya teşvik etmesi", "öğrencilerin düşünce ve davranışlarındaki değişim sürecinin incelenmesine fırsat vermesi" ve "öğrenme hedefinin gerçekleşmesi sürecinde öğretmen ve öğrencilere etkili bir rehberlik sağlaması" öğretim programının tasarlanması sürecinde dikkate alınması gereken önemli ve vazgeçilmez hususlardır.

Öğretmenler tarafından; öğrenenlerin kendi bilgilerini yapılandırmalarına yardımcı olmak ve öğrencilere anlamlı öğrenme sürecinde etkili bir rehberlik sağlayabilmek amacıyla öğrenci kılavuzları (EK-C) oluşturulmalıdır. Öğrenci kılavuzları; öğretmenlerin öğrencilerin konuları nasıl anladıklarını ve önceki düşüncelerinden farklı ne tür düşünceler oluşturduklarını belirleyebilmelerine yardımcı olmalı ve bu bağlamda kavramsal değişim sürecinin yapılandırılmasında etkin bir rol oynamalıdır. Kılavuzların içeriğinde; öğrencilerin nasıl düşündüklerini yansıtmaya yönelik "etkinliklere", "derinleştirme aktivitelerine", "anlam çözümleme tablolarına", "problem çözme uygulamalarına" ve "yansıtıcı günlüklere" yer verilmelidir.

Öğrencilerin kavramları nasıl yapılandırdıklarını belirleyebilmek amacıyla; kavramların özelliklerini ve bu özelliklere ilişkin öğrenci düşüncelerini yansıtan anlam çözümleme tablolarının (EK-Ç) geliştirilmesi gerekmektedir. Anlam çözümleme tabloları; kavramsal anlayışın yeni durumlara uygulanabilmesine yardımcı olmalı ve bu bağlamda öğretimin etkinlik derecesinin belirlenebilmesi sürecine katkıda bulunmalıdır. Anlam çözümleme tablolarına öğrencilerin verdikleri yanıtların; konunun amaçları ve öğrencilerin kazanması beklenen kazanımlar doğrultusunda değerlendirilmesi, öğretmenlere kavramsal değişim sürecine ilişkin anlamlı veriler sağlayacaktır.

Öğretim sürecinin değerlendirilmesi aşamasında kamera kayıtlarından yararlanılmalıdır. Kamera kayıtları; öğretim modelinin uygulanması sürecinde öğretmen ve öğrencilerden beklenen davranışların ölçülmesinde etkin olarak kullanılabilir. Öğrencilerin bilginin yapılandırılması sürecine yönelik olarak grup çalışmalarında göstermiş oldukları davranışların ve bu bağlamda yeni (bilimsel) kavramlara ilişkin olarak öğretmen ve arkadaşlarına yapmış oldukları açıklamaların kamera kayıtları yardımıyla değerlendirilmesi; öğrencilerin öğretim sürecine ilişkin kazanımlarının bilişsel, sosyal ve duyuşsal boyutunun belirlenebilmesine katkıda bulunacaktır.

Öğrencilerin öğretim modeline yönelik düşüncelerini belirlemek amacıyla yansıtıcı günlüklerden (EK-D) yararlanılmalıdır. Öğretim sürecinde kullanılan yansıtıcı günlükler; dersin işlenişi ve bu süreçte gerçekleştiren etkinliklere ilişkin öğrenci düşüncelerinin elde edilebilmesine imkân vermeli, öğrencilerin öğretim sürecine yönelik beklentilerinin belirlenebilmesine yardımcı olmalı, öğretmenlere öğrenme çevresinin tasarlanması sürecine yönelik geri bildirimler sağlamalıdır.

Çalışma; öğrencilerin aynalar konusuna ilişkin kavram yanılgılarına sahip olduğunu, öğretim sürecinin sonunda öğrencilerin büyük çoğunluğunun içerikten bağımsız ve tutarlı bir kavramsal değişimi gerçekleştirdiğini ortaya koymuştur. Araştırmacılar tarafından; yapılandırmacı kurama dayalı öğretim modelleri çerçevesinde, kavramsal değişim sürecine yönelik olarak gerçekleştirilecek farklı çalışmaların fizik öğretimine olumlu katkılar sağlayacağı düşünülmektedir.

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EVALUATION OF PROBLEM-BASED LEARNING ACTIVITY BY STUDENTS

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ABSTRACT: Problem-based learning (PBL); considering the fact that we encounter various problems in our lives, viewing these problems as significant we try to find the cause of them, we solve these problems and also we tackle with potential problems before they occur, is an approach that adopts use of real-life problems in learning process. In PBL, starting with a problem situation by making the information necessary to solve this problem as the learning objective, students are provided with active learning.

The purpose of this study to make an evaluation of a PBL activity carried out in the General Chemistry II course according to the views of the students. The activity was held with the freshman science education students in the Faculty of Education at Nigde University during the spring semester of 2013-14 academic year. The activity prepared on the structure of the atom, electron configuration and periodic table was performed with the discussion of the questions of a scenario, which gives the problem of whether Hydrogen element can be used as a fuel or not and is titled “Death before Born?”, in five groups each of which consisted of 10-15 students on three sessions. The question of a scenario that less than three training sessions in five groups consisting of 10-15 students was carried out by discussion. In each group, the authors of this study served as a guide. Each session lasted 1-2 hours. This event is performed for one week. Students had done the evaluation in a form distributed to them by writing their opinions and suggestions under the titles of guide, scenario, PBL group, you, general chemistry presentation, general chemistry laboratory, applications, discussion session, scientific advice and post module evaluation at the end of the activity. These documents were then analyzed by the content analysis. According to the findings, most of the students make use of PBL and develop cooperative learning, reaching information and research skills; some of the students do not take advantage of PBL and prefer traditional lessons to PBL.

Key words: problem based learning, general chemistry, science education students

PROBLEME DAYALI ÖĞRENME ETKİNLİĞİNİN ÖĞRENCİLERCE DEĞERLENDİRİLMESİ

ÖZET: Probleme dayalı öğrenme (PDÖ); hayatımızda çeşitli problemlerle karşılaştığımızdan, bunları önemli bulup bu sorunların nedenini bulmaya çalıştığımızdan, çözdüğümüzden ayrıca olası sorunları daha gerçekleşmeden önceden giderdiğimizden hareketle öğrenme sürecinde gerçek yaşam problemleri kullanılmasını benimseyen bir yaklaşımdır. PDÖ’de bir problem durumundan yola çıkılarak bu problemin çözümü için gerekli bilgiler öğrenme hedefi yapılarak öğrencinin aktif öğrenmesi sağlanır. Bu çalışmanın amacı Genel Kimya II dersinde gerçekleştirilen bir PDÖ etkinliğinin öğrenci görüşlerine göre bir değerlendirmesini yapmaktır. Etkinlik 2013-14 akademik yılı bahar döneminde Niğde Üniversitesi Eğitim Fakültesi Fen Bilgisi Öğretmenliği 1. sınıf öğrencileriyle gerçekleştirilmiştir. Atomun yapısı, elektron dizilişi ve periyodik dizge konusunda hazırlanan etkinlik, Hidrojen elementinin yakıt olarak kullanılıp kullanılamayacağı problemini “Doğmadan Ölüm Mü?” başlığı altında veren bir senaryonun sorularının üç eğitim oturumunda 10-15 öğrenciden oluşan beş grupta tartışılmasıyla gerçekleştirilmiştir. Her bir grupta bu çalışmanın yazarları yönlendirici olarak görev yapmıştır. Her bir oturum 1-2 saat sürmüştür. Etkinlik bir hafta süresince yapılmıştır. Öğrenciler değerlendirmeyi etkinlik sonunda kendilerine dağıtılan bir formda eğitim yönlendiricisi, senaryo, pdö grubu, kendiniz, genel kimya sunumu, genel kimya laboratuvarı, uygulamalar, tartışma oturumu, bilimsel danışma ve modül sonu değerlendirme başlıkları altında görüş ve önerilerini yazarak yapmışlardır. Bu dokümanlar daha sonra içerik analizi ile analiz edilmiştir. Analizler sonucunda öğrencilerin çoğunluğunun PDÖ'den faydalandığı ve işbirliğiyle çalışma, bilgiye ulaşma ve araştırma becerilerini geliştirdiği, az sayıda öğrencinin ise PDÖ'den faydalanmadığı ve geleneksel yöntemle dersin işlenmesini tercih ettikleri ortaya çıkmıştır.

Anahtar Sözcükler: probleme dayalı öğrenme, genel kimya, fen bilgisi öğretmenliği

GİRİŞ

Hızla büyüyen ve yenilenen bilgiyi, tümüyle edinmek ve bilgi edinmeyi ders saati gibi belirli sürelere sığdırmak imkânsız olup her şeyi öğrenmeye çalışmak yerine 'öğrenmeyi öğrenmek' suretiyle karşımıza çıkan bir sorunu çözmek için gereksinim duyduğumuz bilgiyi tanımlamak ve ona çeşitli kaynakları kullanmak suretiyle erişmek önemlidir (Taşkesenligil, Şenocak ve Sözbilir, 2008).

Kendimizi ve içinde yaşadığımız evreni tanımak, çevremizle olan ilişkileri düzenlemek ve çevremizden faydalanmak için fen öğrenmekteyiz. Bu yüzden fen öğretimi gerçek hayatı öğrenmek demektir. Üniversite eğitimi, sorunlarla başa çıkabilen, onlara çözüm önerileri getirebilen, onları çözen bireyler yetiştirmeyi hedeflemektedir. Düşünen, soran, sorgulayan, araştıran ve karşılaştığı problemlere çözüm üreten bireyler hayatta başarılı olmaktadır (Aydoğdu, 2012).

Probleme Dayalı Öğrenme (PDÖ); hayatımızda çeşitli problemlerle karşılaştığımızdan, bunları önemli bulup bu sorunların nedenini bulmaya çalıştığımızdan, çözdüğümüzden ayrıca olası sorunları daha gerçekleşmeden önceden giderdiğimizden hareketle öğrenme sürecinde gerçek yaşam problemleri kullanılmasını benimseyen bir yaklaşımdır (Şenocak, 2006).

Bilgiyi yapılandırma surecinin öğrencilerin on bilgilerini aktive ederek, iyi yapılandırmamış problemlerin çözüm yollarının grup içi ve diğer sosyal çevreler ile müzakereler ve araştırmalar ile sağlandığı bir öğrenme yöntemidir. Bu nedenle yapılandırmacı yaklaşımın özü olmayı hak etmektedir (Koçakoğlu, 2010).

PDÖ'de bir problem durumundan yola çıkılarak bu problemin çözümü için gerekli bilgiler öğrenme hedefi yapılarak öğrencinin aktif öğrenmesi sağlanır (Şenocak, 2006). PDÖ, kapsamlı ve esnek bilgi temeli oluşturmayı, etkili problem çözme becerisini geliştirmeyi, yaşam boyu öğrenmeyi sağlamayı, işbirlikçi olmayı ve öğrenmeye güdülemeyi amaçlamaktadır (Şenocak, 2006).

Ülkemizde ilk defa Dokuz Eylül Üniversitesi Tıp Fakültesinde uygulanmaya başlanan PDÖ, tıp eğitiminden başka işletme, hukuk, mühendislik (Kılınç, 2007) ve eğitim fakültelerinin bazı bölümlerinde de uygulanmaktadır.

Milli Eğitim Bakanlığı'nın program geliştirme çalışmalarında PDÖ ile ilgili açıklamalara rastlanmamaktadır. Öğretim programlarımız sabit yapıdadır, sadece Seçmeli Tarım (6-8. Sınıflar) Öğretim Programı'nda öğretmenin ünite, konu, sure belirlemede esnektir. Dünyada ise PDÖ'ye ayrı bir önem verilmektedir. Örneğin, Delaware Üniversitesi'nde Fen, Matematik, Mühendislik ve Teknoloji Enstitüsü, 1997'de Ulusal Fen Kurumunca ödüllendirilmiştir çünkü 25 fakültesinde 150'den fazla kursunda PDÖ kullanılmaktadır (Koçaokoğlu, 2010).

Şimdiye kadar ülkemizde kimya ve öğretmen eğitiminde yapılan çalışmalar PDÖ'nün 10. sınıf Kimya dersi "Karışımlar" ünitesinde başarı, tutum ve motivasyonu (Kuşdemir, Ay ve Tüysüz, 2013), sınıf öğretmenliği bölümünün Fen Bilgisi Laboratuvarı dersi Hareket ve Kuvvet konusunda fen öğretimine yönelik öz yeterlik inanç ve problem çözme düzeyini (Yaman ve Yalçın, 2005), fen bilgisi ve kimya öğretmenliği bölümlerinin Genel Kimya Laboratuvarı dersinde metalik aktivite konusunda başarıyı (Sağır, Çelik ve Armağan, 2009), fen bilgisi öğretmenliği bölümünün Genel Kimya dersinde öğrenmede güdüsel stratejiler (motivasyon, öz düzenleme ve kaynak yönetimi stratejisi) düzeyini (Tosun ve Taşkesenligil, 2012), yine fen bilgisi öğretmenliği bölümünün Genel Kimya ve Genel Kimya Laboratuvarı derslerinde Elektroliz ve Pil konusunda Bilimsel İşlem Beceri Testi ortak değişken olarak alındığında kimyaya yönelik tutum, elektrokimya başarı düzeylerini (Aydoğdu, 2012) istatistiksel olarak anlamlı bir şekilde artırdığını göstermiştir.

Öğrenci görüşlerine göre is PDÖ; özgüveni ve kimyaya yönelik ilgiyi artırmakta, sınav kaygısını azaltmakta; problem çözme, kendi kendine öğrenme becerilerini geliştirmekte; grupla işbirliği içerisinde çalışma, iletişim ve eleştiriye açıklık özelliklerini geliştirmekte; bilgi kaynaklarının ve internetin kullanılmasını sağlamakta; farklı kaynaklardan edinilen bilgilerin bir araya getirilebilmesini öğretmekte, ön hazırlık yapmak suretiyle çalışma tarzını değiştirmekte; temel ve karmaşık kavramları öğrenmeyi sağlamakta ve öğrendiklerini başka derslere transfer etme gibi kalıcılık sağlamaktadır. Ancak, öğrencilerin yönteme alışkın olmaması, grup çalışmalarındaki sorunlar, uygulamanın kısa olması, bilgiyi problem çözümünde kullanamama ve değerlendirme problemleri PDÖ'nün başarısını düşürmektedir (Kuşdemir, Ay ve Tüysüz, 2013; Tatar, Oktay ve Tüysüz, 2009; Tosun ve Taşkesenligil, 2012).

Yukarıda bahsedilen çalışmalar, nicel çalışmalar olup öğrenci görüşlerine başvurma yoluyla nitel boyutta eklenmiştir. Bu çalışmanın amacı ise Genel Kimya II dersinde gerçekleştirilen bir PDÖ etkinliğinin öğrenci görüşlerine göre bir nitel değerlendirmesini yapmaktır.

YÖNTEM

Çalışma Grubu

Etkinlik 2013-14 akademik yılı bahar döneminde Niğde Üniversitesi Eğitim Fakültesi Fen Bilgisi Öğretmenliği 1. sınıfa devam eden 60 öğrenci ile gerçekleştirilmiştir. İkinci yazarın ders öğretim elemanı olmasında dolayı bu grup için kolay ulaşılabilir durum örneklemesi kullanılmıştır.

Uygulama

Atomun yapısı, elektron dizilişi ve periyodik dizge konusunda hazırlanan etkinlik, Hidrojen elementinin yakıt olarak kullanılıp kullanılamayacağı problemini "Doğmadan Ölüm Mü?" başlığı altında veren bir senaryonun sorularının üç eğitim oturumunda 10-15 öğrenciden oluşan beş grupta tartışılmasıyla gerçekleştirilmiştir (Ek 1). Her bir grupta bu çalışmanın yazarları yönlendirici olarak görev yapmıştır. Her bir oturum 1-2 saat sürmüştür. Etkinlik bir hafta süresince yapılmıştır.

Veri Toplama

Öğrenciler değerlendirmeyi etkinlik sonunda kendilerine dağıtılan bir form ile yapmışlardır (Ek 2). Öğrenciler bu forma değerlendirmelerini eğitim yönlendiricisi, senaryo, grup, kendiniz, genel kimya sunumu, genel kimya laboratuarı, bilimsel danışma ve görüş ve öneriler başlıkları altında kendi görüşlerini yazmak suretiyle yapmışlardır.

Veri Analizi

Bu dokümanlar daha sonra içerik analizi ile analiz edilmiştir. İçerik analizi ile öğrencilerden değerlendirme formu ile elde edilen verilerde; kodlama, temaları bulma, kod ve temaları düzenleme ve bulguları tanımlama ve yorumlama aşamalarını izleyerek, kavram ve ilişkilere ulaşılmaya çalışılmıştır (Yıldırım ve Şimşek, 2005, s. 227-240; Ek 3).

Geçerlik ve Güvenirlik

Araştırma sonuçlarının aktarılabilirliğini artırmak için Ayrıntılı Betimleme yöntemi kullanılmıştır. Ayrıntılı betimleme için bulgularda doğrudan alıntılara yer verilmiştir. Tutarlık için PDÖ uygulaması (senaryo, problem ve eğitmen dönütleri), öğrencilere verilen değerlendirme ölçeği ve analiz örnekleri eklerde verilmiştir.
Teyit İncelemesi için ulaşılan sonuçlar toplanan verilerle sürekli teyit edilmiştir ve ham veriler ve kodlamalar incelemeye açık tutulmaktadır.

BULGULAR

Eğitmen Değerlendirmeleri

Eğitmenlerle ilgili değerlendirmelerde görüş bildiren 24 öğrenciden sadece ikisi rehberin öğrenme sürecine katkısı olmadığını düşünmüş; bir öğrenci rehberin öğrenmelerine katkısı olduğunu ama en sonda doğruyu söylediğinde daha fazla katkı sağlayabileceğini belirtmiştir. Buna karşılık aynı gruptaki diğer bir öğrenci ise rehberin sonuçta doğrunun ne olduğunu söylememesini, kendilerinin araştırma ve tartışma sonucunda bir sonuca varmalarını öğrenme açısından olumlu olarak değerlendirmiş; aynı gruptaki bir öğrenci öğrenirken "neden" sorusunu kendi kendine ilk kez sormak durumunda kaldığını ve bunun daha derin öğrenmelere yol açtığını keşfetmiştir. Genel olarak öğrenciler, rehberlerin, "tartışmayı", "araştırmayı", "eleştirel düşünmeyi", "kendi kendine öğrenmeyi" desteklemelerinin onların öğrenme süreçlerine katkı sağladığını düşünmüşlerdir. Öğrencilerin değerlendirmelerine örnek olarak;

'Öğrenme sürecine katkı görmedim. İletişim becerilerine katkı yoktu' (R.P.)

'Eğitim yönlendirici bize farklı farklı sorular sorarak, çoklu düşünmemizi sağladı ve bizi araştırmaya yöneltti' (G.Ü)

Senaryo

Öğrencilerin senaryo ile ilgili görüşleri çoğunlukla olumludur (23 öğrenciden sadece 9'u olumsuz düşünceye sahiptir). Senaryo hakkında olumlu düşünenlerden 10'u senaryoyu güncel, altısı anlaşılır, üçü akıcı, biri eski bilgileri pekiştirici, biri merak uyandırıcı, biri eğlendirici ve biri de olay örüntüsü olarak iyi kurgulanmış bulmuştur. Olumsuz görüşe sahip olan öğrenciler ise senaryoyu biraz sıkıcı (bir öğrenci) ve karışık (bir öğrenci) olduğunu ve bazı kısımların ve soruların anlaşılmadığını (yedi öğrenci) ifade ederek daha iyi yazılabileceğini ya da eğitmen tarafından daha açık bir şekilde sorulması gerektiğini belirtmiştir. Öğrencilerin senaryoyla ilgili görüşleri eğitmen grubuna göre incelendiğinde öğrencilerin en az yarıdan fazlasının senaryo hakkında olumlu görüşe sahip oldukları görülmüştür. Öğrencilerin senaryo ile ilgili görüşlerine örnek olarak;

'Senaryomuz güncel konularla destekliydi.' (T.K.)

' Senaryo daha akıcı ya da daha anlaşılır bir şekilde yazılabilirdi. Açıklayıcı bulamadım senaryoları.' (M.B.Y.)

PDÖ Grubu

Bu bölümde öğrenciler grup içi uyum, katılım, iletişim, paylaşım ve grubun hazırlığı hakkında görüş bildirmişlerdir. Grup içi uyum konusunda görüş bildiren 11 öğrenciden sekizi uyumun iyi olduğunu, üçü grup üyelerinin hepsinin aktif olmamasından dolayı grubun çok uyumlu olmadığını, bir öğrenci ise tartışmalarda kasıt arandığından dolayı grubun uyumsuz olduğunu belirtmişlerdir. Grup içi katılım konusunda görüş bildiren dört öğrenciden ikisi katılımın iyi olduğunu, bir öğrenci ilk oturum dışında katılımın iyi olduğunu, bir öğrenci ise katılımın az olduğunu belirtmişlerdir. Bir öğrenci grup çalışmalarında kişisel fikirlerini iletebildiklerinden bahsetmiştir. Grup içinde paylaşım hakkında görüş bildiren üç öğrenciden ikisi grup olarak öğrendikleri bilgileri ve aldıkları notları birbirileriyle paylaştıklarını, bir öğrenci ise grup olarak birbirlerine yardımcı olamadıklarını belirtmiştir. Grubun hazırlığı hakkında görüş bildiren iki öğrenci grupça kütüphaneye gidip çalışarak ön hazırlık yaptıklarını belirtmiştir. Öğrencilerin gruplarıyla ilgili düşüncelerine örnek olarak;

'Grup içinde herkes birbiriyle uyumluydu. Yeni bilgiler bulduğumuzda ders sırasında birbirimizle paylaşım içinde oluyorduk. Ders sonrası kütüphaneye giderek yeterince çalışıyorduk.' (Ş.Ö.)

'Birbirimizle fazla uyumlu değildik aslında tartışma yapılırken o tartışma gerçekten olduğunu düşünüp birbirlerimize cephe almaya başlamışlardı. Tartışmaların "kasıtlı" olduğunu düşünmeye başlamışlardı. Bu benim düşüncem tabii.' (H.A)

Kendiniz

Öğrencilerin çoğunluğu (17 öğrenci) kendileriyle ilgili önemli gelişme gördüklerini belirtmişlerdir. Sadece bir öğrenci aktif olamadığını belirtirken iki öğrenci hem iyi hem kötü olduğunu, bir başkası ise iletişim yeteneğinin az olması ve eğitmenden çekinmesi nedeniyle sürece katılamadığını belirtmiştir.

Kendileriyle ilgili olumlu görüş bildiren öğrencilerden ikisi sorgulamayla ilgili beceriler kazandığını; beş öğrenci kendi kendine öğrenme, bilgiye ulaşma ve araştırma becerilerinin geliştiğini; biri kendi kendine öğrendiği için öğrendiği bilgilerin daha kalıcı olduğunu; ikisi grup arkadaşlarıyla çalışma ve iletişim kurma olanaklarının arttığını, biri kendini ifade etme becerisi kazandığını, bir diğeri tartışma yapmayı öğrendiğini, biri kalıcı eğitimi fark ettiğini yazmıştır.
Öğrencilerin grup çalışmasına katılımları farklı olmuştur. Şöyle ki iki öğrenci grupla çalışmak yerine bireysel çalışmayı tercih ettiklerini, biri gruba katkısında eksiği olduğunu, biri aktif olmadığını belirtmiştir.

Öğrencilerin üçü süreç boyunca kendilerinin aktif ve iyi olduklarını bildirmişlerdir. Öğrencilerin kendileri ile ilgili görüşlerine örnek olarak;

'Araştırma konuları sayesinde öğrenme becerilerim gelişti.' (E.U.)

‘Ben sayısal derslere çok çok çalışmalıyım ki iyi anlayabileyim. Grup çalışması iyi oldu aslında fakat benim için tek çalışmak her zaman daha verimli.’ (İ. K.)

‘Nasıl düşünüleceğinin, bilginin nasıl kullanılacağımı, kendime soru sormasını öğrendim. Tartışmayı sevdiğimi gördüm. ‘ (H.A)

Genel Kimya Sunumu

Bu bölüm ile ilgili görüş bildiren toplam 21 öğrenciden 20’si eğitmenle ilgili değerlendirme yaparken biri eğitmeni değerlendirmemiştir. Eğitmenleri değerlendirenlerden biri zamanın yeterli kullanıldığını üçü zamanın yeterli kullanılmadığını yazarken bir öğrenci PDÖ’yü zaman kaybı olarak görmüştür. Bir öğrenci sunumu iyi olarak nitelendirirken başka bir öğrenci sunumu başarılı olarak nitelendirmiştir. Bir öğrenci eğitmenin kendilerine yardımcı olduğunu belirtmiştir. Aynı gruptaki bir öğrenci sunumun bireysel ilgi uyandırdığından, diğeri beyin fırtınası doğurduğundan ve pekiştirme yaptıklarından, bir diğeri de sunucunun yeterli olduğundan bahsetmiştir. İki öğrenci sunumun etkili olmadığını düşünmüştür çünkü onlara göre öğrenci doğruyu eğitmenden hazır almalıydı. (Geleneksel olarak öğrencinin pasif öğretmenin aktif olduğu bir öğrenme ortamı isteme eğiliminde bu öğrenciler) Bir öğrenci de öğrencilerin derse katılımını değiştirmediğinden (normal derse katılan öğrencilerin PDÖ’ye katıldıklarını, normalde derse katılmayanların PDÖ’ye katılmadıkları), PDÖ’yü zaman kaybı olarak nitelendirmiştir. Bir öğrenci sunumun günlük hayatla ilişkili olduğundan bahsetmiştir. Bir öğrenci sunumun araştırmaya yönlendirdiğini bir diğeri de bilgiyi kullanmayı öğrettiğini yazmıştır. Bir öğrenci sunumun anlaşılırlığı artırdığından, bir öğrenci ise kişi sayısı azlığının verimi artırdığından bahsetmiştir. Genel kimya sunumu ile ilgili görüş bildiren öğrencilerin görüşlerine örnek olarak;

‘Bence bu sunumun fazla faydalı olduğunu sanmıyorum. Böyle işleyeceğimize normal kimya dersinde bu konulardan bahsetseydik dahi iyi olurdu, diye düşünüyorum. Çünkü derse katılanlar da, derse katılmayanlar da hep aynı kişilerdi. Yani bir değişiklik olduğunu pek sanmıyorum. Bence bu sunum zaman kaybına yol açtı. Bir konu hakkında değil de normal ders işlenseydi daha iyi olurdu .’ (S.E.)

‘Zaman çok kısıtlıydı. İçerik bakımından katkısı oldu. Devam etmesi gereken bir sistem.’ (İ.Y.)

Genel Kimya Laboratuvarı

Bu bölüm ile ilgili görüş bildiren toplam 21 öğrenciden 18’i laboratuvarın kullanıldığını belirtirken, üçü laboratuvarın ve ekipmanlarının kullanılmadığını belirtmişlerdir.
İki öğrenci laboratuvarın çalışmaya (PDÖ) uygun olduğunu, biri PDÖ’nün laboratuvarda yapılması gerektiğini belirtirken bir öğrenci laboratuvar uygulamasını iyi olarak değerlendirmiştir.
Bir öğrenci laboratuvarın öğrenmeye katkı sağladığını, biri rapor hazırlamanın zor olsa da uygulamada bir şeyler öğrendiğini, biri eğitici ve akıcı olduğunu, biri grup olarak daha iyi çalışıp tartışabildiklerini, biri öğrenmeyi hayatla ilişkilendirip kalıcı öğrenme sağladığını, biri çalışmaya sevk ettiğini; biri teorik bilginin kalıcılığını ve derse ilgiyi artırdığını, biri öğrenmeyi desteklediğini ve kalıcılığı artırdığını, biri kalıcılığı artırdığını ve zamanın verimi kullanıldığını, biri deneysel ve teoriyi birleştirdiğini yazmıştır. Bir öğrenci ise laboratuvarın PDÖ’ye olmasa da eğitime katkı sağladığını belirtmiştir. (Bu öğrenci eğitmeni aktif ekipmanı sınırlı olarak görse de asıl sorunun konu alanıyla ilgili olduğu fikrindedir. Yani laboratuvar uygulamasının PDÖ modülünü desteklemediğini düşünmektedir). Genel kimya laboratuvarı ile ilgili görüş bildiren öğrenci görüşlerine örnekler;

‘Laboratuvar dersinin bana katkısın olduğunu düşünüyorum Uygulamalı öğretim tekniklerinin öğrenciye her zaman bir katkısının olduğunu düşünüyorum.’ (H.A.)

‘Laboratuvar ortamının çalışmamıza hiçbir ters etkisi olmadı. Grup ile daha iyi çalışma ve tartışma ortamı yarattı.’ (Ş.Ö.)

Bilimsel Danışma

Bilimsel danışma hizmetiyle ilgili olarak görüş bildiren 12 öğrenciden sekizi bilimsel danışma hizmeti aldıklarını ve bunun olumlu olduğu yönünde görüş bildirirken, dördü danışma hizmeti almadıklarını belirtmişlerdir.
Danışmanlık aldıkların belirten 12 öğrencinden yedisi eğitmen yaklaşımının olumlu, eğitmenin sevecen olmasından, konuya hâkim olmasından, zamanı iyi kullanmasından ve eğitmen yardımsever olduğundan danışmanlık hizmetini olumlu olarak değerlendirmişlerdir. Bir öğrenci ise danışmanlık hizmetinin niteliği konusunda herhangi bir görüş belirmemiştir.

Danışman hizmeti almadıklarını belirten bu dört öğrenciden biri olumlu görüş bildirirken diğerleri herhangi bir görüş bildirmemiştir. Danışmanlık hizmetiyle ilgili öğrenci değerlendirmelerine göre üç eğitmene ait gruplardaki öğrencilerin danışmanlık hizmeti aldıklarını belirtmelerine rağmen, diğer iki eğitmenin gruplarındaki öğrencilerin danışmanlık hizmeti alıp almadıklarıyla ilgili çelişkili görüşlere sahip oldukları belirlenmiştir. Bu durumun öğrencilerin PDÖ değerlendirmesine aşina olmadıkları için eğitmenin rolünü anlayamamalarından kaynaklandığı söylenebilir. Danışmanlık hizmeti ile ilgili görüş bildiren öğrencilerin görüşlerine örnek olarak;

'Bilimsel danışma hizmetini aldım, danışmanım yaklaşımı olumlu yöndeydi.' (T.K.)

'Bilimsel danışma hizmeti almadım. Bize yaklaşımı iyiydi.' (T.V.)

Görüş ve Öneriler

Dört öğrenci PDÖ'nün devamını istemiştir (bunlardan biri sözel derslerde kullanılmasını istemiştir). Bu öğrencilerden bir zamanının arttırılmasını, başka biri oturum sayısının artırılmasını ve eğitmenin konu uzmanı olmasını ve soyut derslerde uygulanmasını istemiştir.

Yedi öğrenci PDÖ için olumlu görüş bildirmiş ve yararlı olduğunu çünkü derse hazırlıklı gelmeyi ve konuyu sevmeyi sağladığını (bir öğrenci); çalışmaya yönelttiğini ve verimli olduğunu (bir öğrenci); eğitimcinin iyi bir rehber olduğunu (bir öğrenci); öğretici olduğunu (bir öğrenci); işbirliğini artırdığını (bir öğrenci); işbirlikçi ve kalıcı olduğunu (bir öğrenci); senaryonun ilgi çekici olduğunu (bir öğrenci); ön hazırlık yapmanın tartışmayı sağladığını (bir öğrenci); araştırmaya yönelttiğini, tartışmayı sağladığını ve sorularla ilginin uyanık tutulduğunu (bir öğrenci) belirtmişlerdir.

İki öğrenci öğrenmeye katkısı olmadığını veya normalde derse katılmayan öğrencileri derse katsa da bu katılımın kısa sürdüğünü düşündüğünden PDÖ ile ilgili olumsuz görüş bildirmiştir. PDÖ'nün olumlu ve olumsuz yönü olarak belirtilen katılım değişkeninin geleneksel pasif öğrenci tarzından (bilgiyi hazır alan, derse sınav harici çalışmayan) aktif öğrenciliğe değişen bire uyum sürecini gerektirmesi ve bu uyuma ayak sağlayamayanların PDÖ sürecinde etkin katılım gösterememeleri nedeniyle olduğu düşünülmektedir. PDÖ ile ilgili görüş ve öneriler bildiren öğrencilerin görüşlerine örnek olarak;

'Bence bu uygulama her derste yapılmalı. Öğrenci derse daha hazırlıklı olarak gelir ve kendi araştırma yapacağından konuyu özellikle dersi daha çok iyi sever, konu hâkimiyeti olacağından derse daha istekli katılır. Herkesin yararına.' (Ş.Ö.)

'Genel olarak öğrenme sürecine katkısı pek olumlu olmadı. Bir de derste tek bir hocanın anlattığı konuyu herkes aynı şekilde dinliyordu. Ancak burada farklı hocaların yönlendirmesiyle kendi araştırmamız ile öğrenmeye çabaladık. Modül sonunda her öğrencinin kazanımları aynı değildir.' (T.V.)

SONUÇ

Kuşdemir, Ay ve Tüysüz (2013), PDÖ'nün 10. sınıf kimya dersi "Karışımlar" ünitesinde etkisini ön test-son test kontrol gruplu yarı deneysel modelle incelemişler; başarı, tutum ve motivasyon bakımından deney grubundaki öğrencilerin lehine anlamlı bir fark bulmuşlardır. Deney grubundaki öğrenciler PDÖ'yü özgüven, araştırma-problem çözme-grupla çalışma-bilgiye ulaşma becerisi, bilgi düzeyi, kimyaya ilgi, eleştiriye açıklık özelliklerinin geliştiğini; grup çalışmalarının zevkli olması, internet kullanmaları ve ön hazırlık yapmaları nedeniyle beğendiklerini fakat grup çalışmalarındaki sorunlardan dolayı beğenmediklerini belirtmişlerdir. Öğrenciler geliştirdikleri ilgi ve yetenekler dolayısıyla kendilerini başarılı bulurken; uygulamanın kısa olduğunu, bilgiyi problem çözümünde kullanamadıklarını ve çalışmaya katılımda isteksiz olduklarını belirtmişlerdir.

Tosun ve Taşkesenligil (2012), Fen Bilgisi Öğretmenliği öğrencileriyle Genel Kimya dersinde PDÖ'nün etkisini ön test-son test kontrol gruplu yarı-deneysel desen kullanarak araştırmıştır. Bulgular yöntemin öğrenmede güdüsel stratejiler (motivasyon, öz düzenleme ve kaynak yönetimi stratejisi) bakımından deneysel grup lehine anlamlı bir farklılık oluşturduğunu göstermiştir. Ayrıca deney grubundaki öğrencilerle yapılan mülakatlarda öğrencilerin sınıf çalışmalarını tercih ettikleri, öğrendiklerini başka derslerde kullanabildikleri ve temel ve karmaşık kavramları öğrendikleri, kimyaya karşı olumlu tutum kazandıkları, sınav kaygısı duymadıkları, farklı kaynaklardan edindikleri bilgileri bir araya getirebildikleri, çalışma tarzlarını değiştirdikleri ve gerektiğinde arkadaşlarının yardımına başvurabildikleri belirlenmiştir.

Tatar, Oktay ve Tüysüz (2009), Fen Bilgisi Öğretmenliği öğrencileriyle Isı ve Madde dersinde termodinamiğin birinci yasası konusunda PDÖ uygulamış ve öğrencilerin bu uygulama yönelik görüşlerini almak için mülakat yapmışlardır. Bulgulara göre PDÖ'nün avantajları bilgi kaynaklarını kullanma, grupla ve işbirliği içerisinde çalışma, yüksek motivasyon ve pozitif tutum, akılda kalıcılık, iletişime geçme, problem çözme ve kendi kendine öğrenme iken dezavantajları sınırlı zaman, yönteme alışkın olmama, grupların yapısı ve yetersiz işbirliği, değerlendirme problemi, eksik bilgi edinme ve iletişim problemi olarak belirlenmiştir.

ÖNERİLER

Araştırmaya Yönelik Öneriler

Bu çalışmada, yapılan bir PDÖ uygulaması hakkında öğrencilerin görüşleri alınmıştır. Öğrenci sayısının fazlalığından dolayı öğrenci görüşleri değerlendirme formu ile belirlenmiştir. Nitel araştırmalarda sadece yazılı dokümanlardan faydalanmak yeterli olmamaktadır. Ayrıca görüşme (Mülakat) ve gözlem yöntemlerinin de kullanılmasıyla Çeşitleme (triangulation) yapılması ulaşılan sonuçların geçerliliği ve güvenilirliğini artıracaktır. Bu çalışmada her PDÖ grubuyla odak grup görüşmesi yapılarak süreç hakkında daha ayrıntılı bilgi edinilebilir.

PDÖ'de değerlendirme çalışmaları öğrencilerin değerlendirilmesi, öğretmenin değerlendirilmesi ve öğrenme sürecinin değerlendirilmesi ile yapılmaktadır (Şenocak, 2006). Öğrenci değerlendirmesi yazılı sınav, öz ve akran değerlendirme ve öğretmenin öğrenciyi süreç boyunca takibi şeklinde yapılır (Şenocak, 2006). Öğretmenin ve öğrenme sürecinin değerlendirilmesi ise öğrencilere belli aralıklarla verilen formlarla yapılmaktadır (Şenocak, 2006). Bu çalışmada öğrenci, öğretmen ve öğrenme sürecinin değerlendirilmesi için PDÖ uygulamasının sonunda öğrenci görüşlerine başvurulmuştur. Öğretmenlerin de değerlendirme sürecine katılması gerekmektedir.

Değerlendirme sayısının artırılması PDÖ'de iyi gitmeyen yönlerin düzeltilmesi için öğretmene ve öğrencilere bir geri bildirim sağlayacaktır. Uygulamanın sayısının artırılması, öğrenci ve öğretmenlerin sürece alışmalarını ve güvenilir değerlendirmelerde bulunmalarını kolaylaştıracaktır.

Araştırmalar uzun bir sürece yayılması PDÖ'ye yönelik öğrenci ve uygulamayı yapan öğretmenin görüşlerinin daha ayrıntılı bir şekilde değerlendirilmesini de sağlayacaktır (Kılınç, 2007).

Uygulamaya Yönelik Öneriler

1. PDÖ sürecinde öğrencilerin ders dışında da bir araya gelmeleri gerektiğinden gruplar oluşturulurken öğrencilerin istekleri göz önüne alınmalıdır (Kuşdemir, Ay ve Tüysüz, 2013).
2. Grup çalışmalarında görev paylaşımı yapılması ve herkesin görevini yerine getirmesi hususunda öğrencilere rehberlik yapılmalıdır (Kuşdemir, Ay ve Tüysüz, 2013).
3. PDÖ'nün uygulanması sürecinde yaşanan zaman problemini aşmak için hem öğrenciler hem de öğretmen ciddi bir ön hazırlık yapmalıdır (Kuşdemir, Ay ve Tüysüz, 2013).
4. Üniversitelerin öğretim yöntemlerinde yenilikçi olması ve çağı yakalaması için Tıp'ta olduğu gibi başta eğitim fakültelerinde olmak üzere PDÖ gibi yapılandırmacı yaklaşımların uygulanmasına yönetimlerce karar vermeli ve uygulamaya konmalıdır. Bu surecin ardından ilk ve ortaöğretimde PDÖ kullanımı yaygınlaşabilecektir. Böylece eğitim sistemimiz bilgi depolayan ve sınavları aşan bireyler yerine bilgi edinme yollarını problem çözümünde kullanan ve edindiği bilgiyi hayatında yeni olgularda kullanabilen kişiler yetiştirebilir. Bu ise küresel rekabet ve gelişme gösterebilmemiz için ihtiyacımız olan eğitimli insan potansiyelinin oluşmasına ve gelecek için daha bilinçli bireylerin yetişmesine yardımcı olacaktır (Koçakoğlu, 2010).
5. Geleneksel öğretim yöntemleri, uygulanmasının kolay olması veya öğreticinin yeni yöntemlerden haberdar olmamasından dolayı tercih edildiğinden PDÖ, öğretmen adaylarına lisans eğitimi sırasında verilmeli ve ilgili üniversite müfredatı zenginleştirilmelidir. İlk ve orta dereceli okullarda görev yapan öğretmenlerin büyük bir çoğunluğu geleneksel yöntemleri tercih ettiğinden okul yönetimine ve MEB teftiş kurullarına büyük görevler düşmektedir (Kılınç, 2007). Bu kapsamda değerlendirildiğinde gelenekselci öğretmenlerin hem okulda uygulama yapan öğretmen adaylarına hem de stajyer öğretmenlere iyi örnek olmamaları da söz konusudur.
6. PDÖ'nün hayata geçirilmesi için bu alanda yetişmiş uzmanlara görev verilmesi ve bürokratik kolaylıkların sağlanması gereklidir ayrıca araç-gereç ve ders kitapları da hazırlanmalıdır (Kılınç, 2007).

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EKLER

EK 1: Problem Durumu (I. Eğitim Oturumu, 1. Bölüm'de Kullanılan)

Rüknettin Takoz, Ankara Üniversitesi Kimya Mühendisliği bölümünde yeni ve yenilenebilir enerji kaynakları ile ilgili bitirme tezi hazırlamaktadır. Tezi kapsamında hidrojenin 21. yüzyılın enerji kaynağı olup olamayacağını her yönüyle aydınlatacaktır.
Sizce Rüknettin Takoz neyi aydınlatmak zorundadır?

Hidrojenin; 21. yüzyılın potansiyel enerji kaynağı olup olamayacağını

Hidrojenin 21. yüzyılın enerji kaynağı olup olamayacağına ilişkin hipotezlerinizi ve nedenlerini sıralayınız.

Evrende en çok bulunan elementlerden biri olması Yandığı zaman daha fazla enerji açığa çıkıyor olması Yan ürünlerinin çevreye zarar vermemesi (ATIK H_2O) Boru hatları ve tankerlerle çok uzak mesafelere taşınabiliyor olması (sıvı hidrojen) Güneşin yüzeyinde gerçekleşen ve yüksek sıcaklık oluşumuna yol açan kaynamaların bir yakma sistemi içerisinde oluşturulabileceğinin düşünülmesi nedenlerinden dolayı geleceğin yakıtı olabilir.

Olayı aydınlatabilmek için hangi bilgilere gereksinim duyarsınız? Gerekçeleri ile tartışınız.

Hidrojen elementinin fiziksel ve kimyasal özellikleri nelerdir? Hidrojen nasıl elde ediliyor? Hidrojen yandığında ne gibi yan ürünler açığa çıkıyor? Hidrojen yandığında ne kadar ısı açığa çıkıyor? Hidrojenin füzyon tepkimesine yatkınlığı var mıdır? (füzyon=birleşme)

EK 2: Öğrencilerin Modül İçi Etkinlikleri Değerlendirme Formu Örnek Madde

1. Eğitim Yönlendiricisi

Eğitim Yönlendiricisini; öğrenme sürecine katkısı, eleştirel düşüncenin gelişimine katkısı, bağımsız öğrenme becerilerinin gelişimine katkısı, değerlendirme becerilerinin	Görüş ve Önerileriniz:

gelişimine katkısı, iletişim becerilerinin gelişimine katkısı ve motivasyonu /etkinliği açısından değerlendiriniz	

EK 3: Öğrenci Değerlendirme Formlarının Kodlamasına Örnek

Senaryo çok iyi bir şekilde anlaşılırdı ve öğrenme konusunda beni çok doğru bir şekilde yönlendirdi. Güncel konularda yani hidrojen kullanılması falan günceldir.	EĞİTMEN Yönlendirici SENARYO güncel.

TEACHER CANDIDATES'VIEWS ON SUSTAINABLE DEVELOPMENT

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ABSTRACT: The purpose of this research is to determine and evaluate the teacher candidates' views in various branches about sustainable development. Teacher candidates who were students in various teaching departments in 2012-2013 academic year spring semester in a public university form the study group of this research. 22 female, 13 male in total 35 teacher candidates are in the participant group. Phenomenology research design is used in the research. Teacher candidates were chosen from different departments such as science teaching, mathematics teaching, primary school teaching, pre-school teaching, social sciences teaching, geography teaching, biology teaching, Turkish language teaching and art teaching departments. The data of the research were gathered by means of the half-developed 5 interview questions prepared by the researchers. For the validity of the questions, 5 researchers who are experts in their fields were consulted for their views. During the half-developed interviews, the participants were asked what the sustainable development is, what its importance is, individual contributions of the candidates to the sustainable development, how the sustainable development activities are. The content analysis of the qualitative data methods will be used to resolve the gathered qualitative data. The documents gathered by means of putting the results of the interview in writing will be analyzed via HyperRESEARCHTM 2.6.1. qualitative analysis programme so as to see the data relation and provide convenience while coding. At the end of the research, it is revealed that teacher candidates do not have enough information about what the sustainable development and its importance is and they do not act enough for the sustainable development.

Key words: sustainable development, environment, teacher candidates

ÖĞRETMEN ADAYLARININ SÜRDÜRÜLEBİLİR KALKINMAYA İLİŞKİN GÖRÜŞLERİ

ÖZET: Bu araştırmanın amacı, çeşitli branşlarda öğrenim gören öğretmen adaylarının sürdürülebilir kalkınmaya ilişkin görüşlerini belirlemek ve bu görüşleri değerlendirmektir. Araştırmanın çalışma grubunu 2012-2013 eğitim-öğretim yılı bahar döneminde bir devlet üniversitesinin çeşitli öğretmenlik lisans programlarında öğrenim gören öğretmen adayları oluşturmaktadır. Katılımcı grubunda 22'si kız, 13'ü erkek olmak üzere toplam 35 öğretmen adayı yer almaktadır. Araştırmada olgubilim araştırma deseni kullanılmıştır. Öğretmen adayları fen bilgi öğretmenliği, matematik öğretmenliği, sınıf öğretmenliği, okul öncesi öğretmenliği, sosyal bilgiler öğretmenliği, coğrafya öğretmenliği, biyoloji öğretmenliği, Türkçe öğretmenliği ve resim iş öğretmenliği gibi farklı branşlardan seçilmiştir. Araştırmanın verileri araştırmacılar tarafından hazırlanan yarı-yapılandırılmış 5 adet görüşme sorusu ile toplanmıştır. Soruların geçerliği için alanında uzman 5 araştırmacının görüşüne başvurulmuştur. Yarı yapılandırılmış görüşmeler esnasında katılımcılara sürdürülebilir kalkınmanın ne olduğu, önemi, bireysel olarak adayların sürdürülebilir kalkınmaya yönelik katkıları, sürdürülebilir kalkınma faaliyetlerinin nasıl olduğuna yönelik sorular yöneltilmiştir. Elde edilen nitel verilerin çözümlenmesi için nitel veri analiz yöntemlerinden içerik analizi kullanılmıştır. Görüşme sonuçlarının yazılı hale getirilmesi ile elde edilen dokümanlar, veriler arası ilişkilerin görülmesi ve kodlama yapılırken kolaylık sağlanması bakımından HyperRESEARCHTM 2.6.1. nitel analiz programı ile analiz edilmiştir. Araştırma sonucunda öğretmen adaylarının sürdürülebilir kalkınmanın ne olduğuna ve önemine ilişkin yeteri kadar bilgi sahibi olmadıkları, sürdürülebilir kalkınmaya yönelik çok fazla faaliyette bulunmadıkları ortaya çıkmıştır.

Anahtar sözcükler: sürdürülebilir kalkınma, çevre, öğretmen adayları

GİRİŞ

Yaklaşık 2,5 milyon yıl önce, insanoğlunun yerküreye adım atmasıyla insan ve çevre etkileşimi de başlamıştır. Ancak yüzyıllar boyunca doğayı tükettiğinin farkına varamayan insanoğlu, çevre sorunlarının küreselleşmesiyle birlikte 19. yüzyıldan itibaren, çevre ile olan ilişkisinde pek çok sorunla karşılaşmıştır. Genel olarak çevre sorunları şeklinde tanımlanan bu sorunlar, doğa ve doğa kaynaklarının sürekli, aşırı ve yanlış kullanımı ile doğanın temel fiziksel öğeleri olan su, hava ve toprak kirlenmesinin doğal dengeler üzerinde meydana getirdiği bozulmalardır (Keleş ve Hamamcı, 2002; Kışlalıoğlu ve Berkes, 2007). Bu sorunlar nedeni ile günümüzde artık sağlıklı bir çevrede yaşamak, temel insan haklarından biri olarak kabul edilmekte ve insanlığın en büyük görevlerinden birinin gelecek nesillere yaşanacak bir çevre bırakmak olduğu vurgulanmaktadır (Uzun ve Sağlam, 2005). Gelecek nesillere kaynakları tamamen tüketilmemiş, yaşanılabilir bir çevre bırakma fikri ancak sürdürülebilir kalkınma ile mümkündür.

Brundtland Raporu'na göre sürdürülebilir kalkınma, "günümüzün ihtiyaçlarının, gelecek kuşakların ihtiyaçlarını karşılama kabiliyetini ortadan kaldırmayacak şekilde karşılanmasıdır" (Görmez, 2003). BM Çevre Programı (UNEP), Uluslararası Doğa ve Doğal Kaynakları Koruma Birliği (IUCN) ve Çevre ve Kalkınma Üzerine Dünya Komisyonu, WWF tarafından yapılan diğer bir tanıma göre sürdürülebilir kalkınma, "yaşam kalitesinin, çevredeki yaşamı destekleyici doğal sistemlerin taşıma kapasitesi içerisinde kalacak şekilde iyileştirilmesidir". Sürdürülebilir kalkınma, çevre politikalarıyla kalkınma stratejilerinin bütünleştirildiği bir çevredir (Keleş, 2007).

Sürdürülebilir kalkınmanın en temel hedeflerinden biri çevre eğitimine yönelik faaliyetlerinin düzenlenmesini ve geliştirilmesini sağlamaktır. Bireylerin, gelecek nesiller ve tüm insanlık için sürdürülebilir kalkınma çerçevesi içinde, çevre ve çevre sorunlarına karşı daha bilinçli, daha sorumlu ve hazırlıklı olmalarını sağlayacak amaç ve yöntemler kazandırmak çevre eğitiminin temel hedefleri arasında olmalıdır (Bülbül, 2007). Örgün eğitim sistemi içerisinde çevre eğitiminin bu hedefini gerçekleştirmek elbette ki bu bireyleri yetiştirecek öğretmenlere bağlıdır. Dolayısıyla geleceğin öğretmenleri olan öğretmen adaylarına çevre eğitimi verirken, onların bir zincirin en önemli halkalarından biri olduğu unutulmamalı ve her biri planlı, etkili bir çevre eğitimi sürecine tabi tutulmalıdır. Öğretmen adaylarına, bir yandan çevre ve çevre sorunlarına yönelik bilgiler aktarılırken diğer yandan çevreye yönelik tutumlarının gelişmesi sağlanmalı ve bu tutumların davranışa dönüştürülmelidir (Güven, 2011). Öğretmenlerin her birinin çevreye yönelik gerekli olan değer yargılarını kazanması ve yaşam biçimlerinin değiştirmesi sürdürülebilir kalkınma ve gelişme için potansiyel olarak önemli bir ajandır. Bu önemli potansiyeli kullanmak için yenilikçi öğretmen eğitimi gereklidir ve eğitim fakülteleri bu değişimi gerçekleştirme potansiyeline sahiptir (UNESCO, 2002). Bu fikirden yola çıkarak, bu çalışma ile çeşitli öğretmenlik lisans programlarında öğrenim gören öğretmen adaylarının sürdürülebilir kalkınmaya ilişkin görüşlerini belirlemek ve bu görüşleri değerlendirmek amaçlanmıştır.

YÖNTEM

Bu araştırmada araştırmanın amacına uygun olan verileri elde etmek için nitel araştırma yöntemlerinden olgubilim (fenomenoloji) yöntemi kullanılmıştır. Uygulama sürecinde öğretmen adaylarının sürdürülebilir kalkınmaya yönelik fikirleri alınarak onların konuya ilişkin var olan olguları incelenmiştir. Fenomenolojik yöntem, insanların fenomenleri, yaşadıkları deneyimleri nasıl algılayıp anlamlandırdıklarını, nasıl hatırladıklarını, nasıl tarif ettiklerini, nasıl değerlendirdiklerini ve diğer insanlara nasıl aktardıklarını ortaya koyan araştırmaları içerir (Patton, 2002). Verilerin toplandığı katılımcılar amaçlı örnekleme ile toplanmıştır (Cohen, Monion ve Morrison, 2007). Araştırmacılar farklı branşlarda öğrenim gören öğretmen adaylarının sürdürülebilir kalkınmaya yönelik görüşlerinin değişkenlik gösterip göstermediğini ortaya koymak için özellikle farklı branşlar öğrenim gören adaylar ile çalışmayı seçmiştir. Araştırmanın çalışma grubunu 2012-2013 eğitim-öğretim yılı bahar döneminde bir devlet üniversitesinin çeşitli öğretmenlik lisans programlarında öğrenim gören öğretmen adayları oluşturmuştur. Katılımcı grubunda 22'si kız, 13'ü erkek olmak üzere toplam 35 öğretmen adayı yer almıştır. Öğretmen adayları fen bilgi öğretmenliği, matematik öğretmenliği, sınıf öğretmenliği, okul öncesi öğretmenliği, sosyal bilgiler öğretmenliği, coğrafya öğretmenliği, biyoloji öğretmenliği, Türkçe öğretmenliği ve resim iş öğretmenliği gibi farklı branşlardan seçilmiştir.

Araştırmanın verileri araştırmacılar tarafından hazırlanan yarı-yapılandırılmış 5 adet görüşme sorusu ile toplanmıştır. Soruların geçerliği için alanında uzman 5 araştırmacının görüşüne başvurulmuştur. Elde edilen nitel verilerin çözümlenmesi için nitel veri analiz yöntemlerinden içerik analizi kullanılmıştır. Görüşme sonuçlarının yazılı hale getirilmesi ile elde edilen dokümanlar, veriler arası ilişkilerin görülmesi ve kodlama yapılırken kolaylık sağlanması bakımından HyperRESEARCHTM 2.6.1. nitel analiz programı ile analiz edilmiştir. Çalışmanın bulgularında katılımcıların söylemleri aynen korunarak bulgularda öğretmen adaylarının kendi cümleleri değiştirilmeden, doğrudan aktarılacağı için adayların kimliklerini deşifre etmemek amacıyla her bir öğretmen adayına Ö$_1$, Ö$_2$,Ö$_3$...şeklinde bir kod isim verilmiştir. Hangi kodlu öğrencinin hangi anabilim dalında öğrenim gördüğü ve cinsiyeti Tablo 1'de belirtilmiştir.

Tablo 1. Katılımcıların Kod İsimlerine Göre Cinsiyet Ve Öğrenim Gördükleri Anabilim Dalları

No	Cinsiyet	Bölüm	No	Cinsiyet	Bölüm
Ö$_1$	Kız	Okul öncesi Öğretmenliği	Ö$_{19}$	Kız	Sosyal Bilgiler Öğretmenliği
Ö$_2$	Kız	Biyoloji Öğretmenliği	Ö$_{20}$	Erkek	Sosyal Bilgiler Öğretmenliği
Ö$_3$	Erkek	Coğrafya Öğretmenliği	Ö$_{21}$	Kız	Biyoloji Öğretmenliği
Ö$_4$	Kız	Sınıf Öğretmenliği	Ö$_{22}$	Erkek	Türkçe Öğretmenliği
Ö$_5$	Kız	Sınıf Öğretmenliği	Ö$_{23}$	Kız	Biyoloji Öğretmenliği
Ö$_6$	Erkek	Sosyal Bilgiler Öğretmenliği	Ö$_{24}$	Kız	Biyoloji Öğretmenliği
Ö$_7$	Kız	Türkçe Öğretmenliği	Ö$_{25}$	Kız	Okul Öncesi Öğretmenliği
Ö$_8$	Kız	Matematik Öğretmenliği	Ö$_{26}$	Erkek	Sınıf Öğretmenliği
Ö$_9$	Erkek	Fen Bilgisi Öğretmenliği	Ö$_{27}$	Kız	Fen Bilgisi Öğretmenliği
Ö$_{10}$	Kız	Fen Bilgisi Öğretmenliği	Ö$_{28}$	Kız	Fen Bilgisi Öğretmenliği
Ö$_{11}$	Erkek	Fen Bilgisi Öğretmenliği	Ö$_{29}$	Kız	Sınıf Öğretmenliği
Ö$_{12}$	Kız	Fen Bilgisi Öğretmenliği	Ö$_{30}$	Erkek	Fen Bilgisi Öğretmenliği
Ö$_{13}$	Kız	Sınıf Öğretmenliği	Ö$_{31}$	Kız	Matematik Öğretmenliği
Ö$_{14}$	Kız	Sınıf Öğretmenliği	Ö$_{32}$	Erkek	Coğrafya Öğretmenliği
Ö$_{15}$	Kız	Fen Bilgisi Öğretmenliği	Ö$_{33}$	Erkek	Coğrafya Öğretmenliği
Ö$_{16}$	Erkek	Sosyal Bilgiler Öğretmenliği	Ö$_{34}$	Erkek	Fen Bilgisi Öğretmenliği
Ö$_{17}$	Kız	Okul Öncesi Öğretmenliği	Ö$_{35}$	Erkek	Sosyal Bilgiler Öğretmenliği
Ö$_{18}$	Kız	Resim-İş Öğretmenliği			

BULGULAR

Öğretmen adaylarının sürdürülebilir kalkınmaya ilişkin görüşlerini almak amacıyla öğretmen adaylarına beş adet açık uçlu soru yöneltilmiştir. Farklı branşlarda ve sınıf düzeyinde öğrenim görmekte olan öğretmen adaylarının sürdürülebilir kalkınmaya yönelik görüşleri belirlenmiştir.

Öğretmen adaylarına ilk olarak "Sizce sürdürülebilir kalkınma nedir?" sorusu yöneltilmiş ve Tablo 2'de öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 2. Öğretmen Adaylarının "Sizce Sürdürülebilir Kalkınma Nedir?" Sorusuna Verdikleri Cevaplara İlişkin Sıklık Verileri

Soru	Cevaplar	Öğretmen adayları	Sıklık
Sürdürülebilir kalkınma nedir?	Gelecek nesil ihtiyacı karşılama	Ö$_4$, Ö$_1$, Ö$_2$, Ö$_5$, Ö$_6$, Ö$_8$, Ö$_9$, Ö$_{10}$, Ö$_{11}$, Ö$_{12}$, Ö$_{13}$, Ö$_{14}$, Ö$_{16}$, Ö$_{17}$, Ö$_{18}$, Ö$_{19}$, Ö$_{21}$, Ö$_{22}$, Ö$_{23}$, Ö$_{24}$, Ö$_{25}$, Ö$_{26}$, Ö$_{27}$, Ö$_{28}$, Ö$_{29}$, Ö$_{30}$, Ö$_{31}$, Ö$_{32}$	28
	Kaynakların tükenmemesi	Ö$_2$, Ö,$_3$, Ö$_7$, Ö$_9$, Ö$_{11}$, Ö$_{27}$, Ö$_{33}$	7
	Yenilenemeyen enerji kaynaklarının korunması	Ö$_1$, Ö$_{11}$, Ö$_{14}$, Ö$_{28}$, Ö$_{32}$, Ö$_{21,}$ Ö$_{34}$	7
	İnsan-doğa dengesi	Ö$_4$, Ö$_5$, Ö$_{17}$, Ö$_{18}$, Ö$_{35}$	5
	"Emanet çevre" anlayışı	Ö$_{29}$, Ö$_{31}$	2
	Geri dönüşüm	Ö$_{15}$	1
	Kültürel katkı	Ö$_{20}$	1
	Nesiller arası etkileşim	Ö$_{20}$	1
	Döngü sürekliliği	Ö$_{26}$	1
	Geleceğe enerji aktarımı	Ö$_6$	1
	Bilinçlilik	Ö$_{20}$	1

Öğretmen adaylarının sürdürülebilir kalkınmayı tanımlarken Tablo 2'de verilen ifadeleri kullandıkları belirlenmiştir. Öğretmen adaylarının cevaplarının sürdürülebilir kalkınmanın gelecek nesillerin ihtiyacını karşılamaya yönelik yaşama olduğu (f=28), kaynakların tükenmemesi demek olduğu (f=7), yenilenemeyen enerji kaynaklarının korunması (f=6), insan ve doğa dengesi kurulması, "emanetçi çevre" anlayışı (f=2), geri dönüşüm (f=1), kültürel katkı (f=1), nesiller arası etkileşim (f=1), döngü sürekliliği (f=1), geleceğe enerji aktarımı (f=1), bilinçlilik (f=1) gibi ifadelerden oluştuğu görülmektedir. Öğretmen adaylarının verdiği cevaplardan alıntılara aşağıda yer verilmiştir.

Ö29; "*Bireyin çevresini miras değil emanet olarak görmesi ve o emaneti gelecek nesillere aktaracağının bilincinde olması*." (36.139, 07.03.2015).

Ö13; "*Gelecek kuşakların kendi ihtiyaçlarını karşılayabilme imkanlarını ortadan kaldırmadan bugünkü kuşakların ihtiyaçlarını karşılayabilmektir*." (41.587, 07.03.2015).

Ö26; "*Eldeki kaynakları dikkatli kullanıp geleceğe aktarmaktır. Döngülerin sürekliliğini bozmamak gerekir*." (28.899, 07.03.2015).

Ö15; "*Geri dönüşüm yapılan her şey sürdürülebilir kalkınmaya girer*." (43.547, 07.03.2015).

Öğretmen adaylarına ikinci olarak "Sizce sürdürülebilir kalkınmanın önemi nedir?" sorusu yöneltilmiş ve Tablo 3'de öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 3. Öğretmen Adaylarının "Sizce Sürdürülebilir Kalkınmanın Önemi Nedir?" Sorusuna Verdikleri Cevaplara İlişkin Sıklık Verileri

Soru	Cevaplar	Öğretmen adayları	Sıklık
Sürdürülebilir kalkınmanın önemi nedir?	Gelecek nesle verilen önem	Ö$_{30}$, Ö$_{28}$, Ö$_{27}$, Ö$_{25}$, Ö$_{24}$, Ö$_{23}$,Ö$_{22}$, Ö$_{21}$, Ö$_{20}$, Ö$_{18}$, Ö$_{17}$, Ö$_{16}$, Ö$_{13}$, Ö$_{12}$, Ö$_{11}$, Ö$_{10}$, Ö$_{9}$, Ö$_{8}$, Ö$_{5}$, Ö$_{2}$, Ö$_{1}$, Ö$_{35}$	21
	Kaynak tükenmesi	Ö$_{33}$, Ö$_{32}$, Ö$_{31}$, Ö$_{30}$, Ö$_{27}$, Ö$_{10}$, Ö$_{9}$, Ö$_{2}$, Ö$_{34}$	9
	Hayat kalitesini arttırma	Ö$_{29}$, Ö$_{26}$, Ö$_{19}$, Ö$_{5}$	4
	Çevre kirliliğini önleme	Ö$_{15}$, Ö$_{14}$, Ö$_{3}$	3
	Yaşam devamlılığı	Ö$_{7}$, Ö$_{6}$, Ö$_{4}$	3
	Kıtlık sorununun engellenmesi	Ö$_{6}$	1

Öğretmen adaylarının sürdürülebilir kalkınmanın önemi ile ilgili Tablo 3'de verilen ifadeleri kullandıkları belirlenmiştir. Öğretmen adaylarının cevaplarına göre, sürdürülebilir kalkınmanın gelecek nesillere önem verdiği için (f=21), kaynak tükenmemesini sağladığı için (f=8), hayatın kalitesini arttırdığı için (f=4), çevre kirliliğini önlediği için (f=3), yaşamın devamlılığını sağladığı için (f=3), kıtlık sorununu engellemeye yönelik (f=3), olduğu için önemli buldukları belirlenmiştir. Öğretmen adaylarının verdiği cevaplardan alıntılara aşağıda yer verilmiştir.
Ö22; "*Sürdürülebilir kalkınma olsun ki gelecek nesiller sağlıklı yaşasınlar*." (57.114, 07.03.2015).
Ö10; "*Sürdürülebilir kalkınma sayesinde doğal kaynaklar tükenmeden gelecek nesillere aktarılır*." (69.563, 07.03.2015).
Ö7; "*Bu dünyanın ve üzerinde yaşayan canlıların devamlılığını sağlar*." (59.256, 07.03.2015).
Ö6; "*Dünyanın ve insanların yaşam süresini uzatır. Gelecekte kıtlık vb. sorunların yaşanmasını engeller*." (71.208, 07.03.2015).

Öğretmen adaylarına üçüncü olarak "Sizce sürdürülebilir kalkınma faaliyetleri nelerdir?" sorusu yöneltilmiş ve Tablo 4'de öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 4. Öğretmen Adaylarının "Sizce Sürdürülebilir Kalkınma Faaliyetleri Nelerdir?" Sorusuna Verdikleri Cevaplara İlişkin Sıklık Verileri

Soru	Cevaplar	Öğretmen adayları	Sıklık
Sürdürülebilir kalkınma faaliyetleri nelerdir?	Doğal kaynakları koruma	Ö$_{1}$, Ö$_{2}$, Ö$_{6}$, Ö$_{8}$, Ö$_{10}$, Ö$_{11}$, Ö$_{12}$, Ö$_{13}$, Ö$_{22}$, Ö$_{25}$, Ö$_{29}$, Ö$_{30}$, Ö$_{34}$, Ö$_{35}$,	14
	Yenilenebilir kaynak kullanımı	Ö$_{7}$, Ö$_{15}$, Ö$_{17}$, Ö$_{18}$, Ö$_{19}$, Ö$_{21}$, Ö$_{24}$, Ö$_{26}$, Ö$_{27}$, Ö$_{28}$, Ö$_{32}$, Ö$_{33}$	12
	Bilinçlendirme	Ö$_{14}$, Ö$_{16}$, Ö$_{23}$, Ö$_{31}$, Ö$_{32}$, Ö$_{10}$	5
	Çevre eğitimi	Ö$_{9}$, Ö$_{15}$, Ö$_{29}$	3
	GAP	Ö$_{4}$, Ö$_{5}$, Ö$_{7}$	3
	Turizm	Ö$_{1}$, Ö$_{10}$	2
	Girişimcilik	Ö$_{4}$, Ö$_{7}$	2
	Geri dönüşüm	Ö$_{21}$	1

Öğretmen adaylarının sürdürülebilir kalkınmanın faaliyetlerine yönelik görüşleri ile ilgili Tablo 4'de verilen ifadeleri kullandıkları belirlenmiştir. Öğretmen adaylarının cevaplarına göre, sürdürülebilir kalkınma faaliyetlerinin, doğal kaynakları koruma (f=14), yenilenebilir kaynak kullanımı (f=12), bilinçlendirme (f=5), çevre eğitimi (f=3), GAP (f=3), turizm (f=2), girişimcilik (f=2) ve geri dönüşüm (f=1) olduğu tespit edilmiştir. Öğretmen adaylarının verdiği cevaplardan alıntılara aşağıda yer verilmiştir.

Ö32; "*Yenilenebilen enerji kaynaklarının kullanımının arttırılması ve halkın bilinçlendirilmesi*." (83.087, 07.03.2015).
Ö15; "*Yenilenebilen kaynakların kullanılması ve çevre eğitimine önem verilmesi.*" (89.779, 07.03.2015).

Ö10; "*Turizm ve doğal kaynakları koruma altına alma. Bilinçsizce tüm kaynakları tüketmemeliyiz. Çünkü o doğal kaynaklar da böyle giderse bir gün bitecek. Buna dikkat etmeli, planlı kullanmalıyız, tasarruf ederek…* " (103.215, 07.03.2015).

Ö30; "*Kaynakların kullanımının kontrol altına alınması*." (79,847, 07.03.2015).

Öğretmen adaylarına dördüncü olarak "Sizce sürdürülebilir kalkınma faaliyetleri nasıl arttırılabilir?" sorusu yöneltilmiş ve Tablo 5'de öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 5. Öğretmen Adaylarının "Sizce Sürdürülebilir Kalkınma Faaliyetleri Nasıl Arttırılabilir?" Sorusuna Verdikleri Cevaplara İlişkin Sıklık Verileri

Soru	Cevaplar	Öğretmen adayları	Sıklık
Sürdürülebilir kalkınma faaliyetleri nasıl artırılabilir?	Bilinçlendirme	Ö$_{32}$, Ö$_{30}$, Ö$_{28}$, Ö$_{25}$, Ö$_{24}$, Ö$_{23}$, Ö$_{22}$, Ö$_{21}$, Ö$_{19}$, Ö$_{17}$, Ö$_{16}$, Ö$_{11}$, Ö$_{10}$, Ö$_{8}$, Ö$_{7}$, Ö$_{6}$, Ö$_{5}$, Ö$_{4}$, Ö$_{1}$	19
	Bilmiyorum	Ö$_{26}$, Ö$_{20}$, Ö$_{15}$, Ö$_{14}$, Ö$_{13}$, Ö$_{12}$, Ö$_{34}$, Ö$_{35}$	8
	Eğitim	Ö$_{31}$, Ö$_{29}$, Ö$_{23}$, Ö$_{18}$, Ö$_{2}$	5
	Devlet teşviki	Ö$_{17}$, Ö$_{5}$, Ö$_{4}$, Ö$_{3}$, Ö$_{2}$	5
	Yenilenebilir enerji kaynak kullanımı	Ö$_{7}$	1

Öğretmen adaylarının sürdürülebilir kalkınmanın faaliyetlerini artırmaya yönelik görüşleri ile ilgili Tablo 5'de verilen cevaplar elde edilmiştir. Öğretmen adaylarının cevaplarına göre, sürdürülebilir kalkınma faaliyetlerinin, bilinçlendirme (f=19), eğitim (f=5), devlet teşviki (f=5) ve yenilenebilir enerji kaynaklarının kullanımı (f=1) ile artırılabileceğini düşündükleri belirlenmiştir. Ancak öğretmen adaylarının büyük bir kısmının bu konuda fikrinin olmadığı (f=8), tespit edilmiştir. Öğretmen adaylarının verdiği cevaplardan alıntılara aşağıda yer verilmiştir.

Ö28; "*Çevre bilinci arttırılarak insan davranışlarının doğaya yardımcı olması sağlanabilir*." (99.615, 07.03.2015).

Ö23; " *Dünya çapında bu konu hakkında seminerler düzenlenmeli, projeler yapılmalı ve insanların gerçekten bilinçlendirilmesi lazım*." (117.536, 07.03.2015).

Ö11; "*Halk ve bölge insanları ile birlikte bütün dünya devletlerinin çıkar gözetmeksizin tutarlı bir şekilde kullanımlarıyla ve bilinç duygusunu artırmak ile artırılabilir.*" (134.107, 07.03.2015).

Ö7; "*İnsanları yenilenebilir kaynaklara yönelterek…*" (94.467, 07.03.2015).

Öğretmen adaylarına son olarak "Sürdürülebilir kalkınmaya katkı sağlama bakımından kendinizi nasıl değerlendiriyorsunuz?" sorusu yöneltilmiş ve Tablo 6'da öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 6. Öğretmen Adaylarının "Sürdürülebilir Kalkınmaya Katkı Sağlama Bakımından Kendinizi Nasıl Değerlendiriyorsunuz?" Sorusuna Verdikleri Cevaplara İlişkin Sıklık Verileri

Soru	Cevaplar	Öğretmen adayları	Sıklık
Sürdürülebilir kalkınmaya katkı sağlama bakımından kendinizi nasıl değerlendiriyorsunuz?	Yetersiz	Ö$_{11}$, Ö$_{14}$, Ö$_{25}$, Ö$_{26}$, Ö$_{27}$, Ö$_{34}$, Ö$_{35}$, Ö$_{5}$, Ö$_{9}$, Ö$_{33}$	10
	İyi düzeyde	Ö$_{16}$, Ö$_{19}$, Ö$_{21}$, Ö$_{22}$, Ö$_{23}$, Ö$_{29}$	6
	Geri dönüşüme duyarlı	Ö$_{1}$, Ö$_{15}$, Ö$_{24}$, Ö$_{28}$	4
	Kaynakları dikkatli kullanan	Ö$_{1}$, Ö$_{4}$, Ö$_{18}$, Ö$_{32}$	4
	Bilgi veren	Ö$_{8}$, Ö$_{20}$,Ö$_{30}$	3
	Yenilenebilir kaynakları kullanan	Ö$_{3}$, Ö$_{7}$, Ö$_{32}$	3
	Bilinçli tüketici	Ö$_{17}$, Ö$_{18}$, Ö$_{31}$	3
	Tasarruf eden	Ö$_{1}$, Ö$_{4}$	2

Öğretmen adaylarının sürdürülebilir kalkınmaya katkı sağlama açısından kendilerini nasıl değerlendirdikleri sorusuna verilen cevapların büyük bir kısmının yetersiz (f=10) ifadesinden oluştuğu görülmektedir. Bununla birlikte yine bir kısmının kendisini yeterli gördüğü sonucu ortaya çıkmış (f=6). Diğer cevapların geri dönüşüme duyarlı (f=4), kaynakları dikkatli kullanan (f=4), bilgi veren (f=3), yenilenebilir kaynakları kullanan (f=3), bilinçli tüketici (f=3) ve tasarruf eden (f=3) bireyler olarak kendilerini değerlendirdikleri belirlenmiştir. Öğretmen adaylarının verdiği cevaplardan alıntılara aşağıda yer verilmiştir.

Ö32; "*Yenilenebilen enerji kaynaklarını kullanıyorum. Yenilenemeyen enerji kaynaklarının kullanımında dikkatli oluyorum*." (128.421, 07.03.2015).

Ö28; "*Sadece geri dönüşüm konusunda katkı sağlayabildiğimi ve elimden geleni yaptığımı düşünüyorum*." (131.258, 07.03.2015).

Ö7; "*Mümkün oldukça yenilenebilir kaynakları kullanıyorum. Bu sayede sürdürülebilir kalkınmaya katkı sağlayan bir birey olduğumu düşünüyorum*." (124.533, 07.03.2015).

Ö8; "*Öğrencilerime bilgi verebilirim*." (130.995, 07.03.2015).

SONUÇ

Bu araştırmada farklı branşlarda öğrenim gören öğretmen adaylarının sürdürülebilir kalkınma hakkında görüşlerinin incelenmek amaçlanmıştır. Öğretmen adaylarına yöneltilen açık uçlu sorulardan alınan cevaplara ilgili analizler yapılarak çalışma sonuçlarına ulaşılmıştır.

Araştırma sonucunda öğretmen adaylarının sürdürülebilir kalkınmayı tanımlarken sürdürülebilir kalkınmanın gelecek nesillerin ihtiyacını karşılamaya yönelik yaşama ve kaynakların tükenmemesi demek olduğunu vurguladıkları bununla birlikte yenilenemeyen enerji kaynaklarının korunması, insan ve doğa dengesi kurulması, "emanetçi çevre" anlayışı, geri dönüşüm gibi ifadeler kullandıkları da bulunmuştur. Adaylardan alınan cevaplar incelendiğinde öğretmen adaylarının sürdürülebilir kalkınma tanımına ilişkin doğru ifadeler kullanmakla birlikte sürdürülebilir kalkınma tanımı içinde bulunmayan bazı ifadelere de yer verdileri görülmüştür. Buradan yola çıkarak adayların bazı doğru ifadeler ile birlikte sürdürülebilir kalkınma ile ilgili net bir tanımları olmadığı sonucuna ulaşılmıştır. Yine öğretmen adaylarının yanıtları incelendiğinde adayların sürdürülebilir kalkınmanın önemine ilişkin de benzer şekilde yeterli açıklamalar getiremediği görülmüştür. Adaylar sürdürülebilir kalkınmayı gelecek nesiller için önemli olması, kaynakların tükenmemesini sağlaması, hayat kalitesini arttırması, çevre kirliliğini önlemesi gibi nedenlerden dolayı önemli buldukları belirtmiş, sürdürülebilir kalkınmanın önemini yeterince açıklayamamışlardır. Literatür incelendiğinde bu araştırmanın sonuçlarına benzer şekilde diğer araştırma sonuçlarının da sürdürülebilir kalkınmanın ne olduğunun ve öneminin yeterince bilinmediğine ilişkin sonuçlar ortaya koyduğu görülmektedir (Birdsall, 2006; Wehrmeyer ve Chenoweth, 2006; Eroğlu, 2007; Keleş, 2007; Lourdel, 2007).

Diğer bir soruda öğretmen adaylarının sürdürülebilir kalkınmanın faaliyetlerine ilişkin bilgiler araştırılmış ve adayların sürdürülebilir kalkınma faaliyetlerinin doğal kaynakları koruma, yenilenebilir kaynak kullanımı, bilinçlendirme, çevre eğitimi, turizm, girişimcilik gibi yanıtlar verdiği tespit edilmiştir. Öğretmen adaylarının sürdürülebilir kalkınma faaliyetlerini artırmaya yönelik görüşleri ise, bilinçlendirme yapma, eğitim verme, yenilenebilir enerji kaynaklarını kullanma şeklinde belirlenmiştir. Ancak öğretmen adaylarının büyük bir kısmı bu konuda fikrinin olmadığını belirtmiştir. Yine öğretmen adaylarının sürdürülebilir kalkınmaya katkı sağlama açısından kendilerini nasıl değerlendirdikleri sorusuna verilen cevapların büyük bir kısmının yetersiz ifadesinden oluştuğu görülmektedir. Çok az bir kısmı kendisini kaynakları dikkatli kullanan, bilinçli tüketici ve tasarruflu birey olarak gördüğünü belirtmiştir. Öğretmen adaylarının sorulara verdikleri yanıtlar incelendiğinde öğretmen adaylarının sürdürülebilir kalkınma faaliyetlerini ve bu faaliyetlerin nasıl arttırılacağını çok iyi bilmedikleri, sürdürülebilir kalkınmaya katkı sağlama açısından kendilerini de yetersiz olara değerlendirdikleri sonucuna ulaşılmıştır. Bu sonuç literatürde konu ile ilgili yapılan çalışmaların sonuçları ile paralellik göstermektedir (Moore, 2005; Qablan, 2005; Hudson, 2006; Tombul, 2006; Tuncer ve Erdoğan, 2006; Kühtz, 2007).

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SCIENCE TEACHER CANDIDATES' OPINIONS ON V-DIAGRAMS AS A MEASUREMENT AND EVALUATION INSTRUMENT

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ABSTRACT: The purpose of this research is to receive Science Teacher Candidates' opinions on V-diagrams as a measurement instrument in Physics Laboratory II class and evaluate these opinions. 30 teacher candidates who are the 1st grade students in 2014-2015 academic year spring semester of a public university in Ankara will form the study group of this research. Before the application process, a seminar will be given as to V-diagrams and the preparation of the V-diagrams and prepared V-diagram examples will be shown to the participants by the researchers. During the study process, the participants will be asked to perform the experiments determined in the curriculum and prepare a V-diagram about each experiment instead of traditional reporting methods. The measurement and evaluation of the teacher candidates as to the subject will be realized via these diagrams. At the end of the process, the data of the research will be gathered by means of the half-developed interview questions prepared by the researchers. An interview form including the half-developed questions as to V-diagrams used in the application of the half-developed interviews and the use of these diagrams as a measurement and evaluation instrument instead of traditional methods will be followed. The content analysis of the qualitative data methods will be used to resolve the gathered qualitative data. The documents gathered by means of putting the results of the interview in writing will be analyzed via HyperRESEARCHTM 2.6.1. qualitative analysis programme so as to see the data relation and provide convenience while coding. At the end of the research, teacher candidates' opinions on V-diagrams as a measurement and evaluation instrument of Physics Laboratory II class will be presented.

Key words: v-diagram, measurement and evaluation, teacher candidates

FEN BİLGİSİ ÖĞRETMEN ADAYLARININ BİR ÖLÇME DEĞERLENDİRME ARACI OLARAK V-DİYAGRAMINA İLİŞKİN GÖRÜŞLERİ

ÖZET: Bu araştırmanın amacı, fen bilgisi öğretmen adaylarının Fizik Laboratuvarı II dersinde ölçme ve değerlendirme aracı olarak kullanılan V-diyagramlarına ilişkin görüşlerini almak ve bu görüşleri değerlendirmektir. Araştırmanın çalışma grubunu 2014-2015 eğitim-öğretim yılı bahar döneminde Ankara'da bulunan bir devlet üniversitesinin 1. sınıfına devam eden toplam 30 öğretmen adayı oluşturacaktır. Uygulama sürecine geçilmeden önce araştırmacılar tarafından katılımcılara V-diyagramları ve V-diyagramlarının hazırlanmasına ilişkin bir seminer dersi verilecek, hazırlanmış V-diyagramı örnekleri gösterilecektir. Çalışma süresince katılımcılardan müfredatta belirtilen deneyleri yapması ve geleneksel raporlama yöntemleri yerine her bir deneye ilişkin bir V-diyagramı hazırlaması istenecektir. Öğretmen adaylarının derse ilişkin ölçme ve değerlendirmeleri bu diyagramlar ile gerçekleştirilecektir. Süreç sonunda araştırmanın verileri, araştırmacılar tarafından hazırlanan yarı-yapılandırılmış görüşme soruları ile toplanacaktır. Yarı yapılandırılmış görüşmeler esnasında uygulamada kullanılan V-diyagramları ve bu diyagramların geleneksel yöntemlere alternatif olarak bir ölçme ve değerlendirme aracı olarak kullanılmasına yönelik yarı yapılandırılmış görüşme soruları içeren görüşme formu takip edilecektir. Elde edilen nitel verilerin çözümlenmesi için nitel veri analiz yöntemlerinden içerik analizi kullanılacaktır. Görüşme sonuçlarının yazılı hale getirilmesi ile elde edilen dokümanlar, veriler arası ilişkilerin görülmesi ve kodlama yapılırken kolaylık sağlanması bakımından HyperRESEARCHTM 2.6.1. nitel analiz programı ile analiz edilecektir. Araştırma sonucunda öğretmen adaylarının Fizik Laboratuvarı II dersinin ölçme ve değerlendirmesinde bir araç olarak kullanılan V-diyagramlarına yönelik görüşleri ortaya konacaktır.

Anahtar sözcükler: v-diyagramı, ölçme ve değerlendirme, öğretmen adayları

GİRİŞ

Fen öğretiminde temel amaç, öğrencilerin fen bilimleriyle ilgili bilimsel bilgileri hazır olarak alıp ezberlemeleri değil, hayatları boyunca karşılaşacakları problemleri çözebilmeleri, bilgiye ulaşabilmek için gerekli bilimsel tutum ve becerileri kazanmalarıdır (Akgün, 2000; Kaptan, 1999). Bu tutum ve becerilen istenen düzeyde kazanılabileceği ve fen bilimlerinin etkili öğrenilebileceği ortam olarak ilk akla gelen yerler laboratuvarlardır (Alkan, Çilenti ve Özçelik, 1991).

Fen laboratuvarları, fen ve teknoloji derslerinde daha etkili olarak öğrenilmesi için konuların deneylerle desteklendiği yerlerdir. Fen öğretiminin etkili olması için derste teorik olarak işlenen konuların uygulamalar ile somutlaştırılması ve günlük hayata aktarılması gerekmektedir. Öğrencilerin yaparak yaşayarak öğrenme fırsatı bulduğu, feni öğreniken keyif ve heyecan duyduğu laboratuvarlarda ilk elden somut yaşantıların kazanılmakta ve anlamlı öğrenme gerçekleşmektedir (Çepni ve Ayvacı, 2008). Fakat ülkemizde tüm bu uygulamalı süreç, gelen olarak klasik deney raporları ile değerlendirilmekte ve öğrenim sürecinin ürününü teorik bilgi ağırlıklı çıktılar oluşturmaktadır. Bu durum öğrencilerin ayrıntılı düşünmelerini, anlamlı öğrenmelerini ve önceden var olan bilgiler ile laboratuvar çalışması sırasında ürettikleri yeni bilgiler arasında bağlantı kurmalarını engellemektedir (Atılboz ve Yakışan, 2003). Öğrenciler de, klasik deney raporlarında birçok eksiklik ya da gereksiz bilgiler olduğunu; bu raporlar ile deneyin teorik kısmı ve deney sırasındaki gözlemleri arasında bağlantı kuramadıklarını; deneylerin yüzeysel bir takım özellikleriyle ilgilendiklerini ve hazırlanan raporlar arasında bir standart olmadığını düşünmektedir (Nakiboğlu ve Meriç, 2000). Bu sebeple fen eğitiminde çok önemli bir role sahip laboratuvar etkinliklerinde değerlendirme, performans ölçümü ile gerçek değerlendirmeyi kapsayan ve geleneksel teorik dokümanlardan farklı olan "alternatif değerlendirme' ile yapılmalıdır. Laboratuarlarda kullanılabilecek alternatif değerlendirme araçlarından biri de V- diyagramlarıdır.

V- diyagramları ilk olarak Novak ve Gowin tarafından fen bilimlerinde laboratuvar çalışmalarının amacını ve doğasını aydınlatmak için geliştirilmiştir (Novak ve Gowin, 1984). Bu diyagram deney öncesi, sırası ve sonrası aktivitelerde kullanılarak öğrencilerin deneye yönelik bir rapor oluşturmasını sağlar. Bu sayede öğrenciler fen derslerinde öğrendikleri teorik bilgi ile laboratuvar çalışmaları arasında bağlantı kurar ve laboratuvar raporlarını daha kolay anlar (Gurley Dilger, 1992). V-diyagramı, temel olarak laboratuar çalışmaları sırasında hazırlanan ve aynı zamanda deney raporu yerine de geçen bir öğrenme ve ölçme değerlendirme aracıdır (Nakiboğlu, Benlikaya ve Karakoç, 2001). Bu diyagram ile öğretim programlarını tasarlama ve iyileştirme, araştırma raporu hazırlama ve değerlendirme laboratuar föylerini analiz etme, dersi ve öğrencileri değerlendirme, gibi daha birçok amaç için kullanılabilmektedir (Novak ve Govin, 1984). Bu araştırmada da V-diyagramları laboratuar dersinde ölçme değerlendirme aracı olarak kullanılmıştır. Çalışmada fen bilgisi öğretmen adaylarının Fizik Laboratuvarı II dersinde ölçme ve değerlendirme aracı olarak kullanılan V-diyagramlarına ilişkin görüşlerini almak ve bu görüşleri değerlendirmek amaçlanmaktadır.

YÖNTEM

Bu araştırmada araştırmanın amacına uygun olan verileri elde etmek için nitel araştırma yöntemlerinden olgubilim (fenomenoloji) araştırması kullanılmıştır. Verilerin toplandığı katılımcılar amaçlı örnekleme ile toplanmıştır (Cohen, Monion ve Morrison, 2007). Araştırmanın çalışma grubunu 2014-2015 eğitim-öğretim yılı bahar döneminde Ankara'da bulunan bir devlet üniversitesinin 1. sınıfına devam eden toplam 30 öğretmen adayı oluşturmuştur. Çalışmanın uygulama sürecine geçilmeden önce araştırmacılar tarafından katılımcılara V-diyagramları ve V-diyagramlarının hazırlanmasına ilişkin bir seminer dersi verilmiş, daha önceden araştırmacılar tarafından kurallarına uygun olarak hazırlanmış V-diyagramı örnekleri gösterilmiştir. Daha sonra çalışma süresince katılımcılardan müfredatta belirtilen deneyleri yapması ve geleneksel raporlama yöntemleri yerine her bir deneye ilişkin bir V-diyagramı hazırlaması istenmiştir. Öğretmen adaylarının derse ilişkin ölçme ve değerlendirmeleri bu diyagramlar ile gerçekleştirilmiş, süreç sonunda araştırmanın verileri, araştırmacılar tarafından hazırlanan 3 adet yarı-yapılandırılmış görüşme sorusu ile toplanmıştır. Yarı yapılandırılmış görüşmeler esnasında uygulamada kullanılan V-diyagramları ve bu diyagramların geleneksel yöntemlere alternatif olarak bir ölçme ve değerlendirme aracı olarak kullanılmasına yönelik yarı yapılandırılmış görüşme soruları içeren görüşme formu takip edilmiştir. Soruların ve bu formun geçerliği için alanında uzman 4 araştırmacının görüşüne başvurulmuştur. Elde edilen nitel verilerin çözümlenmesi için nitel veri analiz yöntemlerinden içerik analizi kullanılmıştır. Görüşme sonuçlarının yazılı hale getirilmesi ile elde edilen dokümanlar, veriler arası ilişkilerin görülmesi ve kodlama yapılırken kolaylık sağlanması bakımından HyperRESEARCHTM 2.6.1. nitel analiz programı ile analiz edilmiştir.

BULGULAR

Fen bilgisi öğretmen adaylarının Genel Fizik Laboratuarı II dersinde ölçme ve değerlendirme yöntemi olarak kullanılan V-diyagramlarına ilişkin görüşlerini almak amacıyla öğretmen adaylarına üç adet açık uçlu soru yöneltilmiştir. Öğretmen adaylarının V-diyagramlarına yönelik görüşleri belirlenmiştir.

Öğretmen adaylarına ilk olarak "Sizce V-diyagramlarının klasik deney raporlarından üstünlükleri nelerdir?" sorusu yöneltilmiş ve Tablo 1'de öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 1. Öğretmen Adaylarının "Sizce V-Diyagramlarının Klasik Deney Raporlarından Üstünlükleri Nelerdir?" Sorusuna Verdikleri Cevaplara İlişkin Kod, Tema ve Sıklık Verileri

Tema	Kod	Sıklık
İçerik açısından	Kısa/özet olma	7
	Sistematik olma	7
	Algılamayı kolaylaştırma	5
Görsel açıdan	Bütünü görme	7
	Pratik olma	7
	Göze hitap etme	5
	Düzene sahip olma	5
Öğrenci kazanımları açısından	Bilgiyi özetleme becerisi sağlama	12
	Önemli bilgiyi tespit etmeyi sağlama	8
	Kalıcılığı sağlama	8
	Günlük hayatla ilişki sağlama	6
	Yorum yapma becerisi kazandırma	4
	Motivasyonu sağlama	3
	Araştırma yapma becerisi geliştirme	3
	Laboratuar kaygısını azaltma	1
	Zamanı kullanmayı öğrenme	1

Tablo 1 incelendiğinde öğretmen adayları V-diyagramlarının klasik deney raporlarından üstünlüklerini içerik açısından, görsel açıdan ve öğrenci kazanımları açısından olmak üzere üç tema altında değerlendirdikleri görülmektedir. Öğretmen adayları, içerik açısından V-diyagramlarını kısa, sistematik ve algılanması kolay olma yönünden üstün gördüklerini belirtmiştir. Görsel açıdan V-diyagramı adaylar tarafından bütünü görmeyi sağlama, pratik olma, göze hitap etme ve düzene sahip olma gibi özelliklerinden dolayı üstün bulunmaktadır. Bununla birlikte öğretmen adaylarının öğrenci kazanımları açısından V-diyagramlarının, bilgiyi özetleme becerisi sağlama, önemli bilgiyi tespit etmeyi sağlama, kalıcılığı sağlama, günlük hayatla ilişki sağlama, yorum yapma becerisi kazandırma, motivasyonu sağlama, araştırma yapma becerisi geliştirme, laboratuar kaygısını azaltma ve zamanı kullanmayı öğrenme gibi üstünlükleri olduğunu belirttikleri görülmüştür. Öğretmen adaylarının cevaplarından doğrudan alıntılara aşağıda yer verilmiştir.

Ö12; *"…diğer deney raporlarından sadece teorik bilgi ve yorum kısımları varken V diyagramları sayesinde konuları günlük hayatla ilişkilendirilip örnekler verebildim*." (410,568 25.02.2015).

Ö5; "*V-diyagramları deneyi raporlaştırma açısından daha anlaşılır ve açık öğrenmeyi kolaylaştırıcı bir rapor türü*" (214,371 25.02.2015).

Öğretmen adaylarına ikinci olarak "V -diyagramlarına yönelik sizin görüşleriniz nelerdir?" sorusu yöneltilmiş ve Tablo 2'de öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 2. Öğretmen Adaylarının "V-Diyagramlarına Yönelik Sizin Görüşleriniz Nelerdir?" Sorusuna Verdikleri Cevaplara İlişkin Kod, Tema ve Sıklık Verileri

Tema	Kod	Sıklık
Sevdiğim yönleri	Kullanışlı olma	6
	Araştırma yapmayı sağlama	5
	Görsel olma	5
	Özet olma	5
	Odak sorusu oluşturma	4
	Günlük hayat örnekleri ile ilişki kurma	4
	Anlamayı kolaylaştırma	4
	Düzenli olması	4
	Sentez yapma zorluğu	8
	Yorum yapma zorluğu	7

Sevmediğim yönleri	Günlük hayat ile ilişki kurma	2
	Düzen oluşturma	2
	Zaman alıcı olma	2

Tablo 2 incelendiğinde öğretmen adaylarının V-diyagramlarına yönelik görüşlerini sevdikleri ve sevmedikleri yönlerden ele aldıkları görülmektedir. Öğretmen adayları V- diyagramının sevdikleri yönlerini kullanışlı olma, araştırma yapmayı sağlama, görsel olma, özet olma, odak sorusu oluşturma, günlük hayat örnekleri ile ilişki kurma, anlamayı kolaylaştırma ve düzenli olma şeklinde belirtmektedir. Diğer taraftan öğretmen adayları, sentez yapma zorluğu, yorum yapma zorluğu, günlük hayat ile ilişki kurma, düzen oluşturma ve zaman alıcı olma gibi yönlerinden dolayı V-diyagramlarını sevmediklerini belirtmişlerdir. Öğretmen adaylarının cevaplarından doğrudan alıntılara aşağıda yer verilmiştir.

Ö3; *"…Ancak odak sorusu farklıydı. Amaç ile odak sorusunun farklı olduğunu gördük. Odak sorusu daha can alıcı oluyor bu şekilde deneyin asıl amacını daha kolay algılıyoruz*." (419,584, 25.02.2015).

Ö8; "*Günlük hayatla bağdaştırılarak çevremize olan bakış açımızı değiştirebilir."* (536,611, 25.02.2015).

Öğretmen adaylarına son olarak "Öğretmen olduğunuzda V-diyagramını kullanır mısınız? Neden?" sorusu yöneltilmiştir. Öğretmen adaylarının tamamı V-diyagramını kullanacağını ifade etmiştir. Tablo 3'de öğretmen adaylarının cevaplarına yer verilmiştir.

Tablo 3. Öğretmen Adaylarının "Öğretmen Olduğunuzda V-Diyagramını Kullanır Mısınız? Neden?" Sorusuna Verdikleri Cevaplara İlişkin Kod, Tema ve Sıklık Verileri

Tema	Kod	Sıklık
İçerik farklılığı	Kullanışlı	2
	İlgi çekici	3
	Anlaşılır	4
	Kısa/özet	2
Görsel farklılık	Düzen ve görünüm	3
	Pratik olma	2
Öğrenci kazanımlarına yönelik farklılığı	Araştırmaya yönlendirme	2
	Düşündürme	3
	Derse hazırlıklı gelmeye yönlendirme	4
	Derse katılımı sağlamaya yönlendirme	2
	Günlük hayatla ilişkilendirmeye yönlendirme	2
	Kalıcılığı sağlama	2
	Sorumluluk bilinci geliştirme	2

Tablo 3 incelendiğinde öğretmen adaylarının V-diyagramını öğretmen oldukları zaman kullanışlı, ilgi çekici, anlaşılır olma gibi içerik farklılığından dolayı, bununla birlikte düzen, görünüm gibi görsel farklılıktan dolayı, son olarak da araştırmaya yönlendirme, düşündürme, derse hazırlıklı gelmeye, derse katılımı sağlamaya yönlendirme gibi öğrenci kazanımlarına yönelik farklılıktan dolayı kullanacaklarını belirttikleri görülmüştür. Öğretmen adaylarının cevaplarından doğrudan alıntılara aşağıda yer verilmiştir.

Ö9; "*Sonuçları da mesela tablolar halinde de bence… normal bir A4 kağıdına tablolar yerleştirildiği zaman bu insan hafizasına ilk bakıldığı anda bile dikkat çekici gibi geliyor. Rakamların normal sayfalara yayılmasındansa tek bir sayfa içerisinde toplanıp aynı sayfada aynı anda hepsinin göz önüne getirilmesi bence çok kullanışlı ve etkili.*" (940,1295, 25.02.2015).

Ö14; "*Deneyi daha rahat hazırlanıyoruz daha öncesi teori ve ilkeleri araç-gereç dolduruyoruz, odak sorusunu hazırlıyoruz, bizim için bir ön hazırlık oluyor. Deneyde ne yapacağımızı hangi malzemeleri kullanacağımızı önceden görmek bizim için deney hakkında fikir veriyor*." (288,551, 25.02.2015).

SONUÇ

Bu araştırmada fen bilgisi öğretmen adaylarının Fizik Laboratuvarı II dersinde ölçme ve değerlendirme aracı olarak kullanılan V-diyagramlarına ilişkin görüşlerini almak ve bu görüşleri değerlendirmek amaçlanmıştır.

Öğretmen adaylarına yöneltilen açık uçlu sorulardan alınan cevaplara ilgili analizler yapılarak çalışma sonuçlarına ulaşılmıştır.

Öğretmen adaylarının V-diyagramlarının klasik deney raporlarından üstünlüklerin ilişkin görüşlerinin araştırıldığı ilk soruya içerik açısından, görsel açıdan ve öğrenci kazanımları açısından olmak üzere üç tema altında değerlendirme yaptığı görülmüştür. Öğretmen adayları, içerik açısından V-diyagramlarının kısa, sistematik ve algılanması kolaylaştırma yönünden üstün olduğunu, görsel açıdan bütünü görmeyi sağlama, pratik olma, göze hitap etme ve düzene sahip olma özelliklerinden dolayı üstün olduğunu düşündükleri belirlenmiştir. Bununla birlikte öğretmen adaylarının V-diyagramlarının öğrenci kazanımları açısından, bilgiyi özetleme becerisi sağlama, önemli bilgiyi tespit etmeyi sağlama, kalıcılığı sağlama, günlük hayatla ilişki sağlama, yorum yapma becerisi kazandırma, motivasyonu sağlama, araştırma yapma becerisi geliştirme, laboratuar kaygısını azaltma ve zamanı kullanmayı öğrenme gibi üstünlükleri olduğunu belirttikleri görülmüştür. Literatür incelendiğinde, V-diyagramlarına ilişkin öğretmen adaylarının bu çalışmada vurguladığı özellikler ile paralellik gösteren çalışma sonuçları olduğu görülmektedir (Novak ve Gowin, 1984; Lebowitz, 1998; Nakiboğlu ve Meriç, 2000; Nakipoğlu, Benlikaya ve Karakoç, 2001; Özer, 2002; Atılboz ve Yakışan, 2003; Evren, 2008; İnce, Güven ve Aydoğdu 2010).

Çalışmada daha sonra öğretmen adaylarına V-diyagramlarına yönelik kişisel görüşleri sorulmuş ve adayların soruya V-diyagramlarının sevdiğim ve sevmediğim yönleri diye temalandırılabilecek kodlar bildirdiği görülmüştür. Öğretmen adaylarının V- diyagramının sevdikleri yönlerini kullanışlı olma, araştırma yapmayı sağlama, görsel olma, özet olması, odak sorusu oluşturma, günlük hayat örnekleri ile ilişki kurma, anlamayı kolaylaştırma ve düzenli olma şeklinde belirtmişlerdir. Diğer taraftan öğretmen adayları, sentez yapma zorluğu, yorum yapma zorluğu, günlük hayat ile ilişki kurmak, düzen oluşturma ve zaman alıcı olma gibi yönlerinden dolayı V-diyagramlarını sevmediklerini belirtmişlerdir. Araştırmadan elde edilen bu sonuç literatür ile benzerlik göstermektedir (Roth, 1990; Roehrig ve diğerleri, 2001; Demirtaş, 2006; Tatar ve diğerleri, 2007; Evren, 2008).

Çalışmada son olarak öğretmen adaylarına öğretmen olduklarında V-diyagramlarını kullanıp kullanmayacaklarını nedenleri ile birlikte açıklamaları istenmiştir. Öğretmen adaylarının V-diyagramını öğretmen oldukları zaman kullanışlı, ilgi çekici, anlaşılır olma gibi içerik farklılığından dolayı, bununla birlikte düzen, görünüm gibi görsel farklılıktan dolayı, son olarak da araştırmaya yönlendirme, düşündürme, derse hazırlıklı gelmeye, derse katılımı sağlamaya yönlendirme gibi öğrenci kazanımlarına yönelik farklılıktan dolayı kullanacaklarını belirttikleri görülmüştür. Bu sonuç literatürde konu ile ilgili yapılan çalışmaların sonuçları ile paralellik göstermektedir (Lebowitz, 1998; Sarıkaya ve diğerleri, 2004; Karamustafaoğlu, Karamustafaoğlu ve Yaman, 2005).

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THE EFFECTS OF TECHNOLOGY SUPPORTED TEACHING AND CONCEPTUAL CHANGE TEXTS FOR THE REMEDYING THE MISCONCEPTIONS ON THE TOPIC OF CELL

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ABSTRACT: This study investigated the effects of technology supported teaching and conceptual change texts for remedying students' misconceptions on the topic of "Eukaryotic Cell Organelle" and "The Differences between Animal and Plant Cells." This study was conducted in an Anatolian High School, the part of a Multi-Program School. The sample of the study was consisted of 21 students studying at 9th grade. An achievement test, including 11 open ended questions, focusing on common misconceptions on the aforementioned topics was administered to the students before and after the intervention. Two questions of the achievement test required some figures to draw for the students. After the pre-test, students took three hours teaching with the help of video, animations, visual aids, and seven conceptual change texts developed by one of the authors. Pre-test results indicated that the students had several misconceptions on the cell and related topics. However, post-test results indicated that the students demonstrated scientifically more normative conceptions. It is concluded that conceptual change texts integrated with technology aids are effective for the remedying the students' misconceptions on the topic of "Eukaryotic Cell Organelle" and "The Differences between Animal and Plant Cells." It is implicated that biology teaching could be effective and meaningful with the technology aids and conceptual change texts for the biology students.

Key words: cell, organelle, misconception, technology supported teaching, conceptual change texts

TEKNOLOJİ DESTEKLİ ÖĞRETİM VE KAVRAMSAL DEĞİŞİM METİNLERİNİN HÜCRE KONUSUNDAKİ KAVRAM YANILGILARININ GİDERİLMESİNE ETKİLERİ

ÖZET: Bu çalışmada, teknoloji destekli öğretimin ve kavramsal değişim metinlerinin "Ökaryot Hücre Organelleri" ve "Hayvan ve Bitki Hücreleri Arasındaki Farklar" konularındaki kavram yanılgılarını gidermedeki etkisi incelenmiştir. Çalışma, çok programlı bir lisenin Anadolu Lisesi kısmında gerçekleştirilmiştir. Örneklem, 9. sınıf eğitimi alan 21 öğrenciden oluşmaktadır. Çalışmada yaygın kavram yanılgılarına odaklanan ve 11 açık uçlu sorudan oluşan bir başarı testi, ön test ve son test olarak uygulanmıştır. Testte yer alan sorulardan ikisi, öğrencilerin çizim yapmasını gerektiren sorulardır. Ön test uygulamasından sonra öğrenciler, video, animasyon ve görsel öğelerin kullanıldığı teknoloji destekli üç saatlik uygulamaya tabii tutulmuşlardır. Ayrıca uygulama sırasında yazarlardan biri tarafından geliştirilmiş olan yedi farklı kavramsal değişim metni kullanılmıştır. Ön test sonuçları öğrencilerin hücre ve ilgili konularda birçok kavram yanılgısına sahip olduklarını göstermiştir. Son test sonuçlarına göre ise öğrenciler bilimsel olarak daha doğru kavramlara sahiptirler. Sonuç olarak kavramsal değişim metinlerinin ve teknoloji desteğinin birlikte kullanılmasının, öğrencilerin "Ökaryot Hücre Organelleri" ve "Hayvan ve Bitki Hücreleri Arasındaki Farklar" konularındaki kavram yanılgılarını gidermede etkili olduğu gözlenmiştir. Eğitimsel çıkarım olarak kavramsal değişim metinlerinin kullanıldığı teknoloji destekli biyoloji öğretiminin öğrenciler için etkili ve anlamlı olduğu sonucuna varılabilir.

Anahtar sözcükler: hücre, organel, kavram yanılgısı, teknoloji destekli öğretim, kavramsal değişim metinleri

GİRİŞ

Fen öğretimi alanında yapılan çalışmalar incelendiğinde, öğrencilerin öğrenme ortamına taşıdıkları ön bilgilerinin zaman zaman hatalı olabildiği, bu durumun da öğrencilerin, bilimsel açıdan doğruluğu kabul gören bilgiye ulaşmalarını engelleyebildiği veya zorlaştırdığı görülmektedir (Yeşilyurt & Gül, 2012). Kavram yanılgıları, diğer derslerde olduğu gibi biyoloji konularının öğrenilmesinde de büyük bir engel olarak karşımıza çıkmakta ve öğrencilerin biyoloji konularında öğrenme güçlükleri yaşamalarına yol açmaktadır (Kılıç & Sağlam, 2004; Yeşilyurt & Gül, 2012). Bu nedenle öğrencilerin kavram yanılgılarının tespit edilmesi ve giderilmesi önemli ve dikkate değer bir hale gelmektedir (Kırıkkaya & Güllü, 2008; Yakışan, Selvi, & Yürük, 2007).

Soyut kavramların anlatımında, zihinde canlandırmanın zorluğu da dikkate alınarak görsel ve düşünsel yapıların harekete geçirilmesi önem arz etmektedir. Bu yüzden eğitim ortamlarında teknolojik materyallerin kullanılması önemlidir (Barnea & Dori 1996; Kahraman & Demir 2011). Eğitim ortamlarında teknolojik materyal kullanımının öğrencilerin fen başarılarına etkileri araştırıldığında, bu uygulamaların geleneksel öğretim yöntemlerine göre daha etkili olduğunu görülmüştür (Sanger & Badger, 2001; Kahraman & Demir 2011). Buna bağlı olarak teknolojik imkanların gün geçtikçe daha ulaşılır ve etkin olarak kullanılabilir hale gelmesiyle biyoloji konularının öğrenilmesinde görsel teknolojik materyallerin etkili sonuçlar ortaya koyduğu da bilinmektedir (Köse, Kaya, Gezer, & Kara, 2011). Geleneksel öğrenme etkinliklerinin aksine, teknoloji destekli öğrenme etkinliklerinde öğrenciler, hem işitsel hem de görsel öğeler içeren materyaller sayesinde etkileşim seviyelerini üst düzeyde tutabilmektedirler (Benli, Kayabaşı, & Sarıkaya, 2012). Bu sayede öğretim faaliyetlerinin kavram yanılgılarına yol açmayacak şekilde gerçekleştirilebilmesinde, teknoloji destekli öğretim etkinliklerinin yararlı olacağı düşünülmektedir (Kahraman & Demir 2011).

Teknolojinin eğitim alanlarında aktif olarak kullanılmasına bağlı olarak birden fazla duyu organına hitap edecek materyallerin geliştirilmesi, teknolojinin eğitim alanına vereceği önemli katkılarından biri olarak ön plana çıkmaktadır. Teknoloji desteğinin sağlandığı öğrenme ortamlarında soyut kavramların öğrenilmesindeki başarı artmaktadır (Büyükkasap & Samancı, 1998; Ertepınar, Demircioğlu, Geban, & Yavuz, 1998; Coştu, Çepni, & Yeşilyurt, 2002; Çoştu, Karataş, & Ayas, 2003; Köse, Gezer, Bilen, & Gencer, 2007; Pektaş, Çelik, Katrancı, & Köse, 2009; Köse, Kaya, Gezer, & Kara, 2011). Teknolojik imkanların eğitim ortamlarında yaygınlaşmasıyla birlikte görsel ve işitsel ders materyallerinden biri olan animasyonların kullanımı da yaygınlaşmıştır (Genç, 2013). Demirci (2003)'ye göre öğretim ortamlarında animasyonların kullanımı, öğrencilere, anlamakta güçlük çektikleri soyut kavramları yapılandırmalarında kolaylık sağlamaktadır.

Teknoloji ile desteklenmiş öğrenme ortamlarının yanı sıra, öğrencilerdeki kavram yanılgılarının giderilmesi için farklı yöntem ve teknikler uygulanmaktadır. Sıklıkla kullanılan uygulamalar kavram karikatürleri (Köse, 2008; Kete, Avcu, & Aydın, 2009; Taş, 2013), kavram haritaları (Kaptan, 1998; Kaya, 2003; Kılıç & Sağlam, 2004) ve kavramsal değişim metinleridir (Pınarbaşı & Canpolat, 2002; Pabuçcu & Geban, 2006; Çetingül & Geban, 2011; Köse, Kaya, Gezer, & Kara, 2011; Şen & Yılmaz, 2012; Akyürek & Afacan 2013).

Biyoloji alanında kavram yanılgılarının sıklıkla karşılaşıldığı konulardan biri de hücresel yapılar ve hücre organelleridir (Maraş & Akman, 2009; Çavaş, 2010; Kete, Horasan, & Namdar, 2012). Bu çalışmada, hücre konusunda öğrencilerin kavram yanılgılarını gidermek için teknoloji destekli bir ortamda kavramsal değişim metinleri kullanılmıştır. Kavramsal değişim metinleri kullanılırken öncelikle çalışılan konu ile ilgili yaygın kavram yanılgıları tespit edilir ve metin içerisinde belirtilerek yanlışın nedeni açıklanır. Bu sayede öğrenciler, sahip oldukları kavram yanılgılarını sorgulama ve öğrenmelerindeki yetersizliği görme fırsatı edinirler. Devamında ise öğrencilere yeni ve bilimsel bilgiler verilerek örnekler sunulur (Chambers & Andre, 1997; Akyürek & Afacan, 2013).

AMAÇ

Bu çalışmada, teknoloji ile desteklenmiş ve kavramsal değişim metinlerinin kullanıldığı bir öğrenme ortamında 9. Sınıf öğrencilerinin "Ökaryot Hücre Organelleri" ve "Hayvan ve Bitki Hücreleri Arasındaki Farklar" konularındaki kavram yanılgılarının giderilmesi amaçlanmıştır. Bu amaca bağlı olarak araştırma soruları aşağıdaki gibidir.

1. Dokuzuncu sınıf öğrencilerinin "Ökaryot Hücre Organelleri" ve "Hayvan ve Bitki Hücreleri Arasındaki Farklar" konularındaki kavram yanılgıları nelerdir?
2. Teknoloji destekli öğretim ve kavramsal değişim metinlerinin birlikte kullanılması, 9. sınıf öğrencilerinin "Ökaryot Hücre Organelleri" ve "Hayvan ve Bitki Hücreleri Arasındaki Farklar" konularındaki kavram yanılgılarını gidermekte ne derece etkilidir?

YÖNTEM

Örneklem

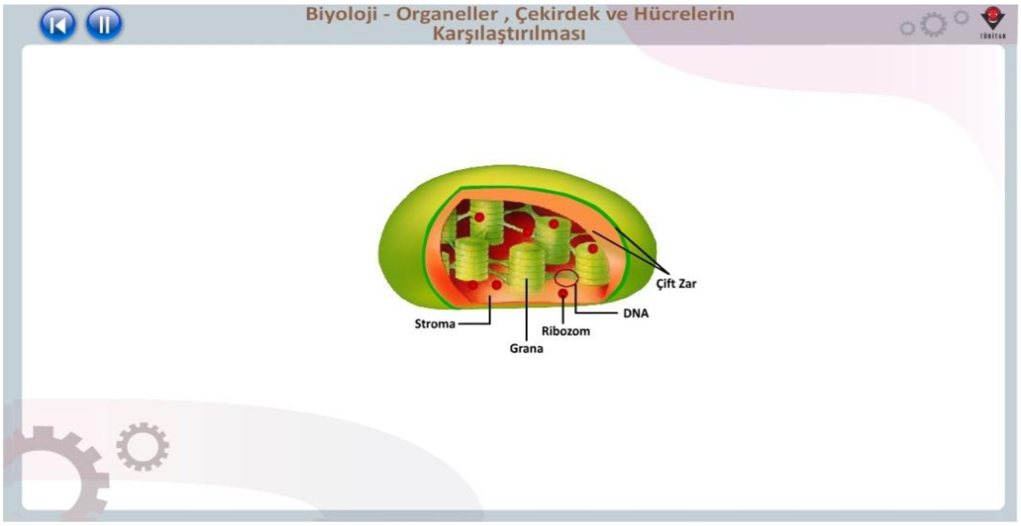
Çalışma, İç Anadolu Bölgesindeki bir kasabada yer alan çok programlı bir lisenin, Anadolu Lisesi kısmında 9. sınıf eğitimi alan 21 öğrenci ile gerçekleştirilmiştir. 21 öğrencilik grup, 8 erkek ve 13 kız öğrenciden oluşmaktadır.

Veri Toplama Araçları ve Uygulama

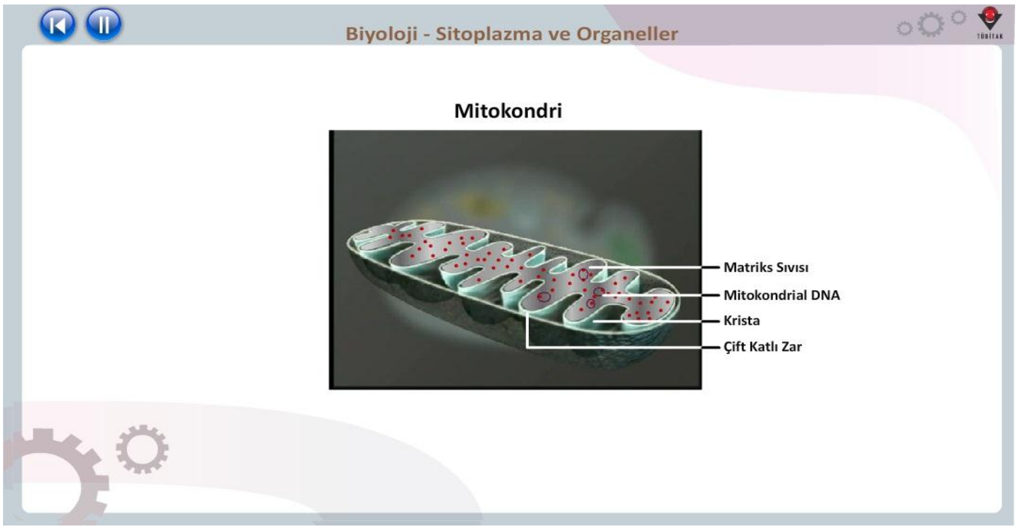
Çalışmada öğrencilere, 11 sorudan oluşan ve öğrencilerin "Ökaryot Hücre Organalleri" ve "Hayvan ve Bitki Hücreleri Arasındaki Farklar" konularındaki yaygın kavram yanılgılarına odaklanan bir başarı testi ön test ve son test olarak uygulanmıştır (EK 1). Fakat testte yer alan 11 numaralı soru, öğrenci çizimleri açık ve anlaşılır olmadığından değerlendirmeye dahil edilmemiştir. Başarı testine dahil edilen ilk 3 soru, Martin (2011)'e ait Exposing Student Misconceptions about Cellular Structure: A Curriculum Topic Study adlı çalışmadan adapte edilmiş, testte yer alan diğer 8 soru ise, araştırmacılar tarafından geliştirilmiştir.

Testte yer alan 3. soru, hayvan ve bitki hücrelerinin çizimlerinin yapılmasını gerektiren bir sorudur. Diğer sorular ise öğrencilerin hayvan ve bitki hücrelerinde yer alan organeller, organellerin yapıları ve birbirlerine dönüşümleri, hücre ve hücresel yapıların büyüklükleri ve DNA'nın hücre içerisinde hangi kısımlarda bulunabileceğine yönelik kavram yanılgılarını ortaya çıkarmayı amaçlayan açık uçlu sorulardır.

Çalışmanın uygulaması seçilen örneklemin biyoloji öğretmeni ve aynı zamanda çalışmanın yazarlarından biri olan araştırmacı tarafından yapılmıştır. Çalışmanın ilk aşamasında gerçekleştirilen ön test uygulamasının ardından ders öğretmeni tarafından üç ders saati süresince teknoloji destekli öğretim uygulaması gerçekleştirilmiştir. Bu uygulamada öğrencilere Eğitim Bilişim Ağı (EBA) - www.eba.gov.tr adresinde yer alan dijital ders içeriği ve animasyonlar (Şekil 1 ve 2) ile çalışmaya hazırlık sürecinde elde edilen görsel materyaller kullanılmıştır (Şekil 3). Öğretmen, dersin işlenişi sırasında ihtiyaç duyduğu kısımlarda gerekli açıklamaları yapmıştır.



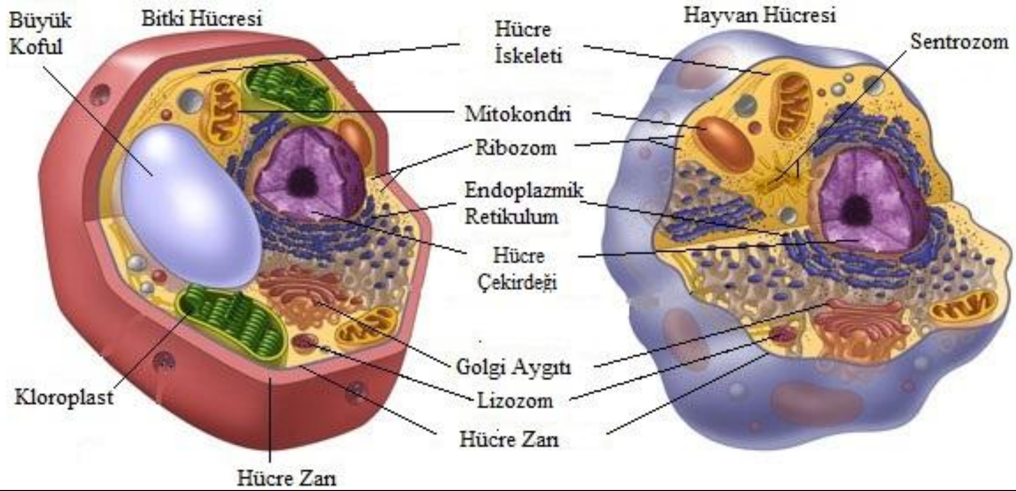
Şekil 1. Kloroplast'ın Yapısı



Şekil 2. Mitokondri'nin Yapısı

Teknoloji destekli öğretim uygulamasının ardından öğrencilere, araştırmacılar tarafından ön test sonuçlarında gözlemlenen kavram yanılgılarını gidermeye yönelik olarak hazırlanmış olan kavramsal değişim metinleri dağıtılmıştır. Kavramsal değişim metinleri hazırlanırken Posner, Strike, Hewson, & Gertzog (1982)'un kavramsal değişim koşullarına uygun olarak hazırlanmıştır. Metinlerde öncelikle söz konusu kavram yanılgısı ifade edilmiş, daha sonra bilimsel olarak neyin, neden doğru olduğu açık ve anlaşılır ifade ve örneklerle açıklanmıştır. Bu uygulamada 7 ayrı metinden yararlanılmıştır. Metinlerden ikisi Şekil 3 ve Tablo 1'de görülmektedir. Bu metinlerden ikisi şekil içermektedir. Öğrencilerden metinleri okuduktan sonra, önceki fikirleri ile yeni fikirlerini karşılaştırmaları istendi. Son aşamada ise, çalışmanın başında uygulanmış olan ve 10 sorudan oluşan test, hiçbir değişikliğe uğratılmadan son test olarak uygulanmıştır.

***Bitki ve hayvan hücreleri yapı olarak birbirinin aynısıdır şeklinde bir görüş doğru değildir. Çünkü her iki hücre türünün yapı olarak benzerlikleri olduğu kadar, farklılıkları da vardır. Bir hayvan hücresinde de bitki hücresinde olduğu gibi zarlı ve zarsız organeller birlikte bulunur. Ancak bitki hücrelerinde plastit adı verilen **kloroplast, lökoplast** ve **kromoplast** organelleri yer alırken hayvan hücrelerinde plastitler bulunmaz. Ayrıca olgunlaşmış bir bitki hücresinde **merkezi koful** adı verilen büyük ve tek koful bulunurken, hayvan hücrelerinde küçük ve çok sayıda koful yer alır. Hayvan hücresinde sentrozom adı verilen ve hücre bölünmesinde görev alan organel ve hücre içi sindirimden sorumlu lizozom organeli yer alır. Bitki hücrelerinde ise bu iki organel de bulunmaz. Ayrıca şekil olarak incelendiğinde genellikle hayvan hücreleri yuvarlak, bitki hücreleri ise **hücre duvarının** varlığından dolayı köşelidir. Bu da yapısal bir fark olarak göze çarpar.



Şekil 3. Hayvan ve Bitki Hücrelerinin Yapılarına İlişkin Kavramsal Değişim Metni

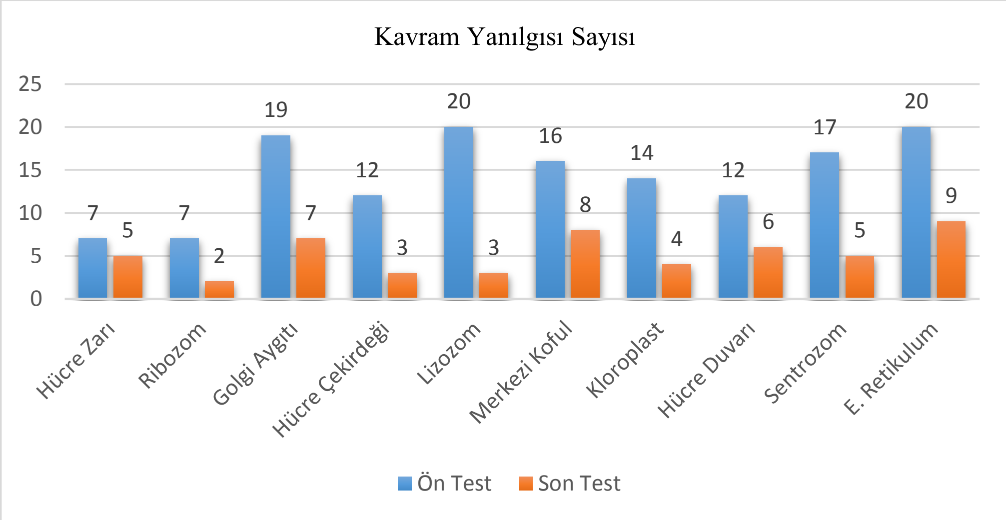
Tablo 1. Hücre Zarının Yapı ve Görevine İlişkin Kavramsal Değişim Metni

Hücre zarı tüm hücrelerde bulunmaz şeklindeki bir algı hatalıdır. Çünkü dünyada yapısına bakılmaksızın tüm hücreler hücre zarına sahiptir. Hücre zarı canlı, esnek ve seçici geçirgen yapıdadır. Esnek yapısı hücreye belirli bir şekil verirken seçici-geçirgen olması hücre madde giriş-çıkışlarının kontrol altında olmasını sağlar. Zar, tıpkı bir ülkenin sınırlarında yer alan sınır kapıları gibi giriş ve çıkışları kontrol edici özelliktedir. Bu sayede hücrenin ihtiyaç duyduğu maddeler alınırken, ihtiyacı olmayanlar hücre dışında kalır. Yine aynı şekilde hücrenin ihtiyaç duymadığı maddelerin çıkışına izin verilirken ihtiyaç duyulan maddelerin hücre içinde kalması sağlanır. Hücre zarı hücreyi çepeçevre sardığı için sitoplazma, organeller ve çekirdeği bir arada tutar. Aksi durumda yani hücre zarı olmasaydı akışkan yapıdaki sitoplazma ve içerisindeki çekirdek ve organel gibi yapıların bir arada durması mümkün olmazdı. Bu nedenle tüm hücreler hücre zarına sahiptirler.

Veriler betimsel olarak analiz edilmiştir. Öğrencilerin ön testteki kavram yanılgıları tespit edilmiş ve bu kavram yanılgılarının ne ölçüde giderildiği son test sorularına verilen cevaplarla kıyaslanarak belirlenmiştir.

BULGULAR

Uygulanan ön testte yer alan hücresel yapılar ve organellerin hangi hücre tiplerinde bulunduğunu belirlemeye yönelik 1 numaralı soruya verilen cevaplar değerlendirildiğinde, öğrencilerin ciddi ölçüde kavram yanılgılarına ve bilgi eksikliklerine sahip oldukları sonucuna varılmıştır (Şekil 4).



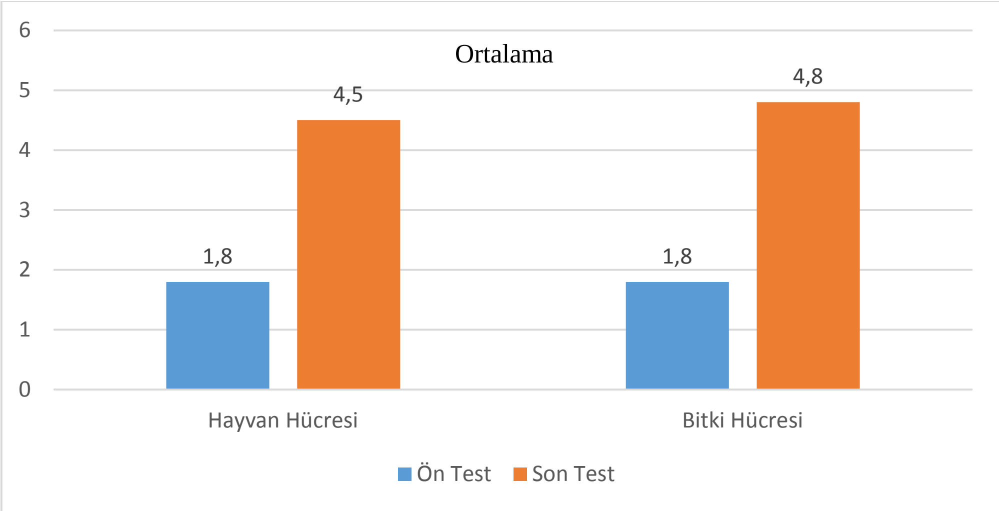
Şekil 4. Hücresel Yapılara Ait Kavram Yanılgılarındaki Değişim

Özellikle golgi aygıtı, lizozom, sentrozom ve endoplazmik retikulum organellerinde çok sayıda öğrencinin benzer kavram yanılgılarına sahip olduğu görülmüştür. Hücre zarı, ribozom, hücre çekirdeği ve hücre duvarı gibi yapı ve organellerde ise bu oran düşmektedir. Örneğin ön test sonuçlarına göre öğrencilerden 17'si sentrozom, 19'u golgi aygıtı, 20'si lizozom ve endoplazmik retikulum hakkında yanlış cevap verirken, bu rakam hücre zarı ve ribozomda yediye, hücre duvarı ve hücre çekirdeğinde ise 12'ye düşmektedir. Bu duruma, öğrencilerin golgi aygıtı, lizozom, sentrozom ve endoplazmik retikulum gibi hücre organellerine, diğer hücresel yapı ve organellere oranla daha az aşina olmalarının sebep olabileceği düşünülmektedir.

Araştırmada elde edilen ilginç bulgulardan biri de hücre zarının hangi hücre tiplerinde bulunduğuna dair soruya dört öğrencinin hem ön test hem de son test uygulamalarında "Hücre zarı hiçbir hücrede bulunmaz" şeklinde cevap vermeleridir. Yani öğrenciler, zarsız bir hücrenin var olabileceği olgusuna sahiptirler. Bu durumun, gerçekleştirilen eğitim uygulamalarına rağmen öğrencilerin, "zarlı ve zarsız organel" kavramlarını zihinlerinde "zarlı ve zarsız hücre" şeklinde düşünüyor olmalarından kaynaklanabileceği düşünülmektedir.

Öğrencilere, bitki ve hayvan hücresindeki yapı ve organeller için verdikleri cevapların nedenleri sorulduğunda, ön testte hiçbir öğrenci bilimsel olarak doğru açıklamada bulunmamıştır. Son testte ise sadece bir öğrenci bilimsel olarak doğru açıklamada bulunmuştur. Bu durum yapılan uygulamanın bitki ve hayvan hücresindeki benzerlik ve farklılıklar konusunda öğrencilerde derinlemesine bir kavram değişimi meydana getirmediği şeklinde yorumlanabilir. Bu yetersizlik, yapılan uygulamanın kısa süreli olmasından kaynaklanıyor olabilir. Bu yetersizliğin diğer bir sebebi ise öğrencileri düşünme ve araştırmaya sevk eden, bilimsel açıklama gerektiren "Neden, Nasıl" gibi soruların onlara yeterince yöneltilmemesinden kaynaklanıyor olabilir.

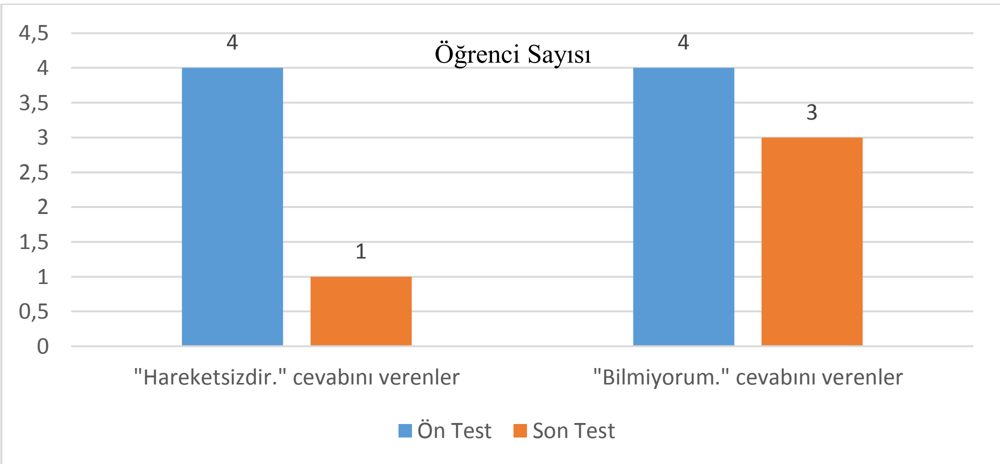
Başarı testinde yer alan hayvan ve bitki hücrelerinin çizimlerinin yapılmasının istendiği soruda, öğrenciler ön testte her iki hücre tipinde de 1,8'er ortalama ile hücresel yapı ve organları doğru biçimde gösterebilmişlerdir. Bu ortalama, son testte hayvan hücresi için 4,5'e, bitki hücresi için ise 4,8'e çıkmıştır. Burada, oransal anlamda olumlu yönde ciddi bir değişim olmasına rağmen öğrencilerin, plastitler, lizozom, golgi aygıtı, endoplazmik retikulum gibi organellerin çizimlerinde sorunlar yaşadıkları bulgusuna erişilmiştir (Şekil 5).



Şekil 5. Hücresel Yapı ve Organellerin Çizimlerde Doğru Biçimde Gösterilme Ortalamaları

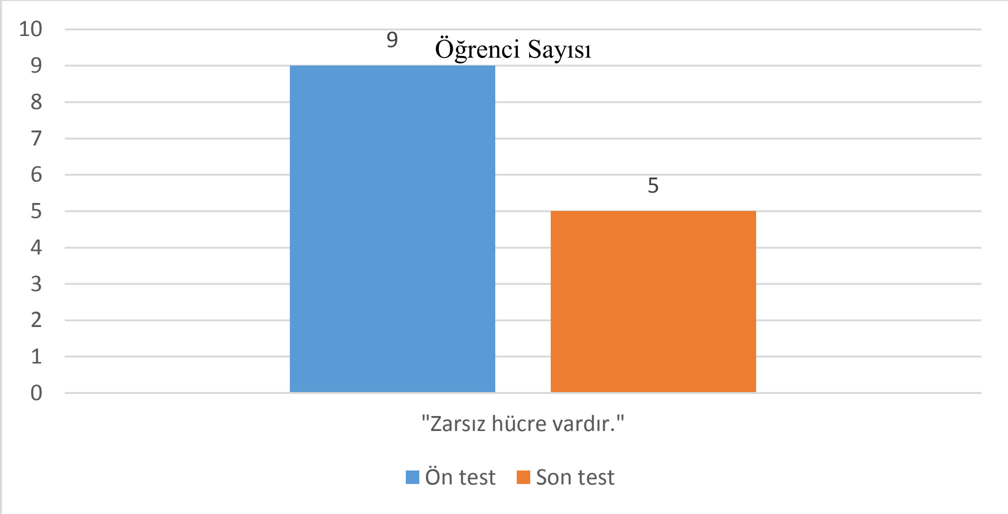
Organel terimine öğrencilerin yüklediği anlamlar ön test sonuçlarına göre incelendiğinde, yine çeşitli kavram yanılgıları gözlenmiştir. Bu kavram yanılgıları şunlardır: "Hücre içinde bulunan minerallerdir", "Sitoplazmada bulunur, hücrelerin hareket etmesine yardımcı olurlar", "Vücudumuzun dik durmasını sağlar" ve "Çekirdeğin içinde sıvı olan şeydir". Konuyla ilgili öğrencilerin son test cevapları incelendiğinde her ne kadar öğrencilerin kavram yanılgıları önemli ölçüde ortadan kalkmış olsa da bilimsel olarak net ve yeterli açıklamayı yalnızca bir öğrenci yapabilmiştir.

Organellerin hücre içerisinde hareketli mi yoksa sabit mi olduklarının sorulduğu soruya verilen cevaplar analiz edildiğinde, ön test sonuçlarına göre dört öğrencinin organellerin sabit olduklarını ifade ettikleri, dört öğrencinin de "Bilmiyorum" şeklinde cevap verdiği görülmüştür. Uygulamanın ardından gerçekleştirilen son test sonuçları incelendiğinde, ön testte organellerin hücre içerisinde sabit oldukları şeklinde kavram yanılgısına sahip dört öğrenciden üçünün bu yanılgıyı giderdiği, bu sayının "Bilmiyorum" şeklinde cevap veren öğrencilerde ise birde kaldığı gözlenmiştir (Şekil 6).



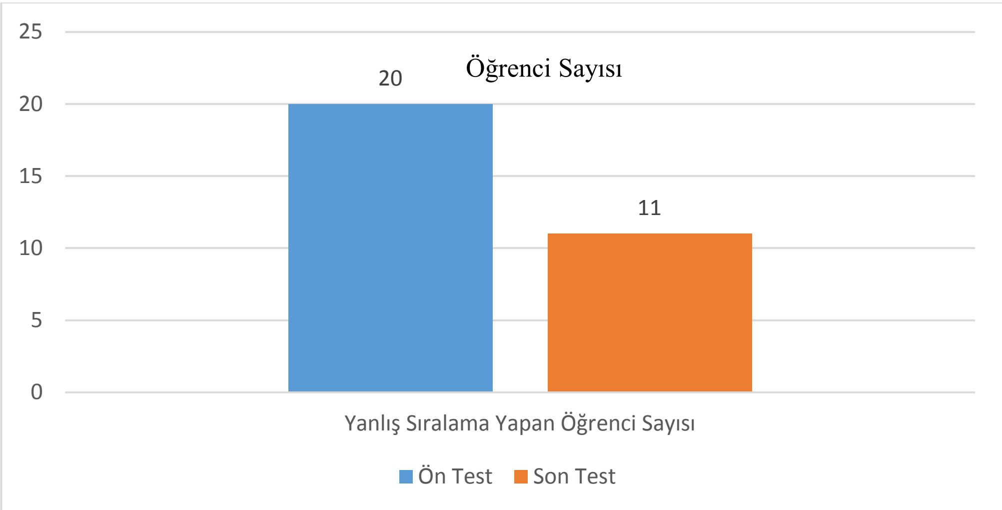
Şekil 6. Organellerin Hareketine Dair Verilen Cevaplar

Hücrelerin zarlı ve zarsız hücreler şeklinde sınıflandırılıp sınıflandırılamayacağının sorulduğu soruda ise ön test sonuçlarına göre dokuz öğrenci zarsız hücre olabileceği yönünde bir yorum yapmıştır. Son test sonuçlarına göre, bu dokuz öğrenciden dördü bu konudaki kavram yanılgısını giderebilmiştir (Şekil 7).



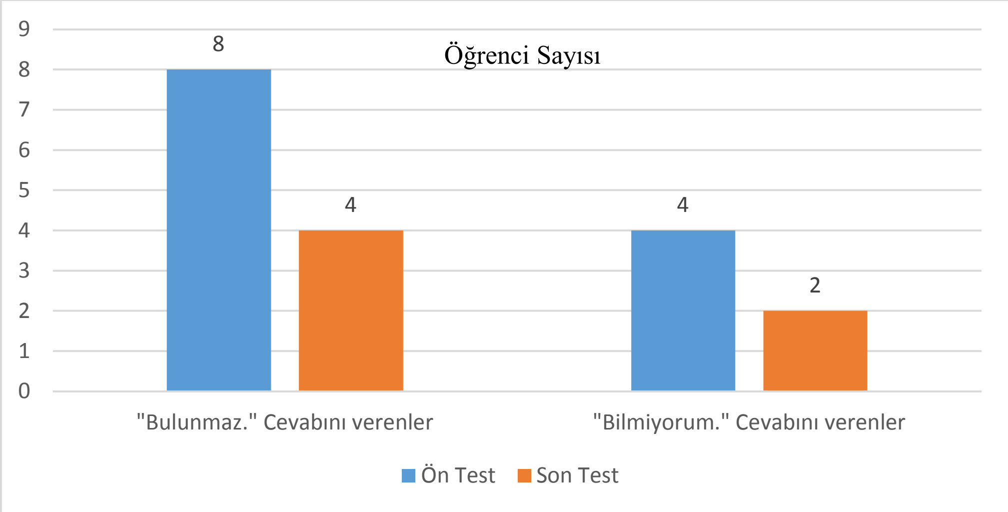
Şekil 7. Zarsız Hücrelerin Var Olduğunu Söyleyen Öğrenciler

Başarı testinde yer alan bir diğer soruda ise öğrencilerden, "hücre, atom, organ, organel ve doku" kavramlarını büyükten küçüğe doğru sıralamaları istenmiştir. Ön test uygulamasında, öğrencilerden yalnızca bir tanesi sıralamayı doğru olarak yapabilmiştir. Son test sonuçlarına göre ise, 10 öğrencinin sıralamayı eksiksiz ve doğru olarak yaptığı görülmektedir (Şekil 8). Buradaki temel yanılgı, doku kavramını öğrencilerin sıralamada doğru yerde düşünememesidir. Bu durum, öğrencilerin diğer kavramlara göre doku kavramı ile daha az karşılaşıyor olmalarından kaynaklanabilir.



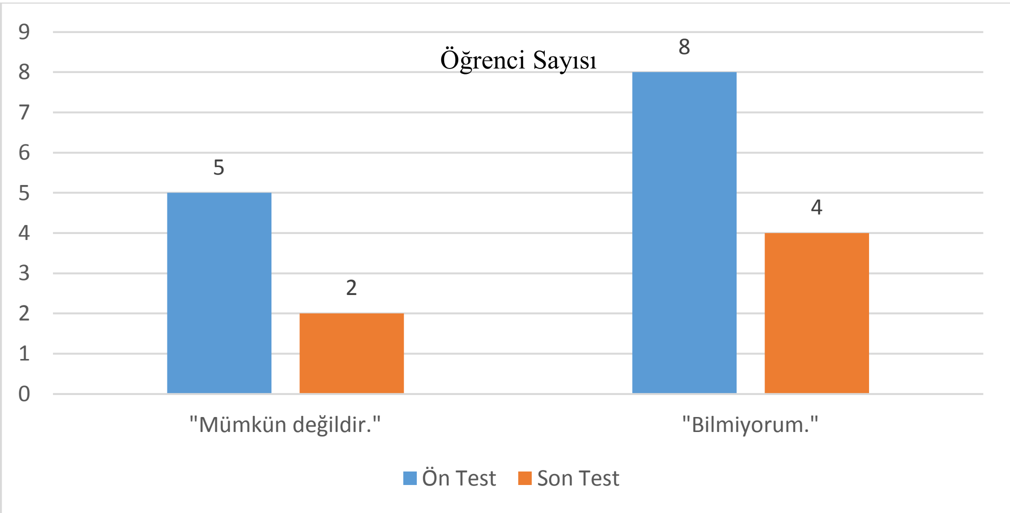
Şekil 8. Canlıya Ait Kavramların Büyüklük – Küçüklük Sıralaması

Başarı testinde yer alan ve hücrede DNA'nın çekirdek dışında bulunup bulunmadığının sorulduğu soruda ön test sonuçlarına göre sekiz öğrenci, DNA'nın sadece çekirdekte bulunabileceğini, dört öğrenci ise cevabı bilmediğini ifade etmiştir. Son test sonuçlarına göre, DNA'nın çekirdek dışında bulunamayacağını söyleyen sekiz öğrenciden dördü ve sorunun cevabını bilmediğini yazan dört öğrenciden ikisi DNA'nın hücre içerisinde çekirdek dışında başka yapılarda da bulunabileceğini ifade ederek kavram yanılgılarını gidermişlerdir (Şekil 9).



Şekil 9. DNA'nın Hücre İçinde Bulunduğu Yapılar

Organellerin birbirlerine dönüşüp dönüşemeyeceği konusunda ise, ön test uygulamasında öğrencilerin beş tanesi bunun mümkün olamayacağını ifade ederken sekiz öğrencinin cevabı "Bilmiyorum" şeklinde olmuştur. Son test sonuçlarına bakıldığında ise bu rakamların "Mümkün değildir" cevabını veren öğrencilerde ikiye, "Bilmiyorum" cevabını veren öğrencilerde ise dörde düştüğü tespit edilmiştir (Şekil 10).



Şekil 10. Organellerin Farklılaşması ve Dönüşümü

SONUÇ VE TARTIŞMA

Çalışmada elde edilen bulgular, öğrencilerin hücre gibi temel bir konuda ve bu konuya ait çok sık karşılaşılan ve bilinen hücre zarı, hücre çekirdeği gibi kavramlarda bile çok sayıda kavram yanılgısına sahip olduklarını göstermiştir. Ayrıca öğrencilerin bazılarının, ortaokul fen bilgisi derslerinden aşina oldukları halde hücre konusuna ciddi bilgi eksikliklerine sahip oldukları tespit edilmiştir. Gerçekleştirilen eğitim uygulamalarının, öğrencilerin test başarılarını dolayısıyla tespit edilen kavram yanılgılarının ortadan kaldırılmasını olumlu yönde etkilediği görülmektedir. Yani, hücresel yapılar, hücre organelleri ve hayvan ve bitki hücreleri arasındaki farklılıklar konularındaki kavram yanılgılarının giderilmesinde teknoloji destekli eğitim ve kavramsal değişim metinlerinin kullanılmasının etkili olduğu söylenebilir. Ancak araştırma sonuçları, öğrencilerin kavram yanılgılarının arzu edilen ölçüde giderilemediğine işaret etmektedir. Bunun başlıca sebebi uygulama süresinin kısa olması olabilir. Öğrencilerin kavram yanılgılarını ortadan kaldırmayı mümkün kılacak uzunlukta bir eğitim süreci planlaması yapılması, başarı oranını artırıcı bir önlem olarak düşünülebilir. Uygulama süresinin uzun tutulması hem kavram yanılgılarını belirlemede, hem öğrencilerin kavram yanılgılarını fark etmelerini sağlamada hem de bu yanılgıların giderilmesinde çok daha etkili olabilir.

Kavram yanılgılarının giderilmesi, oldukça zaman alıcı ve çaba gerektiren bir süreçtir (Özdemir & Clark, 2007). Çünkü kanıksanmış ve zihinde yer etmiş kavram yanılgılarının giderilmesi için oldukça planlı ve kararlı bir süreç işletilmelidir. İlgili literatür incelendiğinde kavram yanılgılarının giderilmesine yönelik çok sayıda teknoloji destekli eğitim uygulamasının gerçekleştirildiği (Akkoyunlu & Kurbanoğlu, 2003; Akçay, Aydoğdu, Yıldırım & Şensoy, 2005; Arslan, 2006; Hançer & Yalçın, 2009; Pektaş, Çelik, Katrancı & Köse, 2009; Güven & Sülün, 2012) ve kavramsal değişim metinlerinin kullanıldığı (Köse, Kaya, Gezer & Kara, 2011; Akyürek & Afacan, 2013) görülmektedir. Bu araştırmaların sonuçları değerlendirildiğinde, gerçekleştirilen uygulamaların kavram yanılgılarını giderme konusunda etkili sonuçlar verdiği görülmüştür. Bu sonuçlar, bizim çalışmamızla elde edilen sonuçlarla genel olarak örtüşmektedir.

Araştırma sonuçlarına göre en çok dikkat çeken noktalardan biri, öğrencilerin bir kısmının sorulara yeterli açıklıkta vermemiş olmalarıdır. Özellikle cevapların gerekçeleri ile ifade edilmesinin istendiği sorularda bazı öğrenciler bundan kaçınmış, cevap veren öğrencilerin de tamamına yakını bilimsel ve geçerli bir neden ortaya koyamamıştır. Bu da bize öğrencilerin yalnızca kavram yanılgıları nedeniyle değil, bilgi eksiklileri nedeniyle de soruları cevaplamada sıkıntılar yaşadıklarını göstermektedir.

Araştırmanın Sınırlılıkları

Araştırmanın sınırlılıklarına bakıldığında; uygulama süresinin kısa tutulmasının, kavram yanılgılarının istenilen seviyede giderilmesinin önünde bir engel olduğu görülmektedir. Ayrıca verilerin analizi sırasında fark edilmiştir ki verilerin toplanmasında tek bir kaynaktan faydalanılmış olunması, özellikle açıklama gerektiren ve nedensellik arayan sorularda yeterli veri elde edilmesinin önüne geçmiştir. Çünkü öğrencilerin büyük bir kısmı verdikleri cevapları açıklamaktan kaçınmıştır. Bu durumun ortadan kaldırılabilmesi için uygulama sonrasında öğrencilerle birebir görüşmelerin yapılması ve cevaplarının nedenlerine ulaşılmaya çalışılmasının faydalı olacağı düşünülmektedir.

ÖNERİLER

Bu çalışma sonucunda öğrencilerin, özellikle çok sık karşılaşmadıkları hücresel kavramlar konusunda ciddi yanılgılara sahip oldukları görülmüştür. Bu nedenle teknoloji destekli eğitim ve kavramsal değişim metinleri kullanılarak yapılacak çalışmalarda planlama, daha geniş bir sürece yayılacak şekilde yapılabilir.

Kavramsal değişim metinleri hazırlanırken mümkün olduğunca görselliği zengin tutacak öğelere yer verilmeli, renkli baskı uygulanarak metinler daha ilgi çekici hale getirilmelidir.

Çalışmamızda veri toplama aracının yazılı materyalden ibaret olması, açıklama gerektiren sorularda istenilen derinlikte cevap alınamamasına neden olmuştur. Benzer bir uygulamada, uygulama öncesinde ve sonrasında öğrencilerle görüşme yapılması daha zengin verilere ulaşılmasını sağlayabilir.

Bu çalışma göstermiştir ki öğrenciler, ortaokuldan lise kademesine gelirken yalnızca yanılgılarla değil birçok bilgi eksiğiyle de gelmektedir. Bu nedenle bu eksikliklerin ve kavram yanılgılarının diğer konularda da hangi seviyede olduğunun belirlenmesi için farklı konularda benzer araştırmalar yapılmalıdır.

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EK 1

Bu çalışma, sizin canlı bir hücrede yer alan yapılar ile hayvan ve bitki hücrelerinin farklılıkları ve benzerlikleri konusundaki bilgilerinizi ölçmek amacıyla hazırlanmıştır. Herhangi bir puanlama yapılmayacak ve değerlendirme açısından notlarınızı etkileyecektir. Lütfen tüm sorulara detaylı bir biçimce cevap vermeye çalışınız.

1)Aşağıda verilen hücresel yapıların yanlarındaki boş kutulara, o hücresel yapı sadece bitki hücresinde bulunuyorsa B, sadece hayvan hücresinde bulunuyorsa H, her iki hücre çeşidinde de bulunuyorsa Hİ ve hiçbirinde bulunmuyorsa HB yazınız.

Hücre Zarı		Merkezi Koful	
Ribozom		Kloroplast	
Golgi Aygıtı		Hücre Duvarı	
Hücre Çekirdeği		Sentrozom	
Lizozom		Endoplazmik Retikulum	

2) Şimdi de yukarıda verdiğiniz cevaplara göre, verilen yapıların hangi hücrede bulunduğuna nasıl karar verdiğinizi açıklayınız.

3) Sahip olduğunuz bilgilere göre, bir bitki ve bir hayvan hücresi çizerek kısımlarını gösteriniz

4) Organel ne demektir? Bir organelin hücre içerisinde ne tür görevleri olabilir?

5) Hücrede organeller, sitoplazma içerisinde yer alırlar. Bu organeller daima sabit durumda mıdırlar yoksa hücre içersinde hareket edebilirler mi? Açıklayınız.

6) Zarı olmayan hücreler var mıdır? Hücreleri zarlı ve zarsız hücreler şeklinde sınıflandırmak mümkün müdür? Cevabınızı nedenleri ve örnekleriyle açıklayınız.

7) Hayvan ve bitki hücrelerinde hangi zarlı organeller bulunabilir?

Hayvan:

Bitki:

8) Aşağıda verilen kavramları, büyükten küçüğe doğru sıralayınız.

Hücre – Atom – Organ – Organel – Doku

9) Bir hayvan ya da bitki hücresinde, çekirdek dışında herhangi bir yapıda DNA bulunabilir mi? Cevabınızı açıklayınız.

10) Sizce bir hücrede organellerin farklılaşabilmeleri ya da birbirlerine dönüşebilmeleri mümkün müdür? Açıklayınız.

11) Bir insan vücudunu ve bir hücreyi çizimle göstermeniz gerekseydi, insan vücudunu ve hücreyi hangi büyüklükte ve nasıl çizerdiniz? Gösteriniz.

EXAMINING OF PROBLEMS PARTAKING IN MATHS TEXTBOOKS OF NINTH GRADE

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ABSTRACT: In this study, it was aimed to examine the problems partaking in maths textbook of ninth grades that is taught in public secondary schools of Adana province in 2014-2015 academic year in terms of language, visual elements, content, problem types, and, compliance with the objectives of the 2013 mathematics curriculum. For this purpose, the problems were examined by document analysis method of qualitative research methods.

The population of the research is the math textbooks used in the 2013-2014 academic year in Turkey. The sample of the study is Adana Province is prepared by a special publishing textbook and by State textbook used in the ninth grade.

The problems was evaluated with the Problem Checklist. Data were analyzed by percentage and frequency.

Research results have shown that the problem of language in the textbook publishing in a particular textbook is clear both in the state and attributes, fate.

Research results have shown that the languages of the problems of both textbook is clear and understandable. There is not spelling mistake in the both textbooks problems and there is harmony between everyday language and mathematical language. The results shows that the visual elements used in the problems of both textbooks (shapes, pictures, tables and graphs etc.) is illustrative of nearly half and it is complementary, and their colors is net. Shows in addition to the problems are not encouraged to do researchto the students, the problems are not encouraged enough to think creatively for the students, problems is kind does not require the work together for the students problems are kind of students' problem-solving strategies that do not require one or more of the more well to use simultaneously. This addition results in textbooks for both publications have demonstrated that included single and unchanging routine problems with the correct answer.

Key words: textbook, mathematics teachers, problem solving

DOKUZUNCU SINIF MATEMATİK DERS KİTAPLARINDA YER ALAN PROBLEMLERİN İNCELENMESİ

ÖZET: Bu çalışmada ortaöğretim dokuzuncu sınıf matematik ders kitaplarında yer alan problem yapılarının dil ve anlatım, görsel unsurlar, içerik, 2013 matematik öğretim programı amaçlarına uygunluk ve problem türü bakımından incelenmesi amaçlanmıştır. Bu amaç doğrultusunda ortaöğretim dokuzuncu sınıf matematik ders kitaplarında yer alan problemler nitel araştırma yöntemlerinden doküman incelemesi yöntemi ile incelenmiştir.

Araştırmanın evrenini Türkiye'de 2014-2015 öğretim yılında 9. sınıflarında okutulan matematik ders kitapları oluşturmaktadır. Çalışmanın örneklemini ise Adana İlinde 9. Sınıflarda kullanılan Devlet Kitapları ile bir özel yayınevi tarafından hazırlanan kitaplar oluşturmaktadır. Kitaplarda yer alan "Problem Kontrol Listesi" değerlendirilmiştir.

Araştırmada ortaya çıkan bulgular için frekans ve yüzde değerleri belirlenmiştir. Araştırma sonuçları hem devlet hemde hem de özel bir yayıncılığa ait ortaöğretim dokuzuncu sınıf matematik ders kitabında yer alan problemlerin sunumunda kullanılan dilin açık ve anlaşılır olduğu, günlük dille matematik dili arasında uyum olduğu ve yazım hatası olmadığı, şekil, resim tablo ve grafik gibi görsel unsurlar açısından yarıya yakınının açıklayıcı ve tamamlayıcı olduğu, renklerin net olduğu sonucuna ulaşılmıştır. Bunun yanı sıra ise her iki yayına ilişkin kitaplardaki problemlerin kişisel konularla ilgili olduğu ancak bilim ve iş yaşamına yönelik çok az sayıda örnek olduğu, 2013 programına uygunluğu açısında incelendiğinde ise her iki yayına ait matematik ders kitaplarında yer alan problemlerin somut materyal üzerinde çalışma fırsatı vermediği, öğrencinin kendi yaşantısına uyarlayamadığı, öğrenciyi araştırmaya teşvik edemediği, öğrencinin yeni matematiksel bilgiler oluşturmasına olanak vermediği, öğrencileri yeterince yaratıcı düşünmeye özendirmediği, öğrencilerin pek fazla birlikte çalışması gerekmediği ve öğrencilerin problem çözme stratejilerinin bir veya birkaçının aynı anda pek fazla kullanılması gerekmediği görülmemektedir. Ayrıca sonuçlar her iki yayına ilişkin ders kitabında da tek ve değişmez doğru cevaba sahip olan rutin problemlere yer verildiğini göstermiştir.

Anahtar sözcükler: ders kitabı, problem, problem çözme.

GİRİŞ

Problem çözme ile ilgili araştırmalarda öğrencilerin, problemleri çözmeleri için problemin ifadesini ve problemdeki sayısal ilişkileri kurabilmelerinin gerektiği (Tatar ve Soylu, 2006), problemlerde var olan görsel elemanların niteliğinin problem çözme başarısı üzerinde olumlu etkiye sahip olduğu (Beckmann, 2004), problem çözme stratejilerini etkili bir bir şekilde kullanmanın problem çözme üzerinde belirleyici olduğu (Çalışkan, Selçuk ve Erol, 2006, s.73) öne çıkmaktadır. Bunun yanı problem çözme çalışmalarında,öğrencilerin çözüm yaklaşımlarını ve çözümlerini sınıf ortamında paylaşmaları ve bunları tartışmalarına olanak sunulması, öğrencilerin seviyesine ve ilgilerine uygun, aktif katılımlarını sağlayacak gerçekçi problem çözme çalışmalarına yer verilmesi vurgulanmaktadır (MEB,2013, s. II). Problemlerin anlaşılmasında içeriğin farklı biçimlerde ifade edilmesi çok önemli bir yol oynar. Matematikte semboller, tablolar ve grafikler matematiksel fikirlerle insanlar arasında iletişim kurmanın görsel bir yoludur. Semboller, grafikler ve tablolar zihinsel harekete geçiriciler oldukları kadar güçlü birer öğrenme araçlarıdır (Van de Walle, 2007, 5).

Matematik öğretim programlarının merkezinde problem çözme ile ilgili amaçlar olmalıdır (NCTM, 2000, s. 51). Ülkemizde Orta Öğretim matematik öğretim programında teknolojik gelişmelerle birlikte daha önceki kuşakların karşılaşmadığı yeni problemlerle karşılaşılan günümüz dünyasında, matematiğe değer veren, matematiksel düşünme gücü gelişmiş, matematiği modelleme ve problem çözmede kullanabilen bireylere her zamankinden daha çok ihtiyaç duyulduğu vurgulanmaktadır. Bu doğrultuda, tasarlanan lise matematik öğretim programı öğrencileri matematiksel düşünme gücü gelişmiş iyi birer problem çözücü olarak yetiştirmeyi amaçlamaktadır (MEB,2013, s. I)

Öğretim programlarının hayata geçirilmesinin araçlarından biri de ders kitaplarıdır (Artut ve lldırı, 2013). Ders kitapları öğretmenin öğretim etkinliklerinde gücünü daha iyi kullanmasını sağlayan, öğretmek istediği kavramları sistematik bir şekilde ele almasını kolaylaştıran; öğrencinin de öğretmenin anlattıklarını istediği zaman ve yerde istediği tempoda tekrar etmesine imkân veren temel materyallerdir (Aycan, Kaynar, Türkoğuz ve Arı, 2001).
Ders kitapları iyi seçilmişse, Milli Eğitim Bakanlığının programlarını iyi yansıtıyorsa, öğrenci ve öğretmen açısından kullanılması kolaysa; görsel açıdan albenisi varsa, gerekli resimleri ve şekilleri işlevsel olarak içinde bulunduruyorsa bu o alana ilişkin iyi bir kitaptır denilebilir (Ceyhan ve Yiğit, 2004). Artut ve Ildırı (2013)' te ders kitaplarında ve çalışma kitaplarında yer alan problemlerin özellikleri problem çözme öğretimini ve problem çözme başarısını etkileyen önemli öğelerden biri olduğu belirtilmektedir.

Yukarıda yapılan açıklamalar doğrultusunda ders kitaplarının matematik öğretiminde önemli bir yere sahip olduğu ve problem çözme becerisinin matematik dersinde kazanılması gereken önemli bir kazanım olduğu görülmektedir. Matematik ders kitapları ile yapılan çalışmalar incelendiğinde çalışmaların daha çok ders kitaplarının öğretmen ve öğrenci görüşlerine göre değerlendirilmesine (Dane, Doğar ve Balkı, 2004; Çakır**,** 2009; Yüksel, 2010**;** Taşdemir, 2011) ilişkin, öğrenci düzeyine uygunluğunun incelenmesine (Yapıcı, 2004) ilişkin, öğretmen adayları gözüyle matematik ders kitaplarında görsel ögelerin kullanımına (Delice, Aydın ve Kardeş, (2009) ilişkin ve İlköğretim matematik ders ve öğrenci çalışma kitaplarının yapısalcı yaklaşım açısından değerlendirilmesine (İzmirligil, 2008) ilişkin çalışmalar olduğu görülmüştür. Diğer yandan ilköğretim matematik kitaplarının farklı değişkenlerle ele alınıp incelendiği (Mutu, 2008; Arslan ve Özpınar, 2009; Çiğilli, 2009; Çakır, 2009; Sefa, 2009; Aydın, 2010; Kurtulmuş, 2010; Yüksel, 2010; Taşdemir; 2011) çalışmalarda söz konusudur. Matematik ders kitaplarıda yer alan problemlerin daha çok ilköğretim düzeyinde yapıldığı görülmüştür. Olkun ve Toluk (2002), Delil (2006), Artut ve Ildırı (2013), Coşar (2010), Seis (2011), Coşar (2011), Baki, İskenderoğlu ve Aydoğdu (2011) ilköğretim ders kitaplarında yer alan problemlerin çeşitli ölçütlere göre incemişlerdir.

Stigler, Fuson, Ham ve Kim (1986), Rusya ve Amerika'daki ilkokul 1., 2. ve 3. sınıf Matematik ders kitaplarındaki toplama-çıkarma sözel problemlerini analiz etmişler. Zhu ve Fan (2004), Çin ve Amerika'da kullanılan Matematik ders kitaplarındaki problem türlerini karşılaştırmışlardır.

Orta öğretim düzeyinde matematik ders kitapları ile ilgili olarak yapılan literatür incelendiğinde ise Gün (2009) tarafından ortaöğretim dokuzuncu sınıf Matematik ders kitabına ilişkin öğretmen ve öğrenci görüşlerini belirlemek amacıyla bir çalışma yapıldığı görülmektedir. Ünver (2009) ise çalışmasında dokuzuncu sınıf seviyesinde fonksiyon konusunda yer alan benzetimlerin, matematik ders kitabında ve sınıflarında nasıl kullanıldığını incelemiştir.

Ulaşılabilen kaynaklar çerçevesinde dokuzuncu sınıf ders kitaplarında yer alan tüm problemlerin ortaöğretim matematik programına uygunluğunu, problemlerin yapısını, içeriğini, problemlerin sunumunu ve türünü inceleyen bir çalışmaya rastlanmamıştır. Bu bağlamda bu araştırmanın sonuçlarının matematik ders kitaplarında yer alacak problemlerin belirlenmesine katkı sağlayacağı düşünülmektedir. Bu bağlamda bu çalışmanın genel amacı ortaöğretim dokuzuncu sınıf matematik ders kitaplarında yer alan problem yapılarının dil ve anlatım, görsel unsurlar, içerik, 2013 matematik öğretim programı amaçlarına uygunluk ve problem türü bakımından incelenmesidir. Bu genel amaç doğrultusunda aşağıda belirtilen alt amaçlar incelenmiştir.

1. Ortaöğretim dokuzuncu sınıf matematik ders kitabındaki problemlerin dil ve anlatım bakımından özellikleri nelerdir?
2. Ortaöğretim dokuzuncu sınıf matematik ders kitabındaki problemlerin görsel unsurlar bakımından özellikleri nelerdir?
3. Ortaöğretim dokuzuncu sınıf matematik ders kitabındaki problemlerin içerik bakımından özellikleri nelerdir?
4. Ortaöğretim dokuzuncu sınıf matematik ders kitabındaki problemlerin 2013 Matematik Programına uygunluğu açısından özellikleri nelerdir?
5. Ortaöğretim dokuzuncu sınıf matematik ders kitabındaki problemlerin tür açısından özellikleri nelerdir?

YÖNTEM

Bu çalışmada ortaöğretim dokuzuncu sınıf matematik ders kitaplarında yer alan problemleri incelemek amacıyla nitel araştırma yöntemlerinden doküman incelemesi ile gerçekleştirilmiştir. Doküman incelemesi, araştırılması hedeflenen olgu veya olgular hakkında bilgi içeren yazılı materyallerin hepsini kapsar (Yıldırım ve Şimşek, 2006). Bu çalışmada da ortaöğretim matematik öğretim programına göre hazırlanmış mevcut 9. sınıf matematik ders kitaplarında problemler belli ölçütlere göre incelenmiştir.

Çalışma grubu

Araştırmanın evrenini Türkiye'de 2014-2015 öğretim yılında 9. sınıflarında okutulan matematik ders kitapları oluşturmaktadır. Çalışmanın örneklemini ise Adana İlinde 9. Sınıflarda kullanılan Milli Eğitim Bakanlığı, Talim ve Terbiye Kurulunun 31.07.2013 tarih ve 86 ve 100 sayılı ders kitabı olarak kabul edilen Devlet Kitapları ile bir özel yayınevi tarafından hazırlanan kitaplar oluşturmaktadır. Bu kitaplar Kitap A ve Kitap B olarak kodlanmıştır.

Veri Toplama Aracı

Bu çalışmada veri toplama aracı olarak devlet tarafından hazırlanan matematik ders kitabı ile bir özel yayıncılık tarafından hazırlanan matematik ders kitaplarda yer alan problemler veri aracı olarak kullanılmıştır. Kitaplarda yer alan problemler iki matematik eğitimcisi ve iki matematik öğretmeninin görüşleri alınarak belirlenmiştir. Belirlenen problemler "Problem Kontrol Listesi" değerlendirilmiştir. Ildırı (2009) tarafından geliştirilen "Problem Kontrol Listesi (PKL)", bu çalışmada araştırmanın amacı doğrultusunda gözden geçirilerek ve dokuzuncu sınıf matematik ders kitabındaki problemlere uyarlanmıştır. PKL, toplam yirmi dört maddeden oluşmaktadır. Belirlenen ölçütler özelliklerine göre; dil ve anlatım, görsel unsurlar, içerik, 2013 Matematik Programı amaçlarına uygunluk ve problemlerin türü olmak üzere beş ana başlık altında toplanmıştır. Dil ve anlatım başlığı altında problemlerde kullanılan cümlelerin açık ve anlaşılır olması, yazım hatası içermemesi ve matematiksel dil ile olan tutarlılığına; görsel unsurlar başlığı altında problemlerin görsel unsurlarla birlikte verilmesi ve bu görsellerin amacına hizmet etmesine; içerik başlığı altında araştırma konusu problemler sosyal, kişisel, çeşitli iş yaşamı, bilim ve diğer konularla ilişkisini göz önünde bulundurması; 2013 Matematik Öğretim Programının amaçlarına uygunluğu ve problemlerin türüne göre incelenmiştir.

Verilerin Analizi

Araştırmada doküman analizi elde edilen veriler, dokuzuncu sınıf matematik kitabında yer alan problemler incelenip ve eğer ilgili kategori dokümanda varsa ‘1’ değeri, yoksa ‘0’ değeri verilerek betimsel istatistik yapılarak, maddelerin yüzde (%) ve frekans (f) değerleri hesaplanmıştır. Kontrol listesinde iki araştırmacının uyuşma oranını belirlemek için $\mathrm{P} = \frac{\mathrm{Na} \times 100}{\mathrm{Na+Nd}}$ formülü kullanılarak iki kodlayıcı arası uyuşum yüzdesi %98 olarak hesaplanmıştır.

BULGULAR

Bu bölümde yapılan doküman incelemesi sonucunda elde edilen veriler araştırmanın alt amaçları doğrultusunda ele alınmıştır. İlk olarak ortaöğretim dokuzuncu sınıf matematik ders kitabında yer alan problemlerin ifade edilmesinde kullanılan cümlelerin dil ve anlatımına ilişkin özelliklerini belirlemek amacıyla problem kontrol listesine göre yapılan incelemelerde ortaya çıkan bulgular Tablo 1’de yer almaktadır.

Tablo 1. Ortaöğretim 9. Sınıf Matematik Kitabındaki Problemlerin Dil ve Anlatımına İlişkin Frekans Dağılımı

	Kitap A						Kitap B					
	Uygun		Uygun Değil		Toplam		Uygun		Uygun Değil		Toplam	
	f	%	f	%	f	%	f	%	f	%	f	%
1. Problemin sunumunda kullanılan dil açık ve anlaşılır ifadeler içermektedir.	507	100	0	0	507	100	78	100	0	0	78	100
2. Günlük dil ile problemin sunumunda kullanılan matematiksel dil arasında tutarlılık vardır.	507	100	0	0	507	100	78	100	0	0	78	100
3. Problemlerin sunumunda kullanılan cümlelerde yazım hatası bulunmaktadır.	0	0	507		507	100	0	0	78	100	78	100

Tablo 1’de problemlerin dil ve anlatımına ilişkin maddelerin ortaöğretim dokuzuncu sınıf devlet ve özel yayıncılığa ait matematik ders kitapları incelendiği zaman; problemlerin sunumunda kullanılan dilin ve gündelik dil ile problemin sunumunda kullanılan dil arasında tam tutarlılık olduğu (%100) ve problemlerin sunumunda kullanılan cümlelerde yazım hatalarının bulunmadığı görülmektedir. Yani problemlerin tamamı gündelik dil ile uyumlu ve yazım hatası bulunmayan problemlerdir. Ortaöğretim dokuzuncu sınıf matematik ders kitabında yer alan problemlerin sunumunda kullanılan şekil, resim, tablo ya da grafik gibi görsel unsurların niteliklerine İlişkin veriler Tablo 2’de verilmiştir.

Tablo 2: Ortaöğretim 9. Sınıf Matematik Kitabındaki Problemlerin Sunumunda Kullanılan Görsel Unsurların Niteliklerine İlişkin Frekans Dağılımı

	Kitap A						Kitap B					
	Uygun		Uygun Değil		Toplam		Uygun		Uygun Değil		Toplam	
	f	%	f	%	f	%	f	%	f	%	f	%
5. Problemin sunumunda kullanılan şekil, resim, tablo ya da grafik gibi görsel unsurlar problemi açıklayıcı ve tamamlayıcı niteliktedir.	255	50,29	252	49,71	507	100	25	32,05	53	67,95	78	100
6. Problemin sunumunda kullanılan şekil, resim, tablo ya da grafik gibi görsel unsurların renkleri açık ve net görülmektedir.	210	41,42	297	58,58	507	100	25	32,05	53	67,95	78	100
7. Problemin sunumunda kullanılan şekil, resim, tablo ya da grafik gibi görsel unsurlar problemle aynı sayfada verilmiştir.	274	54,04	233	45,96	507	100	25	32,05	53	67,95	78	100

Tablo 2'de ortaöğretim dokuzuncu sınıfa ilişkin Kitap A' da yer alan problemlerin sunumunda kullanılan görsel unsurların niteliklerine ilişkin sonuçların yüzde oranları incelendiği zaman; kullanılan şekil, resim, tablo ya da grafik gibi görsel unsurların %50,29'unun problemi açıklayıcı ve tamamlayıcı nitelikte olduğu, %41,42'sının renklerinin açık ve net olarak görüldüğü ve %54,04'ünün problemle aynı sayfada yer aldığı görülmektedir. Kitap B' de yer alan problemlerin sunumunda kullanılan görsel unsurların niteliklerine ilişkin sonuçların yüzde oranları incelendiğinde ise; kullanılan şekil, resim, tablo ya da grafik gibi görsel unsurların %67,95'inin problemi açıklayıcı ve tamamlayıcı nitelikte olduğu, %67,95'inin renklerinin açık ve net olarak görüldüğü ve %67,95 inin problemle aynı sayfada yer aldığı görülmektedir. Tablo 2' den elde edilen bulgular devlet tarafından hazırlanan matematik ders kitabı ile bir özel yayıncılık tarafından hazırlanan matematik ders kitabının her ikisinde de yer alan problemlerin sunumunda kullanılan görsel unsurların niteliklerine ilişkin sonuçlarının uyumlu olduğu görülmüştür.

Üçüncü alt amaç olarak ortaöğretim dokuzuncu sınıf matematik ders kitabında yer alan problemlerin içerik unsuruna göre incelenmiştir. Buna ilişkin bulgular Tablo 3'te verilmiştir.

Tablo 3. Ortaöğretim 9. Sınıf Matematik Kitabındaki Problemlerin İçeriğine İlişkin Frekans Dağılımı

	Kitap A						Kitap B					
	Uygun		Uygun Değil		Toplam		Uygun		Uygun Değil		Toplam	
	f	%	f	%	f	%	f	%	f	%	f	%
8. Problem kişisel konular ile ilgilidir.	366	78,19	141	27,81	507	100	0	0	78	100	78	100
9. Problem sosyal konular ile ilgilidir.	263	51,87	244	48,13	507	100	77	98,72	1	1,28	78	100
10. Problem çeşitli iş yaşamı konuları ile ilgilidir.	39	7,69	468	92,31	507	100	8	10,26	70	89,74	78	100
11. Problem bilim konuları ile ilgilidir.	195	38,46	312	61,54	507	100	4	5,13	74	94,87	78	100
12. Problem diğer konular ile ilgilidir.	35	6,90	472	93,10	507	100	0	0	78	100	78	100

Tablo 3'de Kitap A'da yer alan problemlerin içeriğine ilişkin sonuçların yüzde dağılımları incelendiği zaman; problemlerin %78,19'unun kişisel konular, %51,87'sinin sosyal konular, %7,69'sının çeşitli iş yaşamı konuları, %38,46'sının bilim konuları ve %6,9'unun diğer konular kategorisine girdiği görülmektedir. Buna göre ortaöğretim dokuzuncu sınıf Kitap A matematik ders kitabında yer alan problemler en çok kişisel konularla ve sosyal konularla ilgili içeriğe sahipken çeşitli iş yaşamı, bilim konuları ve diğer konuları ile ilgili içeriğe sahip problemlerin sayısının daha az olduğu görülmektedir. Ayrıca Tablo 3' de ortaöğretim dokuzuncu sınıf Kitap B matematik ders kitabında yer alan problemlerin içeriğine ilişkin sonuçların yüzde dağılımları incelendiği zaman; problemlerin %98,72'sinin sosyal konular, %10,26'sının çeşitli iş yaşamı konuları, %5,13'ünün bilim konuları olduğu görülmektedir. Ancak Kitap B' deki problemlerde kişisel konular ve diğer konular kategorisinde hiç soru olmadığı görülmektedir. Buna göre ortaöğretim dokuzuncu sınıf Kitap B matematik ders kitabında yer alan problemler en çok kişisel sosyal konularla ilgili içeriğe sahipken kişisel konular, çeşitli iş yaşamı, bilim konuları ve diğer konuları ile ilgili içeriğe sahip problemlerin sayısının daha az olduğu hatta kişisel konulara ve diğer konulara hiç yer verilmediği görülmektedir. Tablo 3'ten ortaöğretim dokuzuncu sınıf Kitap A matematik ders kitabında ve ortaöğretim dokuzuncu sınıf Kitap B matematik ders kitabında yer alan problemlerin içeriğine ilişkin sonuçların yüzde dağılımlarının sosyal konularla ilgili olmasında uyumlu olduğu ancak kişisel konularla ilgili olması bakımından %78,19 bir farkla ayrıldıkları görülmüştür.

Dördüncü alt amaç olarak ortaöğretim dokuzuncu sınıf matematik ders kitabında yer alan problemlerin 2013 matematik öğretim programında yer alan amaçları gerçekleştirmeye yönelik olarak hazırlanıp hazırlanmadığını ortaya çıkarmak için problem kontrol listesinin 13-24. maddelerine göre incelenmesiyle ortaya çıkan frekans dağılımı Tablo 4'te yer almaktadır.

Tablo 4. Ortaöğretim 9. Sınıf Matematik Kitabındaki Problemlerin 2013 Matematik Öğretim Programının Amaçlarına Uygunluğuna İlişkin Frekans Dağılımı

	Kitap A Uygun		Uygun Değil		Toplam		Kitap B Uygun		Uygun Değil		Toplam	
	f	%	f	%	f	%	f	%	f	%	f	%
13. Problem, öğrenciye somut materyal üzerinde çalışma fırsatı vermektedir.	54	10,65	453	89,35	507	100	15	19,23	63	80,77	78	100
14. Problem, öğrencinin kendi hayatından yani ev, aile, okul, arkadaş çevresi veya çeşitli iş alanlarından uyarlanmıştır.	3	0,59	504	99,41	507	100	7	8,97	71	91,03	78	100
15. Problemde, çözümde kullanılacak bilgilerden bir ya da birkaçı eksik verilerek öğrencileri verilmeyen bilgileri kendi çabaları ile araştırarak bulmaya teşvik edici nitelikte tasarlanmıştır.	322	63,51	185	36,49	507	100	0	0	78	100	78	100
16. Problem, öğrencilerin yeni matematiksel bilgiler oluşturmasına olanak vermektedir.	506	99,80	1	0,20	507	100	2	2,56	76	97,44	78	100
17. Problem, çözüm sürecinde öğrencilerin birlikte çalışmasını gerektirmektedir.	329	64,89	178	35,11	507	100	2	2,56	76	97,44	78	100
18. Problemin tek ve değişmez bir doğru cevabı vardır.	453	89,35	54	10,65	507	100	76	97,44	2	2,56	78	100
19. Problem, çözüm sürecinin önemli olduğu, çözüm yollarının ve cevabın farklı koşullarda değişebildiği türdendir.	55	10,85	452	89,15	507	100	76	97,44	2	2,56	78	100
20. Problemin belirli çözüm yoluyla ulaşılabilecek bir cevabı vardır.	444	87,57	63	12,43	507	100	76	97,44	2	2,56	78	100
21. Problemin çözümü şekil, resim, tablo ve grafik gibi görsel unsurların kullanılmasını gerektirmektedir.	450	88,76	57	11,24	507	100	76	97,44	2	2,56	78	100
22. Problem, problem çözme stratejilerinin bir ya da birkaçının aynı anda çözümde kullanılabileceği türdendir.	207	40,83	300	59,17	507	100	29	37,18	49	62,82	78	100
23. Problem, öğrencileri yaratıcı düşünmeye özendirmektedir.	260	51,28	247	48,72	507	100	14	17,95	64	82,05	78	100
24. Problemin çözümüne belirli bir algoritma ya da prosedür ile ulaşılabilmektedir.	224	44,18	283	55,82	507	100	76	97,44	2	2,56	78	100

Tablo 4'te ortaöğretim dokuzuncu sınıf Kitap A matematik ders kitabında yer alan problemlerin 2013 Matematik Programının amaçlarına uygunluğuna ilişkin bulguların yüzde dağılımları incelendiği zaman; problemlerin %10,65'inin öğrenciye somut materyal üzerinde çalışma fırsatı verdiği, % 0,59'unun öğrencinin kendi hayatından yani ev, aile, okul, arkadaş çevresi veya çeşitli iş alanlarından uyarlandığı, % 63,51 öğrencileri verilmeyen bilgileri kendi çabaları ile araştırarak bulmaya teşvik edici nitelikte olduğu ve % 99.80'inin öğrencilerin yeni matematiksel bilgiler oluşturmasına olanak verdiği görülmektedir. Tablo 4'te ortaöğretim dokuzuncu sınıf Kitap A matematik ders kitabında yer alan problemlerin % 64,89'unun çözüm sürecinde öğrencilerin birlikte çalışmasını gerektirdiği, % 89,35'inin tek ve değişmez bir doğru cevabının olduğu, %

10,85'inin cevabının farklı koşullarda değişebildiği, % 87,57'sinin belirli çözüm yoluyla ulaşılabilecek bir cevabının olduğu, % 88,76'sının çözümünde görsel unsurların kullanılması gerektirdiği, % 40,83'ünün çözümünde problem çözme stratejilerinin bir ya da birkaçının aynı anda kullanılabildiği,% 51,28'inin öğrencileri yaratıcı düşünmeye özendirdiği ve % 44,18'inin çözümüne belirli bir algoritma ya da prosedür ile ulaşılabildiği görülmektedir.

Ayrıca Tablo 4'te ortaöğretim dokuzuncu sınıf Kitap B matematik ders kitabında yer alan problemlerin 2013 Matematik Programının amaçlarına uygunluğuna ilişkin bulguların yüzde dağılımları incelendiği zaman; problemlerin %19,23'ünün öğrenciye somut materyal üzerinde çalışma fırsatı verdiği, % 8,97'sinin öğrencinin kendi hayatından yani ev, aile, okul, arkadaş çevresi veya çeşitli iş alanlarından uyarlandığı ve % 2,56'sının öğrencilerin yeni matematiksel bilgiler oluşturmasına olanak verdiği görülmektedir. Bu durum ortaöğretim dokuzuncu sınıf Kitap matematik ders kitabındaki problemlerin büyük oranda öğrencinin gündelik yaşamından uyarlanamadığı, yeni matematiksel bilginin oluşmasına olanak vermediği, öğrencilere yeterince problemi somutlaştırma fırsatı vermediği, öğrencileri araştırmaya çok fazla teşvik etmediği görülmüştür. Tablo 4'te ortaöğretim dokuzuncu sınıf Kitap B matematik ders kitabında yer alan problemlerin % 2,56'sının çözüm sürecinde öğrencilerin birlikte çalışmasını gerektirdiği, % 97,44'ünün tek ve değişmez bir doğru cevabının olduğu, % 2,56'sının cevabının farklı koşullarda değişebildiği, % 97,44'ünün belirli çözüm yoluyla ulaşılabilecek bir cevabının olduğu, % 97,44'ünün çözümünde görsel unsurların kullanılması gerektirdiği, % 37,18'inin çözümünde problem çözme stratejilerinin bir ya da birkaçının aynı anda kullanılabildiği,% 17,95'inin öğrencileri yaratıcı düşünmeye özendirdiği ve % 97,44'ünün çözümüne belirli bir algoritma ya da prosedür ile ulaşılabildiği görülmektedir.

Tablo 4' te yer alan bulgular ortaöğretim dokuzuncu sınıf Kitap A matematik kitabı ile Kitap B matematik ders kitabının somut materyal üzerinde çalışma fırsatı vermediği, öğrencinin kendi yaşantısına uyarlayamadığı, öğrenciyi araştırmaya teşvik edemediği, öğrencinin yeni matematiksel bilgiler oluşturmasına olanak vermediği, öğrencileri yeterince yaratıcı düşünmeye özendirmediği, öğrencilerin pek fazla birlikte çalışması gerekmediği ve öğrencilerin problem çözme stratejilerinin bir veya birkaçının aynı anda pek fazla kullanılması gerekmediği görülmemektedir. Ayrıca ortaöğretim dokuzuncu sınıf Kitap A matematik kitabı ile ortaöğretim dokuzuncu sınıf Kitap B matematik ders kitabında tek değişmez doğru cevaplı problemlerin çok olduğu ve çoğu probleme belirli algoritma ya da prosedür ile ulaşılabildiği görülmüştür. Bu bakımdan ortaöğretim dokuzuncu sınıf Kitap A matematik kitabı ile ortaöğretim dokuzuncu sınıf Kitap matematik ders kitabı birbirleriyle uyumlu kitaplardır.

Son alt amaç olarak ortaöğretim dokuzuncu sınıf matematik ders kitabında yer alan problemlerin türlerini belirlemek amacıyla problem kontrol listesinin 25. ve 26. maddesine göre yapılan inceleme sonuçları Tablo 5'te yer almaktadır.

Tablo 5.Ortaöğretim 9. Sınıf Matematik Kitabındaki Problemlerin Türlerine İlişkin Frekans Dağılımı

	Kitap A Uygun		Uygun Değil		Toplam		Kitap B Uygun		Uygun Değil		Toplam	
	f	%	f	%	f	%	f	%	f	%	f	%
25.Rutin problem yer almaktadır.	493	97,24	14	2,76	507	100	76	97,44	2	2,56	78	100
26. Rutin olmayan problemler yer almaktadır.	14	2,76	493	97,24	507	100	2	2,56	76	97,44	78	100

Tablo 5'te ortaöğretim dokuzuncu sınıf Kitap A matematik ders kitabındaki problem türlerine ilişkin bulgularının yüzde frekansları incelendiğinde; problemlerin %97,24'ünü rutin problemler, %2,76'sını rutin olmayan problemler oluşturduğu görülmektedir. Ayrıca Tablo 5'te ortaöğretim dokuzuncu sınıf Kitap B matematik ders kitabındaki problem türlerine ilişkin bulgularının yüzde frekansları incelendiğinde; problemlerin %97,44ünü rutin problemler, %2,56'sını rutin olmayan problemler oluşturduğu görülmektedir. Tablo 5'ten açıkça görülüyor ki hem devlet tarafından yayınlanan ortaöğretim dokuzuncu sınıf matematik ders kitabı hem de özel bir yayınevi tarafından yayınlanan ortaöğretim dokuzuncu sınıf matematik ders kitabı büyük çoğunlukla ve birbirine yakın yüzdelerle rutin problemler içerdiği görülmektedir.

SONUÇ

Araştırmanın sonucunda hem devlet tarafından yayınlanan dokuzuncu sınıf matematik ders kitabı hem de özel bir yayıncılığa ait ortaöğretim dokuzuncu sınıf matematik ders kitabında yer alan problemlerin sunumunda kullanılan dilin açık ve anlaşılır olduğu, günlük dille matematik dili arasında uyum olduğu ve yazım hatası olmadığı sonucuna ulaşılmıştır. Diğer taraftan incelenen kitaplarda yer alan problemlerin şekil, resim tablo ve grafik gibi görsel unsurlar açısından yarıya yakınının açıklayıcı ve tamamlayıcı olduğu, renklerin net olduğu ortaya çıkmıştır. Problemler içerik açısından incelendiğinde ise her iki yayına ilişkin kitaplardaki problemlerin kişisel konularla ilgili olduğu ancak bilim ve iş yaşamına yönelik çok az sayıda örnek olduğu sonucuna ulaşılmıştır. 2013 programına uygunluğu açısında incelendiğinde ise her iki yayına ait (Kitap A,Kitap B) matematik ders kitaplarında yer alan problemlerin somut materyal üzerinde çalışma fırsatı vermediği, öğrencinin kendi yaşantısına uyarlayamadığı, öğrenciyi araştırmaya teşvik edemediği, öğrencinin yeni matematiksel bilgiler oluşturmasına olanak vermediği, öğrencileri yeterince yaratıcı düşünmeye özendirmediği, öğrencilerin pek fazla birlikte çalışması gerekmediği ve öğrencilerin problem çözme stratejilerinin bir veya birkaçının aynı anda pek fazla kullanılması gerekmediği görülmemektedir. Ayrıca her iki yayına ait (Kitap A,Kitap B) ortaöğretim dokuzuncu sınıf matematik ders kitaplarında tek değişmez doğru cevaplı problemlerin çok olduğu ve çoğu probleme belirli algoritma ya da prosedür ile ulaşılabildiği görülmüştür. Son olarak her iki yayına ait (Kitap A,Kitap B) ortaöğretim dokuzuncu sınıf matematik ders kitaplarında büyük çoğunlukla ve birbirine yakın yüzdelerle rutin problemler içermektedir.

ÖNERİLER

Araştırmanının sonucunda, dokuzuncu sınıf matematik ders kitaplarındaki bilim ve iş yaşamına yönelik az sayıda problem yer almaktadır. Öğrencilerin bu tür problemlerle karşılaştırılması hayata bakış açılarını değiştirebilir ve gelecekteki meslek seçimini belirleyebilir. Bu bağlamda matematik ders kitaplarında verilen problemlerin çeşitli iş yaşamı ve bilim konularını daha fazla içerecek şekilde düzenlenebilir. Diğer taraftan kitaplarda yer alan problemlerin çoğunluğu tek ve değişmez bir cevabı olan rutin türde problemlerdir. Ancak öğrencilerin farklı bakış açısı kazanabilmeleri ve üst düşünme becerilerinin geliştirmesine yardımcı olabilecek rutin olmayan problemler de yer verilebilir.

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VIEWS OF PROPECTIVE TEACHERS' ABOUT LEARNING AND TEACHING PROCESS AND EVALUATION OF CONCEPTUAL DEVELOPMENT

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ABSTRACT: It is important that prospective teachers have basic concepts that are located in the teaching and learning process from the time they begin teacher training and reflect these concepts to the learning environment. The aim of the research is to determine views of prospective teachers' about learning and teaching process and to evaluate conceptual development. For this purpose, aimed to equip participants with the basic concept in issues cognitive learning styles, multiple intelligences theory, classroom environment and management, creativity and enhance creativity, thinking process, constructivist theory and the teaching-learning process, cooperative learning, problem solving based learning, active learning in the course of "Effective Learning and Teaching Processes". In this research, qualitative research methods were used to collect data and analyze the results. The participants of the study were 21 elementary science-technology and classroom prospective teachers who attended the course. Written interview form was used to collect data and preparation of this form was benefited from researcher's experience. In this form which was considered concepts included course content, questions aimed at uncovering the conceptual development process. Before and after the course prospective teachers fill in the forms as written to reveal their conceptual development in this process. In order to analyze the data descriptive situation analysis techniques was used. The first step of data analyses written interview forms which filled by prospective teachers read, separated in significant parts and code list was formed. In the light of code list, it was identified themes explaining the data in general and obtaining the codes under specific categories. Data is described, made tabs and interpreted systematically according to the codes and themes. Interpretation of the data prospective teacher's answers evaluated separately before and after the course to reveal their conceptual development. At the results of data analysis, the subcategories/codes of "concepts of effective teaching-learning process", "properties of effective teaching-learning process"; "method-technique-approaches which used effective teaching-learning process" and "concepts in terms of issues which include effective teaching-learning process course" themes and the examples of these codes will be demonstrated. It is clear that prospective teachers progressed as conceptual after effective teaching-learning process course, when evaluate concepts about themes.

Key words: prospective teachers, teaching and learning process, conceptual development.

ÖĞRETMEN ADAYLARININ ÖĞRENME ÖĞRETME SÜREÇLERİNE İLİŞKİN GÖRÜŞLERİ VE KAVRAMSAL GELİŞİMLERİNİN DEĞERLENDİRİLMESİ

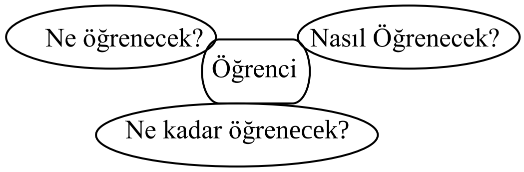
ÖZET: Öğretmen adaylarının öğretmenlik eğitimine başladıkları dönemden itibaren öğrenme-öğretme süreçlerinde yer alan temel kavramlara sahip olmaları ve öğrenme ortamlarına yansıtabilmeleri önem taşımaktadır. Buradan hareketle yapılan araştırmanın amacı öğretmen adaylarının öğrenme öğretme süreçlerine ilişkin görüşleri ve kavramsal gelişimlerinin değerlendirilmesidir. Bu amaçla araştırmaya katılan öğretmen adaylarına "Etkili Öğrenme Öğretme Süreçleri" dersi kapsamında bilişsel öğrenme stilleri, çoklu zekâ teorisi, sınıf ortamı ve yönetimi, yaratıcılık ve yaratıcılığı geliştirmek, düşünme süreci, yapısalcı kuram ve öğrenme-öğretme süreci, işbirliğine dayalı öğrenme, problem çözmeye dayalı öğrenme, aktif öğrenme konularında temel kavramların kazandırılması hedeflenmiştir. Çalışmada, nitel araştırma yöntemi kullanılmıştır. Araştırmanın çalışma grubunu Fen Bilgisi Öğretmenliği ve Sınıf Öğretmenliği bölümlerinde birinci sınıfta okuyan ve derse katılan 21 öğretmen adayı oluşturmaktadır. Verilerin toplanmasında tam yapılandırılmış yazılı görüş formu kullanılmıştır. Formun hazırlanmasında araştırmacıların deneyimlerinden yararlanılarak, dersin içeriğinde yer alan kavramlar dikkate alınıp süreç içerisinde öğretmen adaylarının kavramsal gelişimleri ortaya çıkarılmasını amaçlayan sorulara yer verilmiştir. Öğretmen adaylarının süreç içerisindeki kavramsal gelişimlerinin ortaya çıkarılması amacıyla uygulama öncesinde ve sonrasında yazılı olarak öğretmen adaylarının görüşleri alınmıştır.

Yapılan nitel çalışmada elde edilen verilen içerik analizi yöntemiyle değerlendirilmiştir. Veri analizinin ilk aşamasında öğretmen adayları tarafından doldurulan formlar okunarak anlamlı bölümlere ayrılmış ve kod listesi oluşturulmuştur. Bu listeden yola çıkılarak verileri genel düzeyde açıklayabilen ve kodları belirli kategoriler altında toplayabilen temalar belirlenmiştir. Veriler ortaya çıkan kodlara ve temalara göre sistematik olarak betimlenmiş, tablolaştırılmış ve yorumlanmıştır. Verilerin yorumlanmasında öğretmen adaylarının uygulama öncesi ve sonrasında verdikleri cevaplar ayrı ayrı değerlendirilerek gelişimlerinin ortaya çıkması sağlanmıştır. Çalışmanın sonucunda; etkili öğrenme-öğretme sürecinde yer alan kavramlar, etkili öğrenme-öğretme sürecinin özellikleri**,** etkili öğrenme-öğretme sürecinde kullanılan yöntem-teknik-yaklaşımlar**,** etkili öğrenme-öğretme süreçleri dersinde yer verilen konulara ilişkin kavramlar olmak üzere 4 farklı tema elde edilmiştir. Elde edilen temalara ilişkin kavramlar değerlendirildiğinde, öğretmen adaylarının aldıkları ders sonrasında öğrenme-öğretme süreçlerine ilişkin kavramsal olarak gelişim gösterdikleri belirtilmiştir.

Anahtar sözcükler: öğretmen adayları, öğrenme-öğretme süreci, kavramsal gelişim.

GİRİŞ

Öğrenme öğretme süreci; öğrenenin neyi, ne kadar ve nasıl öğreneceğinin belirlendiği çok boyutlu etkileşim gerektiren bir süreçtir. Öğret-öğren-hatırla şeklinde sıralanan standart öğretim paradigması günümüzde öğrenme öğretme sürecini açıklamakta yetersiz kalmaktadır. Bu paradigmada öğretmen öğretir, öğrenci öğrenir ve yeri geldiği zaman hatırlar şeklinde sürece ilişkin roller belirlenmiştir. Ancak öğrenme öğretme süreci tek yönlü basit iletişim örüntüsü ile tanımlamaz.



Şekil 1. Öğrenme Öğretme Süreci (Saban, 2013)

Öğrenme öğretme sürecinin anlaşılması için önce öğrenme, öğretme ve öğretim gibi temel kavramlarının tanımlanması daha anlamlı olacaktır. Bireyin çevresi ile belli bir düzeydeki etkileşimleri sonucunda meydana gelen nispeten kalıcı izli davranış değişmesi olarak tanımlanan öğrenme (Senemoğlu, 2007), bireyin çevreye uyumunda bir araç olarak anılmaktadır (Fer, 2011). Öğretme genel olarak, davranış değişikliğinin okulda planlı ve programlı bir şekilde yapılması sürecini ifade etmektedir (Demirel, 2003). Ertürk, öğretmeyi daha yalın bir anlatımla, herhangi bir öğrenmeyi sağlama ve kılavuzlama faaliyeti olarak sunmaktadır (Ertürk, 1979).Öğretim ise, eğitimin okul ya da sınıf ortamında planlı ve programlı bir biçimde yürütülen kısmı olarak tanımlanmıştır (Varış, 1978). Açıkgöz, öğretimin başlıca özelliklerini ele alarak daha kapsamlı şekilde, öğretimi; öğrenci gelişimini amaçlayan ve öğrenmenin başlatılması, sürdürülmesi ve gerçekleştirilmesi için düzenlenen planlı etkinliklerden oluşan bir süreç olarak tanımlamaktadır (Açıkgöz, 2009). Öğrenme-öğretme ve öğretim kavramları çoğu zaman birlikte anılmakta ancak hatalı olarak birbirlerinin yerine de kullanılmaktadır. Günümüz eğitim sistemleri içerisinde öğrenme ve öğretme ihtiyaç ve rolleri de değişmektedir. Temel kavramların anlamlandırılmasında, eğitim sistemimizin dayandığı temel felsefe ve prensipler etkili olmaktadır. Öğrenme öğretme sürecinde öğretmen ve öğrencinin rolleri değişmiş, öğretmen salt bilgi sunan olmaktan ziyade öğrenmeleri kolaylaştıran, kılavuzluk eden kişi konumuna geçmiştir. Öğrenci ise, bilgiyi hazır alan değil, araştıran, sorgulayan, kendi öğrenmelerinin sorumluluğunu taşıyan, öğrenme ihtiyaçlarını belirleyebilen birey konumundadır. Öğretmen ve öğrencinin süreçteki rollerinin değişmesi, beraberinde kullanılan yöntem ve tekniklerde de değişikliği gerekli kılmıştır. Buradan hareketle öğrenme öğretme süreçlerinde yeni yönelimlere gerek duyulmuştur.

Öğrenme öğretme süreci üç temel boyuttan oluşmaktadır (Saban, 2013). Birincisi; program veya içerik, ikincisi; süreç veya yöntem, üçüncü ise değerlendirme olarak sıralanmaktadır. Program öğrencinin neyi öğreneceğini bize söylemektedir. Eğitim programını Demirel, öğrenene okulda ve okul dışında planlanmış etkinlikler yoluyla sağlanan öğrenme yaşantıları düzeneği olarak tanımlamaktadır. Öğretim programını ise okulda ya da okul dışında bireye kazandırılması planlanan bir dersin öğretimiyle ilgili tüm etkinlikleri kapsayan yaşantılar düzeneği şeklinde tanımlayarak özelleştirmiştir (Demirel, 2005). Programda yer alan konuların yani içeriğin öğrencilere nasıl sunulacağı, hangi etkinliklerin yapılacağı, bu etkinlikler sırasında hangi yöntem-tekniklerden yararlanılacağı, etkinliklerin ne kadar sürede tamamlanacağı süreç veya yöntem boyutunda ele alınmalıdır. Özdüzenleme becerisine sahip bireyler yetiştirmek eğitim sistemimizin temelinde yer almaktadır. Aynı noktadan hareketle öğrenme, büyük ölçüde öğrenen sorumluluğunda gerçekleşir. Öğrenci hangi konuyu nasıl öğreneceğini, hangi tür etkinlikleri yapmaktan keyif alacağını, öğrenmelerinin hangi stratejiler kullanıldığında kalıcı olacağını en iyi kendisi bilmektedir. Etkili öğrenme öğretme sürecinin son boyutu değerlendirmedir. Daha önceleri sonuç odaklı değerlendirmeler yapılmakta iken sistem sürecin değerlendirilmesinin gerekliliğinin altını çizmektedir. Sadece sürecin sonundaki ürüne bakmak, öğrenenin süreci nasıl geçirdiği hakkında bize bilgi vermede yetersiz kalmaktadır. Bu sebeple alternatif ölçme değerlendirme teknikleri hem öğretmenlerin öğrencilerini değerlendirmelerinde hem de öğrencilerin kendilerini ve arkadaşlarını değerlendirmelerinde işe koşulmaktadır.

Eğitim fakültelerinde "Etkili Öğrenme Öğretme Süreçleri", "Aktif Öğrenme Stratejileri", "Öğrenme Öğretme Kuram ve Yaklaşımları" gibi dersler Meslek Bilgisi kodlu zorunlu dersler arasında yer almamaktadır. Ancak öğretmen adaylarının eğitim sisteminin temellerini içselleştirmeleri için seçmeli ders olarak sunulabilmektedir. Şuan uygulamada olan öğretim programlarının temelinde Yapısalcı Kuram yer almaktadır. Yapısalcı kuram, Piaget'in bilişsel gelişim kuramını temele almıştır ve bilginin aktarımının öğrenmeyi sağlamaya yetmeyeceğini savunmaktadır. Kurama göre öğrenme, bireyin deneyim temelinde geliştirdiği aktif bir süreçtir (Aslim, 2011). Yapısalcı kuramda vurgulanan kavram öğretim değil, öğrenmedir. Öğrenme öğretme süreçlerinin ve öğretmen davranışlarının bu kuramdan etkilendiği ileri sürülmektedir (Yaşar, 1998). Yapısalcı kuram, öğrencilere bir takım temel bilgi ve becerilerin kazandırılması gerektiği görüşünü inkar etmez, fakat eğitimde bireylerin daha çok düşünmeyi, anlamayı, kendi öğrenmelerinden sorumlu olmayı ve kendi davranışlarını kontrol etmeyi öğrenmeleri gerektiğini vurgular (Saban, 2013). Öğrenenin özdüzenleme becerisine sahip oluşu süreci kendisinin yönlendirebileceği anlamına gelmektedir. Bu bakımdan öğrencilerin kendi öğrenme stillerini bilmeleri onların öğrenmelerine, öğrenme öğretme sürecini etkili biçimde tamamlamalarına destek olacaktır. Öğretmenler öğrencilerini iyi tanımalı ve onların kendi bilişsel öğrenme stillerini keşfetmelerine ortam hazırlamalıdır. Öğrencilerin ilgi, ihtiyaç ve yetenekleri birbirinden farklıdır. Öğrenme öğretme sürecinde öğretmenler farklı türden öğrenen öğrencilerine fırsat sunmak durumundadır. Gardner tarafından ortaya atılan çoklu zeka kuramı, öğrenenlerin bireysel farklılıklarına *çoklu zeka teorisi* diyerek dikkat çekmiştir. Garder zekayı; bir veya birden fazla kültürde değer bulan bir ürün ortaya koyabilme kapasitesi, gerçek hayatta karşılaştığı problemlere etkili ve verimli çözümler üretebilme becerisi ve çözüme kavuşturulması gereken yeni veya karmaşık yapılı problemleri keşfetme yeteneği olarak tanımlamaktadır (Saban, 2013). Çoklu zeka kuramına dayalı etkinlikler, ancak öğrencinin aktif olduğu öğrenme ortamlarında uygulanabilir. Aktif öğrenme teknikleri öğrencilere öncelikle, çoklu zekanın gerektirdiği çeşitliliği ve seçme hakkını sunmaktadır (Açıkgöz, 2014). Geleneksel anlayışı temele alan sınıflarda, her öğrenci için farklı etkinlik sunulmaz. Farklı zeka türüne ve farklı öğrenme stiline sahip öğrenciler için çağdaş öğrenme ortamları oluşturulur. Geleneksel sınıf ortamlarında öğrenme öğretme sürecinin sorumluluğu öğretmene aittir ve süreçte öğretmen aktiftir. Ancak çağdaş yaklaşımların benimsenmesi ile birlikte sürecin temelinde öğrenci yer almaktadır ve öğrencinin aktif olduğu yöntem ve teknikler kullanılmaktadır.

Öğrenme öğretme sürecinde aktif öğrenme stratejilerin kullanılması ancak demokratik sınıf ortamlarının oluşturulması ile mümkün kılınacaktır. Araştıran, sorgulayan, bilgiye kendi çabası ile ulaşan öğrenciler yetiştirmeyi amaçladığımız eğitim sistemimiz içerisinde onlara mutlaka düşünmeyi öğretmenliyiz. Eleştirel düşünen, yaratıcı fikrileri olan, empati kurabilen öğrenciler problem durumlarıyla daha rahat başa çıkabilmektedir. Problem çözme, belli amaca ya da amaçlara ulaşmak için bilgileri organize etmeyi, esnek olmayı ve bilişsel kaynakları etkili biçimde kullanmayı gerektirir (Erdem, 2005). Öğrenme öğretme sürecinde öğrenciler farklı problem durumlarıyla karşılaştırılır ve uygun çözüm yollarını kimi zaman kendi başlarına kimi zaman da arkadaşları ile birlikte çalışarak bulmaları istenir. İş birliğine dayalı öğrenme, takım çalışması gibi etkinlikleri kullanmaları öğrenenlerin kendi aralarındaki iletişimi güçlendirir, birbirlerinin öğrenmelerinden de faydalanmalarını sağlar. Öğretmenler süreçte öğrencilerine farklı fırsatlar sunmaya gayret göstermelidir.

Geleneksel sınıf ortamlarına kıyasla aktif öğrenme ortamlarında öğretmen ve öğrencilerin rollerinde değişmeler meydana gelmiştir. Bilim ve teknolojideki ilerleme tüm sistemleri olduğu gibi eğitim sistemini de etkilemektedir. Öğretmenlerin görevi, bu ilerlemeye paralel olarak sisteme yansıyan yeni yönelimleri takip etmek ve sınıflarında uygulamaktır. Öğretmenler öğrenme öğretme sürecine ilişkin kuramsal bilgilerin temelini lisans eğitimleri sırasında almaktadırlar. Buradan hareketle öğretmen adaylarının öğrenme öğretme sürecine ilişkin görüşleri araştırmaya konu olmuştur. Öğretmen adaylarının öğrenme öğretme süreçlerine ilişkin görüşleri ve kavramsal gelişimlerinin değerlendirilmesinin amaçlandığı çalışmada şu sorulara yanıt aranmıştır:

1. Fen bilgisi ve sınıf öğretmeni adaylarının etkili öğrenme-öğretme sürecine ilişkin görüşleri nelerdir?
2. Fen bilgisi ve sınıf öğretmeni adaylarının öğrenme öğretme süreçlerine ilişkin kavramsal gelişimleri nasıldır?

YÖNTEM

Araştırmada, öğretmen adaylarının öğrenme öğretme süreçlerine ilişkin görüşlerini belirlemek ve kavramsal gelişimlerini değerlendirmek amacıyla nitel araştırma yöntemi kullanılmıştır. Bu yöntemle, öğretmen adaylarının "Etkili Öğrenme ve Öğretme Süreçleri" dersine katılmaları sonucunda meydana gelen değişimlerini ortaya koyan verilerin elde edilmesi amaçlanmıştır.

Çalışma Grubu

Araştırmanın çalışma grubu fen bilgisi öğretmenliği ve sınıf öğretmenliği bölümlerinde birinci sınıfta okuyan 21 öğretmen adayı oluşturmaktadır. Çalışma grubunun belirlenmesinde öğretmen adaylarının "Etkili Öğrenme Öğretme Süreçleri" dersine katılarak dersin içeriği hakkında bilgi sahibi olmaları önemsenmiştir. Katılımcıların 8'i erkek 13'ü kız öğretmen adayından oluşmaktadır.

Verilerin Toplanması ve Analizi

Araştırmanın uygulama sürecinde Öğretmen adaylarına "Etkili Öğrenme Öğretme Süreçleri" dersi kapsamında bilişsel öğrenme stilleri, çoklu zekâ kuramı, sınıf ortamı ve yönetimi, yaratıcılık ve yaratıcılığı geliştirmek, düşünme süreci, yapısalcı kuram ve öğrenme-öğretme süreci, işbirliğine dayalı öğrenme, problem çözmeye dayalı öğrenme, aktif öğrenme konularında temel kavramların kazandırılması hedeflenmiştir.

Araştırmada veri toplama aracı olarak öğretmen adaylarının öğrenme öğretme süreçlerine ilişkin görüşlerini belirleyebilmek ve kavramsal gelişimlerini değerlendirmek amacıyla araştırmacılar tarafından geliştirilen dört sorudan oluşan yapılandırılmış görüşme formu kullanılmıştır. Öğretmen adaylarından görüşme formunu yazılı olarak doldurmaları istenmiştir. Formda yer alan soruların hazırlanmasında araştırmacıların deneyimlerinden yararlanılarak, dersin içeriğinde yer alan kavramlar dikkate alınıp süreç içerisinde öğretmen adaylarının kavramsal gelişimlerinin ortaya çıkarılmasını amaçlayan sorulara yer verilmiştir. Belirlenen sorular fen eğitimi ve sınıf öğretmenliği alanında uzman iki kişinin görüşleri doğrultusunda yeniden düzenlenmiştir. Öğretmen adaylarından yapılan uygulama öncesinde ve sonrasında görüşme formunu doldurmaları istenmiştir.

Verilerin analizinde uygulama öncesinde ve sonrasında katılımcıların görüşlerine ilişkin yazılı olarak elde edilen veriler nitel araştırma tekniklerinden içerik analizi (Yıldırım ve Şimşek, 2008) kullanılarak çözümlenmiştir. Yazılı metinler birkaç kere okunarak katılımcıların cevaplarındaki kodlar belirlenmiş ve bu sayede veriler belirli temalar altında toplanmıştır. Veriler ortaya çıkan kodlara ve temalara göre sistematik olarak betimlenmiş, tablolaştırılmış ve yorumlanmıştır. Güvenirlik ve iç geçerliğin sağlanması için görüşmelerden elde edilen cevaplar iki farklı araştırmacı tarafından bağımsız olarak kodlanmıştır. Creswell (2007) nitel araştırmalarda tema ve kodların farklı araştırmacılar tarafından desteklenmesinin yapılan araştırmanın güçlenmesinin sağlanmasında önemli olduğunu vurgulamıştır.

BULGULAR

Görüşme formlarının analizi sonucunda öğretmen adaylarının etkili öğrenme-öğretme sürecine ilişkin görüşleri ve kavramsal gelişimleri 4 farklı tema doğrultusunda değerlendirilmiştir. Bu temalar şu şekildedir:

- etkili öğrenme-öğretme sürecinde yer alan kavramlar
- etkili öğrenme-öğretme sürecinin özellikleri
- etkili öğrenme-öğretme sürecinde kullanılan yöntem-teknik-yaklaşımlar
- etkili öğrenme-öğretme dersinde yer verilen konulara ilişkin kavramlar

"Etkili öğrenme-öğretme sürecinde yer alan kavramlar" temasına ilişkin uygulama öncesi ve sonrasında belirlenen kod listesi tabloda sunulmuştur.

Tablo 1. "Etkili Öğrenme-Öğretme Sürecinde Yer Alan Kavramlar" Temasına İlişkin Kod Listesi

KODLAR	
UYGULAMA ÖNCESİ	**UYGULAMA SONRASI**
Öğretmen	Öğretmen
Öğrenci	Öğrenci
Okul	Okul
Sınıf	Sınıf

Eğitim	Eğitim
Öğretim	Öğretim
İletişim	İletişim
Ders	Ders
Yaratıcılık	Yaratıcılık
Sınıf ortamı	Sınıf ortamı
Etkinlik	Bilişsel öğrenme
	Plan yapma
	Zaman yönetimi
	Zeka alanları
	Aktif öğrenme
	Verimli öğrenme
	Günlük yaşam
	Bireysel özellikler
	Sınıf yönetimi
	Düşünme becerileri
	Öğretim teknikleri

Tablo 1 incelendiğinde uygulama öncesinde yer alan etkinlik kavramının uygulama sonrasında yer almadığı görülmektedir. Öğretmen, öğrenci, okul, sınıf, eğitim, iletişim, ders, yaratıcılık, sınıf ortamı kodları uygulama öncesi ve sonrası için ortak kavramlar olarak belirlenmiştir. Öğretmen adayları uygulama sonrasında ise bilişsel öğrenme, plan yapma, zaman yönetimi, zeka alanları, aktif öğrenme, verimli öğreme, günlük yaşam, bireysel özellikler, sınıf yönetimi, düşünme becerileri ve öğretim teknikleri kavramlarını eklemişlerdir. "Etkili öğrenme-öğretme sürecinin özellikleri" temasına ilişkin uygulama öncesi ve sonrasında belirlenen kod listesi tabloda sunulmuştur.

Tablo 2. "Etkili Öğrenme-Öğretme Sürecinin Özellikleri" Temasına İlişkin Kod Listesi

KODLAR	
UYGULAMA ÖNCESİ	**UYGULAMA SONRASI**
Öğrencide merak uyandırır	Öğrencilerin gelişimi dikkate alınır
Öğrenci seviyesi dikkate alınır	Öğrencilerin aktif katılımı sağlanır
Öğrenci merkezlidir	Öğrencilerin yetenekleri dikkate alınır
Eğlenerek öğrenmeyi sağlar	Öğrencilerin bireysel farklılıkları dikkate alınır
	Öğrencilerin öğrendiklerini sorgulaması sağlanır
	Öğrencilerin yaratıcılığını geliştirir
	Öğrencilerin düşüncelerini rahat ifade edebilmesi sağlanır
	Öğretmen davranışları belirlenir
	Öğretmen-öğrenci iletişimini sağlar
	Etkili ve verimli sınıf ortamı yaratılır
	Görsel ve işitsel materyaller kullanılır
	Bilgilerin kalıcılığı artar
	Öğrenmeyi etkileyen faktörler belirlenir
	Konuların anlaşılırlığını arttırır
	Konuların günlük yaşamla ilişkilendirilmesi sağlanır

Tablo 2 incelendiğinde etkili öğrenme öğretme sürecinin özelliklerine ilişkin uygulama öncesinde ve sonrasında ortak ifadelerin yer almadığı görülmektedir. Öğretmen adayları uygulama öncesinde etkili öğrenme-öğretme sürecinin öğrencide merak uyandırma, öğrenci seviyesini dikkate alma, öğrenci merkezli olma ve eğlenerek öğrenmeyi sağlama gibi özelliklerini belirtmişlerdir. Uygulama sonrasında ise öğretmen adaylarının öğrenme-öğretme sürecinin özelliklerini öğrenciler, öğretmen, içerik ve süreç kavramları açısından değerlendirerek çok sayıda özelliğe yer verdikleri söylenebilir. Buna göre etkili öğrenme-öğretme sürecinde öğrencilerin gelişimlerinin, yeteneklerinin, bireysel farklılıklarının dikkate alındığı, derse aktif katılımlarının sağlandığı, öğrendiklerini sorgulama ve düşüncelerini rahat ifade edebildikleri ortamların sağlandığı ve yaratıcılıklarının geliştirildiği ifade edilmiştir. Etkili öğrenme-öğretme sürecinde öğretmenlerin davranışlarının belirlendiği ve öğrencilerle iletişimlerinin arttığı belirtilmiştir. İçerik ve süreç açısından ise etkili öğrenme-öğretme sürecinde etkili ve verimli sınıf ortamı yaratıldığı, görsel ve işitsel materyallerin kullanıldığı, bilgilerin kalıcılığının arttığı, öğrenmeyi etileyen faktörlerin belirlendiği, konuların anlaşılırlığının arttığı ve günlük yaşamla ilişkilendirilmesinin sağlandığı ifade edilmiştir. "Etkili öğrenme-öğretme sürecinde kullanılan yöntem-teknik-yaklaşımlar" temasına ilişkin uygulama öncesi ve sonrasında belirlenen kod listesi tabloda sunulmuştur.

Tablo 3. "Etkili Öğrenme-Öğretme Sürecinde Kullanılan Yöntem-Teknikler-Yaklaşımlar" Temasına İlişkin Kod Listesi

KODLAR	
UYGULAMA ÖNCESİ	**UYGULAMA SONRASI**
Sunuş yoluyla öğretim Soru-cevap Beyin fırtınası	Sunuş yoluyla öğretim Soru-cevap Beyin fırtınası Çoklu zeka kuramı Tartışma Yapılandırmacı yaklaşım İşbirliğine dayalı öğrenme

Tablo 3 incelendiğinde öğretmen adaylarının, sunuş yoluyla öğretim, soru-cevap ve beyin fırtınası tekniklerini hem uygulama öncesinde hem de uygulama sonrasında belirtirken uygulama sonrasında çoklu zeka kuramı, tartışma, yapılandırmacı yaklaşım ve iş birliğine dayalı öğrenme yöntem-teknik-yaklaşımlarını ekledikleri görülmektedir."Etkili öğrenme-öğretme dersinde yer verilen konulara ilişkin kavramlar" temasına ilişkin uygulama öncesi ve sonrasında belirlenen kod listesi tabloda sunulmuştur.

Tablo 4. "Etkili Öğrenme-Öğretme Dersinde Yer Verilen Konulara İlişkin Kavramlar" Temasına İlişkin Kod Listesi

KODLAR		
Kavramlar	**UYGULAMA ÖNCESİ**	**UYGULAMA SONRASI**
Bilişsel öğrenme stilleri	Dışa dönük İçe dönük Duygusal Algısal Yargısal	Dışa dönük İçe dönük Duyusal Duygusal Algısal Yargısal Sezgisel Düşünen
Çoklu zeka kuramı	Doğa zekası Matematiksel-Mantıksal zeka Sosyal zeka	Matematiksel-mantıksal zeka Bedensel zeka Doğa zekası Dilsel zeka Müziksel zeka Uzamsal zeka İçsel zeka Görsel zeka Sosyal zeka Sözel zeka Ritmik zeka
Sınıf ortamı ve yönetimi	Oturma planı Sınıf mevcudu Sınıf düzeni Öğretmenin rolü Öğrencinin rolü	Fiziksel düzen Öğretmen-öğrenci iletişimi Zamanı etkili kullanma Öğretmenin rolü Öğrencinin rolü Ödül ve ceza Davranış yönetimi Disiplin sağlama
Yaratıcılık ve yaratıcılığı	Deney ve gözlemler yapma	Kendine güveni arttırma

geliştirmek	Yeni fikirler ortaya atma Bireysel farklılıkları dikkate alma Çok yönlü düşünme	Özgün olma Öğrenciyi cesaretlendirme Öğrencilerin kendilerini ifade etmelerine fırsat verme Motivasyonu arttırma Proje ödevleri verme Örnek bir olaya çözüm üretme Yeni fikirlere açık olma
Düşünme süreci	Araştırmaya dayalı ortam sağlama Merak uyandırma Mantıksal bağlantılar kurma Sorularla düşünmeye yönlendirme Düşünme zamanı sağlama	Anlamlı öğrenmeyi sağlama Sınıflandırma becerisi kazandırma Tahmin becerisi kazandırma Öğrenme sürecini sorgulama Düşünme zamanı sağlama Problem çözme becerisi kazandırma Düşünceleri analiz etme Bir konuyu veya sorunu araştırma
Yapısalcı kuram	Öğrenci seviyesini dikkate alma	Öğrencilerin bilgilerini yorumlaması Öğrencilerin öğrenme sürecini sorgulaması Öğrencilerin kendi bilgilerini anlamlandırması Öğrencileri bilgiye ulaşmaları için araştırmaya teşvik etme Öğrencilerin sürece aktif katılımı Öğrencilerin kendi öğrenmelerinden sorumlu olması
İş birliğine dayalı öğrenme	Öğretmen-öğrenci iletişimini sağlama Grup çalışması Öğrenci-öğrenci iletişimini sağlama Yardımlaşma ortamı oluşturma Birden fazla düşünceyi tartışma Her öğrencinin görüş belirtmesi	Küçük grup çalışmaları yapma Öğretmen-öğrenci iletişimini sağlama Öğrencilerin sürece aktif katılımı Öğrencilerin hem kendilerinin hem de diğer arkadaşlarının öğrenmelerinden sorumlu olması Probleme çözüm üretme Fikir alış verişinde bulunma
Probleme dayalı öğrenme	Bir problemi çözme Kalıcı öğrenmeyi sağlama Sorunlara çözüm üretme Öğrenilenleri sorgulama Düşünme ve fikir üretme	Gerçek hayat problemleri Sorumluluk sahibi olma Problemi tanımlama Problemi anlama Problemi analiz-sentez etme Araştırmayı planlama Veri toplama Verileri değerlendirme Sunum yapma
Aktif öğrenme	Laboratuvar uygulamaları yapma Derslerde görsellere yer verme Öğrencilerin derse aktif katılımı Etkili öğrenmeyi sağlama Kalıcı öğrenmeyi sağlama Verimli öğrenme ortamı	Öğrencilerin derse aktif katılımı Dersi planlama Öğrencinin ilgisini çekme Sınıf ortamının düzenleme Öğrenci merkezli öğretim Öğretmenin süreçte rehber olması Grup çalışmaları planlama Öğrenci-öğrenci iletişimini sağlama

Verimli öğrenme ortamı oluşturma

Tablo 4 incelendiğinde öğretmen adaylarının etkili öğrenme-öğretme süreçleri dersinde yer verilen bilişsel öğrenme stilleri, çoklu zekâ kuramı, sınıf ortamı ve yönetimi, yaratıcılık ve yaratıcılığı geliştirmek, düşünme süreci, yapısalcı kuram, işbirliğine dayalı öğrenme, problem çözmeye dayalı öğrenme ve aktif öğrenme konulara ilişkin uygulama öncesinde ve sonrasında belirttikleri ortak kavramların yer aldığı görülmektedir. Öğretmen adayları uygulama sonrasında bilişsel öğrenme stillerini ve çoklu zeka kuramında yer alan zeka türlerinin tamamını belirtmişlerdir. Öğretmen adayları sınıf ortamı ve yönetimi konusu ile ilgili olarak uygulama öncesinde oturma planı, sınıf mevcudu, sınıf düzeni, öğretmenin ve öğrencinin rolü gibi genel kavramlara yer verirken uygulama sonrasında sınıf yönetiminin boyutlarına ilişkin kavramlara yer vermişlerdir. Öğretmen adayları yaratıcılık ve yaratıcılığın geliştirilmesi ve düşünme sürecini öğrenme-öğretme sürecinde yaratıcılık ve düşünme becerilerinin geliştirilmesi için yapılması gerekenler ve öğrencilere sağladığı fırsatlar açısından değerlendirirken, işbirliğine dayalı öğrenme, problem çözmeye dayalı öğrenme ve aktif öğrenme yaklaşımlarını ise temel özellikleri, süreçteki uygulamaları ve sağladığı fırsatlar açısından değerlendirmişlerdir.

SONUÇ VE ÖNERİLER

Çalışmanın sonucunda; etkili öğrenme-öğretme sürecinde yer alan kavramlar, etkili öğrenme-öğretme sürecinin özellikleri**,** etkili öğrenme-öğretme sürecinde kullanılan yöntem ve teknikler**,** etkili öğrenme-öğretme dersinde yer verilen konulara ilişkin kavramlar olmak üzere 4 farklı tema elde edilmiş olup yapılan uygulama öncesi ve sonrasında ortak kodlara rastlanmaktadır. Çalışmada öğrenme-öğretme süreçleri dersi öncesinde ve sonrasında belirlenen kodlar incelendiğinde uygulama sonrasında öğretmen adaylarının daha ayrıntılı açıklamalar yaptıkları görülmektedir. Ayrıca uygulama öncesinde bazı öğretmen adaylarının "konuyla ilgili fikrim yok" şeklinde görüş bildirmelerine rağmen uygulama sonrasında her soruya görüş bildirdikleri görülmektedir.

Sonuç olarak, araştırmadan elde edilen bulgular, öğretmen adaylarının aldıkları ders sonrasında etkili öğrenme-öğretme sürecinde yer alan kavramlar, etkili öğrenme-öğretme sürecinin özellikleri**,** etkili öğrenme-öğretme sürecinde kullanılan yöntem ve teknikler**,** etkili öğrenme-öğretme dersinde yer verilen konulara ilişkin kavramlar temalarına ilişkin olarak yeterli görüşler bildirdiklerini ortaya koymaktadır. Araştırmadan elde edilen sonuçlara dayalı olarak öğretmen adaylarının öğrenimleri süresince öğrenme-öğretme süreçlerine ilişkin kazanımlarının kendi sınıflarında oluşturacakları öğrenme ortamlarına yansıyacağı dikkate alındığında, bu konuda yapılacak çalışmaların gözlemlerle desteklenmesinin önemli olduğu düşünülmektedir. Ayrıca öğretmenlerin öğrenme-öğretme sürecindeki etkililiğine ilişkin öğrenci görüşlerinin değerlendirildiği araştırmalarda yapılabilir.

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GRADE 5 STUDENTS' MENTAL MODELS ON ELECTRICAL CIRCUITS

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ABSTRACT: The topic of electricity is included in curriculum at all educational levels because of its importance and use in daily life. Various studies showed that there are different learning difficulties and misconceptions held by students. This study aimed to determine fifth grade students' mental models and misconceptions on the light given by bulb in a simple electric circuit. For this purpose, 98 fifth grade students have been asked to draw simple electrical circuit using a battery, a bulb, a switch and cable. The descriptive research method was used in this study and drawings were analyzed according to misconceptions and models in the literature. The results of this study showed that many students have drawn the short circuit model and the others drawn the unipolar model and these students believe that only one cable is enough to complete circuit. Connection made by the some students didn't complete, they drew switch on, switches and battery independently from circuit. Therefore, some students didn't draw battery and switch. Some students have used unnecessary connecting cables between the circuit elements. In this research some implications and conclusions have been discussed.

Key words: electric circuit, drawing, mental models, misconceptions

5. SINIF ÖĞRENCİLERİNİN ELEKTRİK DEVRELERİ İLE İLGİLİ ZİHİNSEL MODELLERİ[2]

ÖZET: Elektriğin yaşamdaki önemi ve kullanımı nedeniyle elektrikle ilgili konular fen eğitiminin tüm seviyelerinde yer almaktadır. Buna rağmen farklı eğitim kademelerinde öğrencilerde birçok öğrenme güçlüğüne rastlanılmaktadır. Öğrenme güçlüklerinin önlenebilmesinde öncelikli olarak mevcut durumun teşhis edilmesi ve bu teşhise yönelik bir tedavi uygulanmasının gerekli olduğu düşünülmektedir. Öyle ki teşhis etmeden doğrudan öğretime başlamak öğrencinin kendine göre doğru olduğunu düşündüğü bilgiyle bir sonraki eğitim kademesine geçmesine ve mevcut bilgisine yeni öğrenmelerini entegre etmesine engel olacak, zihinsel bir karmaşa yaşamasına yol açacaktır. Bu nedenle çalışmada 5. sınıf "Yaşamımızın Vazgeçilmezi: Elektrik" ünitesinde yer alan elektrik devresindeki lamba parlaklığını etkileyen değişkenlerin öğretiminde ön koşul olan basit elektrik devresinde lambanın ışık verme durumuyla ilgili öğrencilerin zihinsel modellerinin ortaya konulması ve bu modellerden hareketle kavram yanılgılarının saptanması amaçlanmıştır. 98 öğrenciden bir pil, bir lamba, bir anahtar ve bağlantı kablosundan oluşan malzemeleri kullanarak basit elektrik devresini lamba ışık verecek şekilde çizmeleri istenmiştir. Betimsel araştırma yönteminin kullanıldığı çalışmada alan yazında yer alan kavram yanılgıları ve modeller doğrultusunda çizimler analiz edilmiştir. 15 öğrencinin "Elektrik devresinde lambanın yanması için lambayla güç kaynağının kutuplarından biri arasında tek bir bağlantı olması yeterlidir" düşüncesiyle tek kutuplu modeli çizdikleri saptanmıştır. 2 öğrencinin "Elektrik devresine boş bir bağlantı kablosu eklendiğinde boş kablonun devre üzerinde etkisi olmaz" düşüncesiyle kısa devre modelini çizdikleri saptanmıştır. Bazı öğrencilerin bağlantılarının tam olmadığı, anahtarı açık çizdikleri, anahtarı ve pili devreden bağımsız olarak çizdikleri, bazılarının pil ve anahtar çizmedikleri saptanmıştır. Öğrencilerin çoğunluğunun pil ve oldukça az bir bölümünün de lamba ve anahtar sayılarını hatalı çizdikleri saptanmıştır. Önemli bir bölümünün pili pozitif ve negatif kutuplarıyla çizmedikleri, birden fazla pil çizen öğrencilerin pillerin kutuplarını zıt olacak şekilde yerleştirmedikleri saptanmıştır. Az da olsa bazı öğrencilerin devre elemanlarına ait resim ya da sembol gösterimine uygun olmayan çizimler yaptıkları, devre elemanları arasında gereksiz bağlantı kabloları kullandıkları saptanmıştır. Öğrencilerin yaklaşık 1/4'inin basit elektrik devresini lamba ışık verecek şekilde çizebildiği görülmüştür.

GİRİŞ

[2] Çalışma ilk yazarın doktora tezinin bir parçası olup Ondokuz Mayıs Üniversitesi Proje Yönetim Ofisi tarafından (PYO.EGF.1904.13.006) desteklenmiştir.

Günlük yaşamdaki önemi ve kullanımı nedeni ile erken yaşlarda okul programlarında yer alan elektrik, fen eğitiminin tüm seviyelerinde öğretilen temel konulardan bir tanesidir. Öğrenciler ilköğretim seviyesinden itibaren basit elektrik devreleri ile ilgili deneyim kazanmaya başlarlar. İlerleyen eğitim kademelerinde de sistematik bir şekilde işlenen elektrik konusu fen bilimleri ve fizik derslerinin önemli konuları arasında yer alır (Duit ve Rhöneck, 1997; Yılmaz ve Huyugüzel-Çavaş, 2006). Bununla birlikte elektrik devreleri öğrencilerin anlamakta oldukça zorlandıkları soyut bir konudur (Carlton, 1999). Elektriğin temel kavramlarının öğretimi, basit elektik devresinin anlaşılması ve algılanması çocuklar tarafından çok kolay olmamaktadır. Bu konuda öğrencilerin sahip olduğu birçok öğrenme güçlüğü (Chambers ve Andre, 1997; Engelhardt ve Beichner, 2004; McDermott ve Shaffer, 1992; Shipstone, vd., 1988) ve kavram yanılgıları (Cohen, vd., 1983; Dupin ve Johsua, 1987; Heller ve Finley, 1992; Lee ve Law, 2001; Millar ve King, 1993; Osborne, 1981, 1983; Psillos ve Koumaras, 1988) çeşitli çalışmalarla ortaya koyulmuştur. Bu kavram yanılgıları ile ilgili olarak öğrencilerin çoğunlukla tek kutuplu modeli savunarak (Çepni ve Keleş, 2006; Demirezen ve Yağbasan, 2013; Sencar, vd., 2011; Taşlıdere ve Eryılmaz, 2009) bir elektrik devresinde lambanın yanması için pilin pozitif (+) kutbu veya pilin negatif (-) kutbu arasında yapılacak tek bir bağlantının (Aykutlu ve Şen, 2011; Aykutlu ve Şen, 2012; Bakırcı, vd., 2010; Chambers ve Andre, 1997; Dupin ve Johsua, 1987; Fleer, 1994; İpek ve Çalık, 2008; Keser ve Başak, 2013; Osborne, 1981; Yıldırım, vd., 2008; Yılmaz ve Huyugüzel Çavaş, 2006; Yürümezoğlu ve Çökelez, 2010), pilin pozitif (+) kutbu veya pilin negatif (-) kutbu ile lamba arasındaki yapılacak iki ayrı bağlantının (Yıldırım, vd., 2008) yeterli olduğunu düşündükleri anlaşılmıştır. İletken telleri ya aynı kutba bağladıkları ya da iki teli de lambanın aynı noktasına temas ettirdikleri (Yeşilyurt, 2006), lambaları pile tek bir kablo ile bağladıkları saptanmıştır (Çepni ve Keleş, 2006). Bu bağlantılarda akımın geriye dönüşü sırasında kaybolduğu, (Chambers ve Andre, 1997; Mcdermott ve Shaffer, 1992), pilden çıkan elektriğin tek kablo ile lambaya gittiği ve pile geri dönmediği (Chambers ve Andre, 1997), bir elektrik devresinin tamamlanarak çalışır hale gelmesi için güç kaynağının iki kutbunun da kullanılmasının gerekli olmadığı (Engelhardt ve Beichner, 2004) düşüncelerinin hâkim olduğu anlaşılmıştır. Bazı öğrencilerin devrede anahtar yokken lambanın yanmayacağını ifade ettikleri (Kaya ve Gödek-Altuk, 2010), bazılarının ise bir elektrik devresinden anahtar açıkken de akımın geçeceğini (Yıldırım, vd., 2008) ve elektriğin iletileceğini belirttikleri (Türkoğuz ve Cin, 2013) saptanmıştır. Ayrıca anahtar kapalı iken lambanın ışık vermeyeceğini ve anahtarı ışığı açmak için kullandıklarını ifade ettikleri saptanmıştır. Alan yazında bulunan bazı araştırmalar (Kaya ve Gödek-Altuk, 2010; Küçüközer ve Kocakülah, 2007) bu yanılgının sebebinin günlük yaşamda kullanılan dil olabileceğini belirtmiştir. Öğrenciler tarafından çizilen basit elektrik devrelerinin bazılarında lamba ve pil olmadığı, bazılarında lamba ve pil sayılarının hatalı olduğu, istenmediği halde 2 lambanın paralel bağlandığı ve anahtar çizildiği saptanmıştır. Doğru çizimlerin yanında öğrencilerin kendi bilgi, deneyim ve zihinsel tasarımlarını yansıttıkları hatalı çizimlerin olduğu da görülmüştür (Yürümezoğlu ve Çökelez, 2010).

Lisans düzeyinde öğrenim gören öğrenciler bile elektrik konularının soyut ve karmaşık olması nedeni ile elektik deneylerini yapmada sıkıntı yaşadıklarını ifade etmişlerdir (Çelik, vd., 2012; Ulukök, vd., 2013). Elektrik konusunda yaşanan sıkıntıların ve öğrenme güçlüklerinin önlenebilmesi için öncelikli olarak mevcut durumun teşhis edilmesi ve bu teşhise yönelik bir tedavi uygulanmasının gerekli olduğu düşünülmektedir. Mevcut durumun teşhis edilebilmesi için de konu ile ilgili kavram yanılgıları belirlenmelidir. Öğrencilerin konu ile ilgili sahip oldukları önceki bilgileri ya da kavramları alternatif yapılar (Driver ve Easley, 1978), çocukların bilimi (Gilbert, Watts ve Osborne, 1982; Gilbert, Osborne ve Fensham, 1982), genel duyu kavramları (Halloun ve Hestenes, 1985), yanlış anlama, alternatif çatı, kendiliğinden oluşan bilgiler, saf deneyimsiz teori (Aydoğdu ve Kesercioğlu, 2005), kavram yanılgıları ya da ön kavramlar olarak adlandırılmaktadır (Helm, 1980; Smith, vd., 1993). Kavram yanılgılarının oluşmasında ön bilgiler, öğretim yöntemleri ve ders kitapları gibi farklı kaynaklar etkili olmaktadır (Yağbasan ve Gülçiçek 2003). Öğrenmenin gerçekleşmesini engelleyen kavram yanılgılarının (Çetingül ve Geban, 2005) ortadan kaldırılması ve anlamlı öğrenmenin gerçekleşmesi için mevcut bilgilerin ortaya konulması, öğrenilecek bilgilerle bağlantı kurulması ve yanlış bilgilerin değiştirilmesi gerekir (Smith, vd., 1993). Bu nedenle çeşitli yöntemler kullanılarak öğretmenlerin, öğretmen adaylarının, öğrencilerin vb. öğretim öncesinde kavram yanılgılarına sahip olup olmadıkları belirlenmelidir. Bu yöntemlerden biri de çizim yöntemidir. Açık uçlu bir yöntem olan çizim yöntemi öğrenmelerin ve anlama düzeylerinin kelimelerle sınırlandırılmadan açığa çıkarılması konusunda son derece önemlidir. Tüm yaş gruplarında uygulanabilecek çizim yöntemi öğrencilere kendi öğrenmelerini yansıtma fırsatı verir (Aydoğdu ve Kesercioğlu, 2005). Öğrenmenin gerçekleşebilmesi için öğrencinin kendi şemalarını oluşturması gerekir (Greca ve Moreira, 2000). Bu şemalar olarak zihinsel modeller bireylerin zihnindeki içsel ve bilişsel temsillerdir (Harrison ve Treagust, 1996; Ritchie, vd., 1997). Zihinsel modeller bireye Dünya'yı ve Dünya'daki olayları anlama, sistem hakkında tahmin yapma ve açıklama olanağı sağlarlar (Greca ve Moreira, 2000). Zihinsel modeller İlişkileri anlaşılır hale getirir (Harrison ve Treagust, 1996) ve üreticilik kimlikleri ile yeni bilgiler oluşturmak için kullanılır (Vosniadou ve Brewer, 1992).

Harvard üniversitesinde mezuniyet töreni günü öğrencilerden bir pil, bir iletken tel ve bir de lamba kullanarak basit bir elektrik devresi kurulup kurulamayacağı ve lambanın yanıp yanmayacağını kuramsal olarak ifade etmeleri istenmiştir. Öğrencilerin tamamına yakını bu devre elemanları ile basit elektrik devresinin lamba yanacak şekilde kurulabileceğini söylemiştir. Fakat uygulama aşamasında öğrencilerin önemli bir kısmının devreyi kuramadığı ya da lambayı yakamadığı gözlemlenmiştir. Alan yazında yer alan bu çalışma basit olarak algılanan şeylerin aslında sanıldığı gibi basit olmadığını vurgulaması bakımından son derece önemlidir (Schenps ve Sadler, 2003; Akt: Yürümezoğlu ve Çökelez, 2010). Üniversiteden mezun olan öğrencilerin ortaya koydukları bu sonuçtan hareketle basit elektrik devreleri ile deneyim kazanmaya başlayan ortaokul 5. sınıf öğrencilerinin "Yaşamımızın Vazgeçilmezi: Elektrik" ünitesinde yer alan elektrik devresindeki lamba parlaklığını etkileyen değişkenlerin öğretiminde ön koşul olan basit elektrik devresinde lambanın ışık verme durumuyla ilgili zihinsel modellerinin ortaya konulması ve bu modellerden hareketle kavram yanılgılarının saptanması amaçlanmıştır.

YÖNTEM

Çalışmada betimsel araştırma yöntemi kullanılmıştır. Araştırılan ortamda herhangi bir değişim yapılmaksızın, doğal şartlara müdahale edilmeden mevcut durumu detaylı bir şekilde tanımlamak, açıklamak ve aydınlığa kavuşturmak, değerlendirmeler yapmak, olaylar arasındaki ilişkileri ortaya çıkarmak amaçlanmıştır (Çepni, 2007; Sönmez ve Alacapınar, 2013).

Örneklem

Örneklem bir devlet okulunda ortaokul 5. sınıfta öğrenim görmekte olan 98 öğrenciden oluşmaktadır. Çalışmada evrendeki tüm elemanlar birbirine eşit seçilme şansına sahip olup basit rastgele örneklem seçimi yapılmıştır (Çepni, 2009; Karasar, 2006; Yıldırım ve Şimşek, 2011).

Veri Toplama Aracı

"Size verilecek bir pil, bir lamba, bir anahtar ve bağlantı kablosundan oluşan malzemeleri kullanarak basit bir elektrik devresini lamba yanacak şekilde nasıl kurarsınız? Basit elektrik devresini çiziniz." sorusundan oluşan bir veri toplama aracı uygulanmıştır.

Verilerin Analizi

Çalışmada ortaokul 5. sınıf öğrencilerinin yaptıkları basit elektrik devresine ilişkin çizimlerin analizinde betimsel analiz yöntemi kullanılmıştır. Araştırma sorusunda ve araştırmanın kavramsal çerçevesinde yer alan boyutlar göz önünde bulundurularak veri analizi için uygun bir çerçeve oluşturulmuştur. Bu çerçeveye göre elde edilecek verilerin hangi tema altında yer alacağı belirlenmiştir. Daha önceden belirlenen çerçeveye uygun olarak veriler okunmuş ve düzenlenmiştir. Okunan veriler anlamlı, mantıklı olacak şekilde bir araya getirilmiş ve tanımlanmıştır. Tanımlanan veriler açıklanmış, ilişkilendirilmiş ve anlamlandırılmıştır (Yıldırım ve Şimşek, 2011). Veri analizinde temalara yerleştirilen cevapların frekansları ve yüzdeleri hesaplanmış, frekanslar ve yüzdeler kullanılarak tablolar oluşturulmuş ve hazırlanan tablolar yorumlanmıştır.

BULGULAR

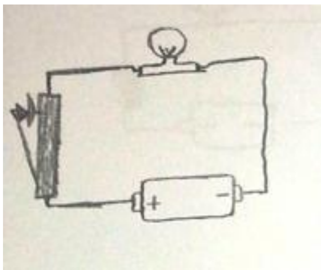
5. sınıf öğrencilerinin basit elektrik devresi ile ilgili çizimleri analiz edilmiş ve Tablo 1'de verilmiştir. Tablo 1 incelendiğinde öğrencilerin basit elektrik devresi ile ilgili çeşitli kavram yanılgılarına sahip oldukları görülmektedir. Öğrencilerin yaptıkları çizimlerde;

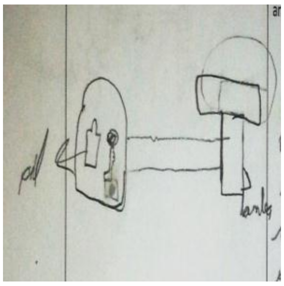
- Lamba (% 4,08), pil (% 54,08) ve anahtar (% 3,06) sayılarının hatalı çizildiği,
- Anahtar (% 3,06) ve pil (% 1,02) için sembol gösterimi kullanıldığı,
- Pil (% 1,02) ve anahtarın (% 5,10) çizilmediği,
- Pilin kutuplarının yanlış yerleştirildiği (% 2,04),
- Anahtarın açık çizildiği (% 5,10),
- Lamba (% 1,02) ve anahtarın (% 2,04) resim ya da sembol gösterimine uygun çizilmediği,
- Tek kutuplu model (% 15,31), devre elemanları arasında eksik bağlantı (% 9,18), pilin devreye hatalı bağlanması (% 2,04), gereksiz bağlantı kablosu kullanılması (% 2,04) ve kısa devre (% 2,04) olmak üzere lambanın yanmayacağı şekilde bağlantılar yapıldığı,
- Anahtar (% 9,18), pil (% 4,08) ve lambanın (% 2,04) devreden bağımsız olarak ayrı çizildiği saptanmıştır.

Tablo 1. Öğrencilerin Basit Elektrik Devresine İlişkin Yaptıkları Çizimler

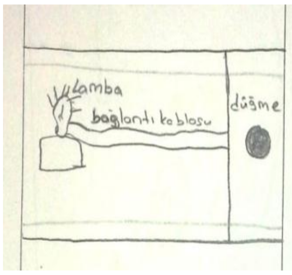
			f	%
Tam doğru çizim		Şekil 1	23	23,47
Lamba	Resim gösterimi	Şekil 1	97	98,98
	Resim ya da sembole uygun değil	Şekil 2	1	1,02
	Sayısı hatalı	Şekil 4	4	4,08
Pil	Resim gösterimi	Şekil 1	96	98
	Sembol gösterimi	Şekil 4	1	1,02
	Çizilmemiş	Şekil 3	1	1,02
	Sayısı hatalı	Şekil 8	53	54,08
	+ ve – kutup çizimi	Şekil 1	23	23,47
	Kutupların yanlış yerleşimi	Şekil 4	2	2,04
Anahtar	Resim gösterimi	Şekil 1	88	89,80
	Sembol gösterimi	Şekil 10	3	3,06
	Resim ya da sembole uygun değil	Şekil 14	2	2,04
	Çizilmemiş	Şekil 5	5	5,10
	Sayısı hatalı	Şekil 6	3	3,06
	Açık	Şekil 7	5	5,10
Bağlantı	Tek kutuplu model	Şekil 8	15	15,31
	Devre elemanları arasındaki bağlantı eksik	Şekil 9	9	9,18
	Pilin devreye bağlanma şekli hatalı	Şekil 10	2	2,04
	Gereksiz bağlantı	Şekil 11	2	2,04
	Kısa devre	Şekil 12	2	2,04
Elemanların devreden bağımsız çizimi	Anahtar	Şekil 13	9	9,18
	Pil	Şekil 13	4	4,08
	Lamba	Şekil 13	2	2,04

Ayrıca 5. sınıfta yer alan öğrencilerin yaptıkları çizimlerden bazı örnekler aşağıda sunulmuştur.


Şekil 1



Şekil 2



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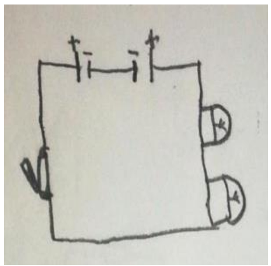
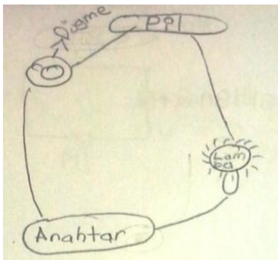

Şekil 4

Şekil 5



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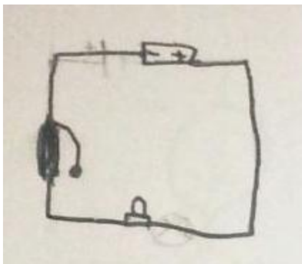
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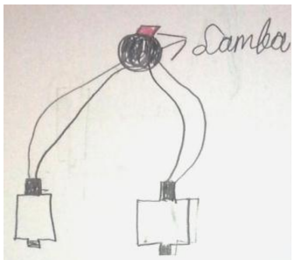

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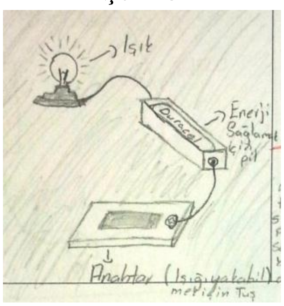
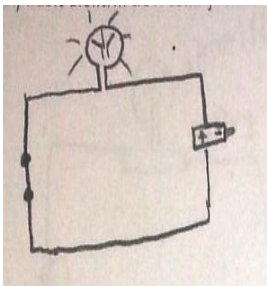
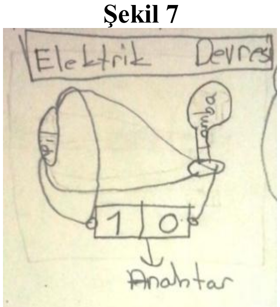
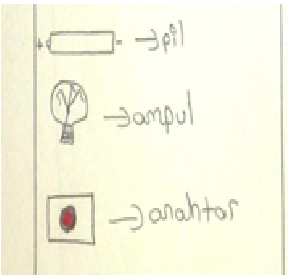


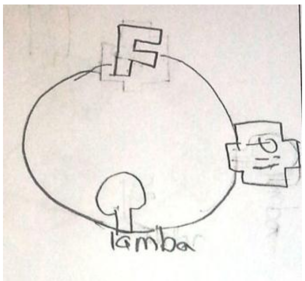




Şekil 9 **Şekil 10** **Şekil 11** **Şekil 12**



Şekil 13



Şekil 14

SONUÇ

Çalışma sonucunda 15 öğrencinin "Elektrik devresinde lambanın yanması için lambayla güç kaynağının kutuplarından biri arasında tek bir bağlantı olması yeterlidir" düşüncesiyle tek kutuplu modeli (şekil 8) çizdikleri saptanmıştır. 9 öğrencinin devre elemanları arasında eksik bağlantılar (şekil 9) yaptıkları görülmüştür. Alan yazında da öğrencilerin çoğunlukla tek kutuplu modeli savunarak (Çepni ve Keleş, 2006; Demirezen ve Yağbasan, 2013; Sencar, vd., 2011; Taşlıdere ve Eryılmaz, 2009) bir elektrik devresinde lambanın yanması için pilin pozitif (+) kutbu veya pilin negatif (-) kutbu arasında yapılacak tek bir bağlantının (Aykutlu ve Şen, 2011; Aykutlu ve Şen, 2012; Bakırcı, vd., 2010; Chambers ve Andre, 1997; Dupin ve Johsua, 1987; Fleer, 1994; İpek ve Çalık, 2008; Keser ve Başak, 2013; Osborne, 1981; Yıldırım, vd., 2008; Yılmaz ve Huyugüzel Çavaş, 2006; Yürümezoğlu ve Çökelez, 2010), pilin pozitif (+) kutbu veya pilin negatif (-) kutbu ile lamba arasındaki yapılacak iki ayrı bağlantının (Yıldırım, vd., 2008) yeterli olduğunu düşündükleri anlaşılmıştır. İletken telleri ya aynı kutba bağladıkları ya da iki teli de lambanın aynı noktasına temas ettirdikleri (Yeşilyurt, 2006), lambaları pile tek bir kablo ile bağladıkları saptanmıştır (Çepni ve Keleş, 2006). 2 öğrencinin "Elektrik devresine boş bir bağlantı kablosu eklendiğinde boş kablonun devre üzerinde etkisi olmaz" düşüncesiyle kısa devre modelini (şekil 12) çizdikleri saptanmıştır. Bazı öğrencilerin anahtarı açık çizdikleri (şekil 7) bazılarının ise anahtar çizmedikleri (şekil 5) görülmüştür. Alan yazında ise öğrencilerin devrede anahtar yokken lambanın yanmayacağını ifade ettikleri (Kaya ve Gödek-Altuk, 2010), bazılarının ise bir elektrik devresinden anahtar açıkken de akımın geçeceğini (Yıldırım, vd., 2008) ve elektriğin iletileceğini belirttikleri saptanmıştır (Türkoğuz ve Cin, 2013). Ayrıca anahtar kapalı iken lambanın ışık vermeyeceğini ve anahtarı ışığı açmak için kullandıklarını ifade ettikleri tespit edilmiştir. Günlük yaşamda kullanılan dilin böyle bir yanılgıya sebep olabileceği ifade edilmiştir (Kaya ve Gödek-Altuk, 2010; Küçüközer ve Kocakülah, 2007). Öğrencilerin bir kısmının lambayı, anahtarı ve pili devreden bağımsız olarak çizdikleri (şekil 13), bazılarının pil çizmedikleri (şekil 3), çoğunluğunun pil (şekil 8) ve oldukça az bir bölümünün de lamba (şekil 4) ve anahtar sayılarını (şekil 6) hatalı çizdikleri saptanmıştır. Benzer şekilde alan yazında da öğrenciler tarafından çizilen basit elektrik devrelerinin bazılarında lamba ve pil olmadığı, bazılarında lamba ve pil sayılarının hatalı olduğu ortaya konulmuştur (Yürümezoğlu ve Çökelez, 2010). Öğrencilerin önemli bir bölümünün pili pozitif ve negatif kutuplarıyla çizmedikleri (şekil 5), birden fazla pil çizen öğrencilerin pillerin kutuplarını zıt olacak şekilde yerleştirmedikleri (şekil 4) saptanmıştır. Az da olsa bazı öğrencilerin devre elemanlarına ait resim ya da sembol gösterimine uygun olmayan (şekil 2, şekil 14) çizimler yaptıkları, devre elemanları arasında gereksiz bağlantı kabloları (şekil 11) kullandıkları saptanmıştır. Çalışma sonucunda öğrencilerin yaklaşık 1/4'inin basit elektrik devresini lamba ışık verecek şekilde çizebildiği (şekil 1) görülmüştür. Buna rağmen çoğu öğrencinin ön bilgi, deneyim ve zihinsel modellerini yansıtarak hatalı çizimler yaptıkları görülmüştür.

ÖNERİLER

Basit elektrik devresi ile ilgili kavram yanılgılarıyla çok küçük yaşlardan üniversite sıraları da dâhil olmak üzere farklı eğitim kademelerinde karşılaşılması nedeni ile konunun öğretiminde somut materyallerle öğrencinin uygulama yapmasına izin verilmelidir. Ayrıca konunun öğretiminde lamba, pil, anahtar, bağlantı kablosu ile basit elektrik devreleri kurulmasının yanında öğrencilerin ilgi ve dikkatini konuya çekmek, canlı tutmak ve ilk-ortaokul yıllarında öğrendiği bilgileri ilerleyen eğitim kademelerine doğru bir şekilde aktarabilmelerini sağlamak için analojik modellerin kullanılmasının gerekli ve önemli olduğu düşünülmektedir.

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elektrik devresinde neler olduğu konusunda öğrenci görüşleri. *Türk Fen Eğitimi Dergisi*, *7*(3), 147-166.

INQUIRE OF THE ELECTRICAL CIRCUIT

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ABSTRACT: Establishing of the electrical circuit is considered as a simple application. However, many studies in the literature showed that the students with different levels of education have learning difficulties and misconceptions related this subject. In this study, students was asked to express faulty circuits shown them and to explained how can be resolved these errors based on guided inquiry. For this purpose, data collection instrument consisting of eight open-ended questions was prepared based on expert opinions and applied to 98 fifth grade students. The descriptive research method was used in this study and students' answers were analyzed according to models on misconceptions in literature. The results of this study showed that many students expressed that bulb gives light when the switch is open and the changing elements places in a circuit causes the bulb not to emit light. The study showed that many students have different learning difficulties and misconceptions related subject. In this research some implications and conclusions have been discussed.

Key words: science education, electrical circuit, inquiry, model, misconceptions

ELEKTRİK DEVRESİNİ SORGULAYALIM[3]

ÖZET: Elektrik devresinin kurulması basit bir uygulama gibi düşünülse de alan yazında farklı eğitim kademelerindeki öğrencilerde kavram yanılgılarının saptandığı çalışmaların bulunması dikkat çekicidir. Bu çalışmada, öğrencilere doğrudan doğru bir elektrik devresi göstermek yerine hatalı devreleri, bu hataların nasıl giderilebileceğini, yeni fen bilimleri öğretim programında da vurgulanan rehberli araştırma-sorgulama yaklaşımı temelinde ifade etmeleri istenmiştir. Bu şekilde öğrencilerin kavram yanılgılarını tümevarımcı bir yaklaşımla saptama bağlamında elektrik devresinde lambanın yanma-yanmama durumunun nedenlerini sorgulamak amaçlanmıştır. Bu amaçla alan yazında konuyla ilgili kavram yanılgılarına ait modeller incelenerek ve uzman görüşleri alınarak hazırlanan 8 açık uçlu sorudan oluşan veri toplama aracı konu öğretilmeden önce 98 beşinci sınıf öğrencisine uygulanmıştır. Öğrencilerden hatalı devrelerde lambanın yanıp yanmayacağını gerekçeleriyle belirtmeleri istenmiştir. Betimsel araştırma yönteminin kullanıldığı çalışmada alan yazındaki kavram yanılgılarına ait modeller doğrultusunda analizler yapılmıştır. Çalışma sonucunda öğrencilerin anahtarın devredeki şekline bakarak açık-kapalı olma durumunu karıştırdıkları, anahtar açıkken lambanın yanacağını, devre elemanlarının yerindeki değişikliğin lambanın yanmamasına neden olacağını düşündükleri tespit edilmiştir. Alan yazında "Lambayla güç kaynağının kutuplarından biri arasında tek bir bağlantı olması yeterlidir" ifadesi ile benzer nitelikte bazı öğrenciler lambayla pilin kutuplarından herhangi biri arasındaki tek bir bağlantının yeterli olacağını ifade ederken farklı olarak bazı öğrenciler de pilin enerji veren tarafının pozitif kutbu olduğunu ve lambanın yanması için sadece pilin pozitif kutbuyla yapılacak tek bir bağlantının yeterli olacağını belirtmiştir. Yoğun olarak tespit edilen önemli bir yanılgı pillerin aynı kutuplarının yan yana geldiği durum için öğrencilerin büyük çoğunluğunun lambanın yanacağını ifade etmeleridir. Öğrencilerle pillerin aynı kutuplarının ve zıt kutuplarının yan yana olacağı iki ayrı devre kurularak somut bir şekilde lambanın hangi durumda yanacağı gösterilmelidir. Anahtarı açık olan devrede lambanın yanacağına yönelik düşüncenin de günlük yaşamda lambayı yakmak için "anahtarı aç", lambayı söndürmek için de "anahtarı kapat" ifadesinden kaynaklanabileceği düşünüldüğünde günlük yaşam dilindeki bu ifadeye rağmen devrede lambanın yanması için anahtarın kapatılarak devrenin kapalı devre olmasının gerektiği somut örnekler üzerinde gösterilmelidir.

Anahtar sözcükler: fen eğitimi, elektrik devresi, sorgulama, model, kavram yanılgısı

GİRİŞ

Elektrik devresinin kurulması basit bir uygulama gibi düşünülse de alan yazında farklı eğitim kademelerindeki öğrencilerde kavram yanılgılarının saptandığı çalışmaların bulunması dikkat çekicidir (Cohen, vd., 1983; Dupin ve Johsua, 1987; Heller ve Finley, 1992; Lee ve Law, 2001; Millar ve King, 1993; Osborne, 1981, 1983; Psillos

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ve Koumaras, 1988). Kavram yanılgılarının ise çoğunlukla tek kutuplu model olarak ifade edilen (Çepni ve Keleş, 2006; Demirezen ve Yağbasan, 2013; Sencar, vd., 2011; Taşlıdere ve Eryılmaz, 2009) bir elektrik devresinde lambanın yanması için pilin pozitif (+) kutbu veya pilin negatif (-) kutbu arasında yapılacak tek bir bağlantının (Aykutlu ve Şen, 2011; Aykutlu ve Şen, 2012; Bakırcı, vd., 2010; Chambers ve Andre, 1997; Dupin ve Johsua, 1987; Fleer, 1994; İpek ve Çalık, 2008; Keser ve Başak, 2013; Osborne, 1981; Yıldırım, vd., 2008; Yılmaz ve Huyugüzel Çavaş, 2006; Yürümezoğlu ve Çökelez, 2010), pilin pozitif (+) kutbu veya pilin negatif (-) kutbu ile lamba arasındaki yapılacak iki ayrı bağlantının yeterli olduğu (Yıldırım, vd., 2008) temelinde yapılandığı görülmektedir. Öğrencilerin iletken telleri ya pilin aynı kutbuna bağladıkları ya da iki teli de lambanın aynı noktasına temas ettirdikleri (Yeşilyurt, 2006), lambaları pile tek bir kablo ile bağladıkları (Çepni ve Keleş, 2006) ve devrenin çalışması için güç kaynağının tek kutbunun kullanılmasının yeterli olduğunu düşündükleri (Engelhardt ve Beichner, 2004) anlaşılmıştır. Bazı öğrencilerin bir elektrik devresinden anahtar açıkken de akımın geçeceğini (Yıldırım, vd., 2008) ve elektriğin iletileceğini belirttikleri saptanmıştır (Türkoğuz ve Cin, 2013). Ayrıca anahtar kapalı iken lambanın ışık vermeyeceğini ve anahtarı ışığı açmak için kullandıklarını ifade ettikleri tespit edilmiştir. Günlük yaşamda kullanılan dilin böyle bir yanılgıya sebep olabileceği belirtilmiştir (Kaya ve Gödek-Altuk, 2010; Küçüközer ve Kocakülah, 2007).

Elektrik konusunda saptanan kavram yanılgıları ve öğrenme güçlüklerinin önlenebilmesi için önce mevcut durumun ve sorunların belirlenmesi daha sonra da sorunların giderilmesine yönelik çalışmaların gerekli olduğu düşünülmektedir. Mevcut durumun belirlenebilmesi için de konu ile ilgili kavram yanılgıları tespit edilmelidir. Öğrencilerin konu ile ilgili sahip oldukları önceki bilgileri ya da kavramları alternatif yapılar (Driver ve Easley, 1978), çocukların bilimi (Gilbert, Watts ve Osborne, 1982; Gilbert, Osborne ve Fensham, 1982), genel duyu kavramları (Halloun ve Hestenes, 1985), yanlış anlama, alternatif çatı, kendiliğinden oluşan bilgiler, saf deneyimsiz teori (Aydoğdu ve Kesercioğlu, 2005), kavram yanılgıları ya da ön kavramlar olarak adlandırılmaktadır (Helm, 1980; Smith, vd., 1993). Bu yanılgılar öğrenmenin gerçekleşmesini engellemektedir (Çetingül ve Geban, 2005).

Bu çalışmada, öğretim öncesinde öğrencilerin ön bilgilerini tespit edebilmek, öğretim sırasında öğrenilecek bilgilerle bağlantı kurulmasını ve kavram yanılgılarının giderilmesini sağlamak için (Smith, vd., 1993) öğrencilere doğrudan doğru bir elektrik devresi göstermek yerine hatalı devreleri, bu hataların nasıl giderilebileceğini, yeni fen bilimleri öğretim programında da vurgulanan rehberli araştırma-sorgulama yaklaşımı temelinde ifade etmeleri istenmiştir. Bu şekilde öğrencilerin kavram yanılgılarını tümevarımcı bir yaklaşımla saptama bağlamında elektrik devresinde lambanın yanma-yanmama durumunun nedenlerini sorgulamak amaçlanmıştır.

YÖNTEM

Çalışmada betimsel araştırma yöntemi kullanılmıştır. Araştırılan ortamda herhangi bir değişim yapılmaksızın, doğal şartlara müdahale edilmeden mevcut durumu detaylı bir şekilde tanımlamak, açıklamak ve aydınlığa kavuşturmak, değerlendirmeler yapmak, olaylar arasındaki ilişkileri ortaya çıkarmak amaçlanmıştır (Çepni, 2007; Sönmez ve Alacapınar, 2013).

Örneklem

Örneklem bir devlet okulunda ortaokul 5. sınıfta öğrenim görmekte olan 98 öğrenci ile oluşturulmuştur. Çalışmada evrendeki tüm elemanlar birbirine eşit seçilme şansına sahip olup basit rastgele örneklem seçimi yapılmıştır (Çepni, 2009; Karasar, 2006; Yıldırım ve Şimşek, 2011).

Veri Toplama Aracı

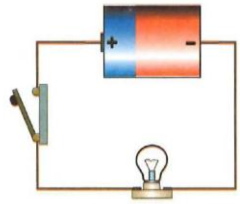
Alan yazında konuyla ilgili kavram yanılgılarına ait modeller incelenerek ve uzman görüşleri alınarak hazırlanan 8 açık uçlu sorudan oluşan veri toplama aracı konu öğretilmeden önce 98 beşinci sınıf öğrencisine uygulanmıştır. Öğrencilere "Şekilde verilen basit elektrik devresindeki lamba yanar mı? Cevabınızın nedenini açıklayınız." sorusu yöneltilmiş ve hatalı devrelerde lambanın yanıp yanmayacağını gerekçeleriyle belirtmeleri istenmiştir.

Verilerin Analizi

Çalışmada ortaokul 5. sınıf öğrencilerinin lambanın yanma-yanmama durumu ve gerekçesine ilişkin cevapların analizinde betimsel analiz yöntemi kullanılmıştır. Araştırma sorusunda ve araştırmanın kavramsal çerçevesinde yer alan boyutlar göz önünde bulundurularak veri analizi için uygun bir çerçeve oluşturulmuştur. Bu çerçeveye göre elde edilecek verilerin hangi tema altında yer alacağı belirlenmiştir. Daha önceden belirlenen çerçeveye uygun olarak veriler okunmuş ve düzenlenmiştir. Okunan veriler anlamlı, mantıklı olacak şekilde bir araya getirilmiş ve tanımlanmıştır. Tanımlanan veriler açıklanmış, ilişkilendirilmiş ve anlamlandırılmıştır (Yıldırım ve Şimşek, 2011). Veri analizinde temalara yerleştirilen cevapların frekansları ve yüzdeleri hesaplanmış, frekanslar ve yüzdeler kullanılarak tablolar oluşturulmuş ve hazırlanan tablolar yorumlanmıştır.

BULGULAR

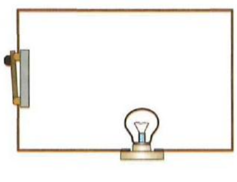
Öğrencilerin şekli verilen devrelerde lambanın yanma-yanmama durumu ve gerekçesi ile ilgili cevapları Tablo 1-8'de verilmiştir.



Tablo 1. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Anahtar*	Açık – elektrik enerjisi geçişi yok*	48	48,98
		Kapalı	9	9,18
		Açık-devre kapalı	1	1,02
	Devre elemanının yeri	Anahtar	1	1,02
	Gerekçe yok		4	4,08
	Toplam		**63**	**64,29**
Yanar	Devre elemanları ve bağlantı	Tam	16	16,33
	Anahtar	Açık-devre açık	12	12,24
	Pil	Var	2	2,04
		+ ve – kutuplar bağlı	2	2,04
	Toplam		**32**	**32,65**
Boş			3	3,06
Toplam			**98**	**100**

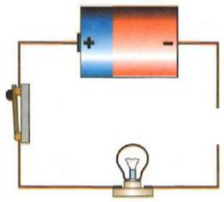
Tablo 1 incelendiğinde lambanın yanmayacağını belirten 63 5. sınıf öğrencisinin % 48,98'inin (48 öğrenci) "*anahtar açıkken devrede elektrik enerjisi geçişi olmaz*" gerekçesi ile lambanın yanmayacağını doğru olarak ifade ettiği görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*anahtar kapalı olduğu için*" (9 öğrenci), "*anahtar açıkken devre kapalı olduğu için*" (1 öğrenci), "*anahtar pozitif kutba bağlı olduğu için*" (1 öğrenci) şeklinde kavram yanılgılı gerekçeler ifade etmişlerdir. Bunun yanında 32 öğrenci (% 32,65) ise "*devre elemanları ve aralarındaki bağlantı tam olduğu için*" (16 öğrenci), "*anahtar açıkken devre açık olduğu için*" (12 öğrenci), "*devrede pil olduğu için*" (2 öğrenci), "*pilin + ve – kutupları bağlı olduğu için*" (2 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.



Tablo 2. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Devre elemanı eksikliği*	Pil*	67	68,37
		Elektrik enerjisi kaynağı*	15	15,31
		Işık kaynağı	1	1,02
	Anahtar	Kapalı	12	12,24
	Toplam		**95**	**96,94**
Yanar	Anahtar	Kapalı	2	2,04
	Devre elemanları ve bağlantı	Tam	1	1,02
	Toplam		**3**	**3,06**
Toplam			**98**	**100**

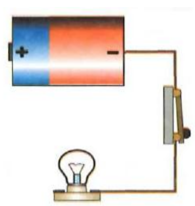
Tablo 2 incelendiğinde lambanın yanmayacağını belirten 95 5. sınıf öğrencisinin % 83,67'sinin (82 öğrenci) "*devrede pil olmadığı için*" (67 öğrenci) ve "*devrede elektrik enerjisi kaynağı olmadığı için*" (15 öğrenci) gerekçeleri ile lambanın yanmayacağını doğru olarak ifade ettiği görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*devrede ışık kaynağı olmadığı için*" (1 öğrenci), "*anahtar kapalı olduğu için*" (12 öğrenci) şeklinde kavram yanılgılı gerekçeler ifade etmişlerdir. Bunun yanında 3 öğrenci ise "*anahtar kapalı olduğu için*" (2 öğrenci) ve "*devre elemanları ve aralarındaki bağlantı tam olduğu için*" (1 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.



Tablo 3. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Bağlantı kesik*	Pilin negatif kutbu ile lamba arasında*	78	79,59
	Elektrik enerjisi*	Geçişi yok*	4	4,08
	Anahtar	Kapalı	7	7,14
	Gerekçe yok		1	1,02
	Toplam		**90**	**91,84**
Yanar	Anahtar	Kapalı	2	2,04
	Devre elemanları ve bağlantı Anahtar	Tam Açık	2	2,04
	Devre elemanının yeri	Lamba (pilin elektrik enerjisi veren kutbu)	2	2,04
		Anahtar (pilin pozitif kutbu)	1	1,02
	Gerekçe yok		1	1,02
	Toplam		**8**	**8,16**
Toplam			**98**	**100**

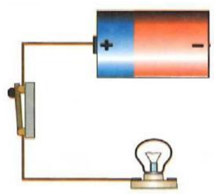
Tablo 3 incelendiğinde lambanın yanmayacağını belirten 90 5. sınıf öğrencisinin % 83,67'sinin (82 öğrenci) "*pilin negatif kutbu ile lamba arasında bağlantı kablosu kesik olduğu için*" (78 öğrenci) ve "*elektrik enerjisi geçişi olmadığı için*" (4 öğrenci) gerekçeleri ile lambanın yanmayacağını doğru olarak ifade ettiği görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*anahtar kapalı olduğu için*" (7 öğrenci) şeklinde kavram yanılgılı bir gerekçe ifade etmişlerdir. Bunun yanında 8 öğrenci ise "*anahtar kapalı olduğu için*" (2 öğrenci), "*devre elemanları ve aralarındaki bağlantı tam ve anahtar açık olduğu için*" (2 öğrenci), "*lamba pilin elektrik enerjisi veren kutbuna bağlı olduğu için*" (2 öğrenci) ve "*anahtar pilin pozitif kutuna bağlı olduğu için*" (1 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.



Tablo 4. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Bağlantı eksik*	Pilin pozitif kutbu ile lamba arasında*	70	71,43
	Elektrik enerjisi*	Geçişi yok*	2	2,04
	Anahtar	Kapalı	14	14,29
		Yeri	2	2,04
		Açık	1	1,02
	Lamba	Yeri (pilin negatif kutbu)	4	4,08
	Gerekçe yok		1	1,02
	Toplam		**94**	**95,92**
Yanar	Devre elemanları ve bağlantı	Tam	3	3,06
	Pil	Negatif kutbu bağlı	1	1,02
	Toplam		**4**	**4,08**
Toplam			**98**	**100**

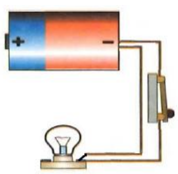
Tablo 4 incelendiğinde lambanın yanmayacağını belirten 94 5. sınıf öğrencisinin % 73,47'sinin (72 öğrenci) "*pilin pozitif kutbu ile lamba arasında bağlantı eksik olduğu için*" (70 öğrenci) ve "*elektrik enerjisi geçişi olmadığı için*" (2 öğrenci) gerekçeleri ile lambanın yanmayacağını doğru olarak ifade ettiği görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*anahtar kapalı olduğu için*" (14 öğrenci), "*anahtar negatif kutupta bağlı olduğu için*" (2 öğrenci), "*anahtar açık olduğu için*" (1 öğrenci), "*lamba pilin negatif kutbuna bağlı olduğu için*" (4 öğrenci) şeklinde kavram yanılgılı gerekçeler ifade etmişlerdir. Bunun yanında 4 öğrenci ise "*devre elemanları ve aralarındaki bağlantı tam olduğu için*" (3 öğrenci), "*pilin negatif kutbu bağlı olduğu için*" (1 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.



Tablo 5. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Bağlantı eksik*	Pilin negatif kutbu ile lamba arasında*	69	70,41
	Elektrik enerjisi*	Geçişi yok*	3	3,06
	Anahtar	Kapalı	12	12,24
		Yeri (pilin pozitif kutbu)	1	1,02
	Toplam		**85**	**86,73**
Yanar	Lamba	Yeri (pilin elektrik enerjisi veren kutbu)	6	6,12
	Devre elemanları ve bağlantı	Tam	5	5,10
	Anahtar	Kapalı	1	1,02
	Gerekçe yok		1	1,02
	Toplam		**13**	**13,27**
Toplam			**98**	**100**

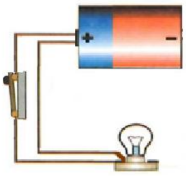
Tablo 5 incelendiğinde lambanın yanmayacağını belirten 85 5. sınıf öğrencisinin % 73,47'sinin (72 öğrenci) "*pilin negatif kutbu ile lamba arasında bağlantı eksik olduğu için*" (69 öğrenci) ve "*elektrik enerjisi geçişi olmadığı için*" (3 öğrenci) gerekçeleri ile lambanın yanmayacağını doğru olarak ifade ettikleri görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*anahtar kapalı olduğu için*" (12 öğrenci) ve "*anahtar pilin pozitif kutbuna bağlı olduğu için*" (1 öğrenci) şeklinde kavram yanılgılı gerekçeler ifade etmişlerdir. Bunun yanında 13 öğrenci ise "*lamba pilin elektrik enerjisi veren kutbuna bağlı olduğu için*" (6 öğrenci), "*devre elemanları ve aralarındaki bağlantı tam olduğu için*" (5 öğrenci) ve "*anahtar kapalı olduğu için*" (1 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.



Tablo 6. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Bağlantı kablosunun yeri*	İkisi de pilin negatif kutbu ile lamba arasında*	65	66,33
		İkisi de pilin pozitif kutbu ile lamba arasında değil	1	1,02
	Anahtar	Kapalı	9	9,18
		Yeri (pilin negatif kutbu)	2	2,04
	Gerekçe yok		4	4,08
	Toplam		**81**	**82,65**
Yanar	Bağlantı kablosunun yeri	İkisi de negatif kutupta	8	8,16
	Devre elemanları ve bağlantı	Tam	6	6,12
	Anahtar	Kapalı	2	2,04
	Toplam		**16**	**16,33**
Boş			**1**	**1,02**
Toplam			**98**	**100**

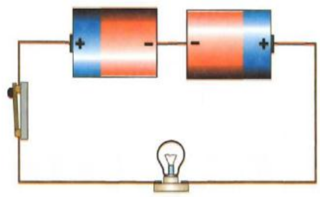
Tablo 6 incelendiğinde lambanın yanmayacağını belirten 81 5. sınıf öğrencisinin % 66,33'ünün (65 öğrenci) "*bağlantı kablosunun ikisi de pilin negatif kutbu ile lamba arasında olduğu için*" gerekçesi ile lambanın yanmayacağını doğru olarak ifade ettiği görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*bağlantı kablosunun ikisi de pilin pozitif kutbu ile lamba arasında olmadığı için*" (1 öğrenci), "*anahtar kapalı olduğu için*" (9 öğrenci) ve "*anahtar pilin negatif kutbuna bağlı olduğu için*" (2 öğrenci) şeklinde kavram yanılgılı gerekçeler ifade etmişlerdir. Bunun yanında 16 öğrenci ise "*bağlantı kablosunun her ikisi de negatif kutupta bağlı olduğu için*" (8 öğrenci), "*devre elemanları ve aralarındaki bağlantı tam olduğu için*" (6 öğrenci) ve "*anahtar kapalı olduğu için*" (2 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.



Tablo 7. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Bağlantı kablosunun yeri*	İkisi de pilin pozitif kutbu ile lamba arasında*	56	57,14
	Elektrik enerjisi*	Geçişi yok*	1	1,02
	Anahtar	Kapalı	12	12,24
		Yeri (pilin pozitif kutbu)	2	2,04
	Gerekçe yok		8	8,16
	Toplam		**79**	**80,61**
Yanar	Devre elemanları ve bağlantı	Tam	13	13,27
	Bağlantı kablosunun yeri	Pilin elektrik enerjisi veren tarafı	4	4,08
	Anahtar	Yeri	1	1,02
	Gerekçe yok		1	1,02
	Toplam		**19**	**19,39**
Toplam			**98**	**100**

Tablo 7 incelendiğinde lambanın yanmayacağını belirten 79 5. sınıf öğrencisinin % 58,16'sının (57 öğrenci) "*bağlantı kablosunun ikisi de pilin pozitif kutbu ile lamba arasında olduğu için*" (56 öğrenci) ve "*elektrik enerjisi geçişi olmadığı için*" (1 öğrenci) gerekçeleri ile lambanın yanmayacağını doğru olarak ifade ettiği görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*anahtar kapalı olduğu için*" (12 öğrenci), "*anahtar pilin pozitif kutbuna bağlı olduğu için*" (2 öğrenci) şeklinde kavram yanılgılı gerekçeler ifade etmişlerdir. Bunun yanında 19 öğrenci ise "*devre elemanları ve aralarındaki bağlantı tam olduğu için*" (13 öğrenci), "*bağlantı kablosu pilin elektrik enerjisi veren tarafına bağlı olduğu için*" (4 öğrenci) ve "*anahtar pilin pozitif kutbuna bağlı olduğu için*" (1 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.



Tablo 8. Basit Elektrik Devresinde Yer Alan Lambanın Yanma-Yanmama Durumu Ve Gerekçesi

			f	%
Yanmaz*	Pillerin bağlanma şekli*	Aynı kutuplar yan yana*	25	25,51
	Anahtar	Kapalı	18	18,37
	Gerekçe yok		10	10,20
	Toplam		**53**	**54,08**
Yanar	Devre elemanları ve bağlantı	Tam	34	34,69
	Elektrik enerjisi kaynağı	Tüm kutupları bağlı	3	3,06
		Var	2	2,04
	Bağlantı kablosu	Elektrik enerjisi veren pozitif kutuplarına bağlı	2	2,04
	Gerekçe yok		4	4,08
	Toplam		**45**	**45,92**
Toplam			**98**	**100**

Tablo 8 incelendiğinde lambanın yanmayacağını belirten 53 5. sınıf öğrencisinin % 25,51'inin (25 öğrenci) "*pilin aynı kutupları yan yana olacak şekilde bağlandığı için*" gerekçesi ile lambanın yanmayacağını doğru olarak ifade ettiği görülmektedir. Lambanın yanmayacağını ifade etmelerine rağmen bazı öğrenciler "*anahtar kapalı olduğu için*" (18 öğrenci) şeklinde kavram yanılgılı bir gerekçe ile ifade etmişlerdir. Bunun yanında 45 öğrenci ise "*devre elemanları ve aralarındaki bağlantı tam olduğu için*" (34 öğrenci), "*elektrik enerjisi kaynağının tüm kutupları bağlı olduğu için*" (3 kişi), "*elektrik enerjisi kaynağı olduğu için*" (2 kişi) ve "*bağlantı kablosu pilin elektrik enerjisi veren pozitif kutuplarına bağlı olduğu için*" (4 öğrenci) şeklinde kavram yanılgılı gerekçelerle yanlış cevap vererek lambanın yanacağını belirtmiştir.

SONUÇ

Çalışma sonucunda bazı öğrencilerin lambanın yanması için pilin pozitif ya da negatif kutuplarından sadece birine bağlı olmasının yeterli olduğunu ifade ettikleri saptanmıştır. Benzer şekilde de alanyazında öğrencilerin tek kutuplu model olarak ifade edildiği üzere (Çepni ve Keleş, 2006; Demirezen ve Yağbasan, 2013; Sencar, vd., 2011; Taşlıdere ve Eryılmaz, 2009) bir elektrik devresinde lambanın yanması için pilin pozitif (+) kutbu veya pilin negatif (-) kutbu arasında yapılacak tek bir bağlantının (Aykutlu ve Şen, 2011; Aykutlu ve Şen, 2012; Bakırcı, vd., 2010; Chambers ve Andre, 1997; Dupin ve Johsua, 1987; Fleer, 1994; İpek ve Çalık, 2008; Keser ve Başak, 2013; Osborne, 1981; Yıldırım, vd.,, 2008; Yılmaz ve Huyugüzel Çavaş, 2006; Yürümezoğlu ve Çökelez, 2010), pilin pozitif (+) kutbu veya pilin negatif (-) kutbu ile lamba arasındaki yapılacak iki ayrı bağlantının yeterli olduğu (Yıldırım, vd., 2008) yanılgısının yaygın şekilde görüldüğü ifade edilmiştir. Öğrencilerin iletken telleri ya pilin aynı kutbuna bağladıkları ya da iki teli de lambanın aynı noktasına temas ettirdikleri (Yeşilyurt, 2006), lambaları pile tek bir kablo ile bağladıkları (Çepni ve Keleş, 2006) ve devrenin çalışması için güç kaynağının tek kutbunun kullanılmasının yeterli olduğunu düşündükleri (Engelhardt ve Beichner, 2004) ortaya koyulmuştur.

Öğrencilerin bir bölümünün ise basit elektrik devresindeki anahtar açık olmasına rağmen kapalı olduğunu, kapalı ve açık devreler için anahtarın devredeki konumunu yanlış ifade ettikleri, anahtarın bağlı olduğu pil kutbunun lambanın yanma-yanmama durumu üzerinde etkili olduğunu belirttikleri ve anahtar kapalı konumdayken lambanın yanmayacağını, açık konumdayken lambanın yanacağını ifade ettikleri saptabnıştır. Alanyazında da bazı öğrencilerin bir elektrik devresinden anahtar açıkken de akımın geçeceğini (Yıldırım, vd., 2008) ve elektriğin iletileceğini belirttikleri saptanmıştır (Türkoğuz ve Cin, 2013). Ayrıca anahtar kapalı iken lambanın ışık vermeyeceğini ve anahtarı ışığı açmak için kullandıklarını ifade ettikleri saptanmıştır (Kaya ve Gödek-Altuk, 2010; Küçüközer ve Kocakülah, 2007).

Öğrencilerin bir kısmının ise pilin ışık kaynağı olduğunu, pilin elektrik enerjisi veren kutbunun pozitif kutbu olduğunu belirttikleri ve pilin kutuplarının devreye bağlanma şekline dikkat etmedikleri saptanmıştır. Ayrıca bazı öğrencilerin devre elemanları ve aralarındaki bağlantının tam olduğu her durumda lambanın yanacağını ifade etmeleri dikkat çekici bir sonuçtur.

ÖNERİLER

Basit bir elektrik devresinde lambanın hangi durumlarda yanmayacağının öğretiminde konuyu somutlaştırmak için deneysel etkinlikler yapılmalıdır. Öğrencilerin kendilerine verilecek hatalı elektrik devrelerini uygulamalı olarak düzeltmeleri istenmelidir. Ayrıca klasik bir elektrik devresinin yanında öğrencilerin konuya yönelik ilgi ve dikkatlerini çekmek, merak uyandırmak amacıyla analojik modellerin kullanılmasının gerekli ve önemli olduğu düşünülmektedir. Ayrıca çalışma kapsamında yoğun olarak tespit edilen bir kavram yanılgısı olması nedeni ile öğrencilerle pillerin aynı kutuplarının ve zıt kutuplarının yan yana olacağı iki ayrı devre kurularak somut bir şekilde lambanın hangi durumda yanacağı gösterilmelidir. Anahtarı açık olan devrede lambanın yanacağına yönelik düşüncenin de günlük yaşamda lambayı yakmak için "anahtarı aç", lambayı söndürmek için de "anahtarı kapat" ifadesinden kaynaklanabileceği düşünüldüğünde günlük yaşam dilindeki bu ifadeye rağmen devrede lambanın yanması için anahtarın kapatılarak devrenin kapalı devre olmasının gerektiği somut örnekler üzerinde gösterilmelidir.

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TEACHERS AND TEACHER CANDIDATES' THE OPINIONS AND AWARENESS LEVELS ABOUT PROJECT BASED LEARNING

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ABSTRACT: Education system processes with the traditional approach to education teacher's knowledge transfering, student's taking the information in the teacher-student-knowledge of revolution. Instead of this, there should be established an environment which solves the identified problems a variety of teaching methods and techniques, the case of realization in access to learning information the student's playing an active role, guiding teacher of this, which is associated with everyday life issues and problems. In this environment student should be able to use problem-solving skills, reveal the direction of research, be able to create the ability to make decisions and be able to contribute to the development of a number of outstanding ability. In recent years in our country studies in science and mathematics education, are concentrated on the impact of the learning of students of various learning approaches. Project-based learning approach is one of these approaches. The aim of this study is to investigate comparatively the perspectives of project-based training and the application level of primary school teachers and the teacher of candidates. The study was carried out under the specific case study. As data collection tool semi-structured interview form consisting of 15 questions was used and validity study was prepared by the researchers. The sample of the study consisted of 20 teacher candidates and 21 primary school teachers. The data obtained from this study were analyzed using NVIVO program. By using data obtained from the study, candidate teachers' and teachers' the levesl of awareness and information on project-based learning and a significant relationship between them will be discussed.

Key words: new approaches in education, project based learning, primary school teachers, teacher candidates

ÖĞRETMEN VE ÖĞRETMEN ADAYLARININ PROJE TABANLI ÖĞRETİM HAKKINDAKİ GÖRÜŞ VE FARKINDALIK DÜZEYLERİ

ÖZET: Eğitim sistemi, öğretmen-öğrenci-bilgi çarkı içerisinde, öğretmenin bilgiyi aktaran, öğrencinin ise bilgiyi alan durumda olduğu geleneksel eğitim anlayışı ile işlemektedir. Bunun yerine, bilgiye ulaşmada ve öğrenmenin gerçekleşmesi durumunda öğrencinin aktif bir rol oynadığı, rehberliği öğretmenin yaptığı, sorunların gündelik yaşamla ilişkilendirildiği ve belirlenen sorunların çözülmesinde çeşitli öğretim yöntem ve tekniklerinin kullanıldığı bir ortamın oluşturulması gerekmektedir. Bu ortamda öğrenci problem çözme becerisini kullanabilmeli, araştırmacı yönünü ortaya çıkarabilmeli, karar verme yeteneğini oluşturabilmeli ve bir takım öne çıkan becerilerinin gelişmesini sağlayabilmelidir. Son yıllarda ülkemizde fen ve matematik eğitimi alanında yapılan çalışmalar, çeşitli öğrenme yaklaşımlarının öğrencilerin öğrenmeleri üzerindeki etkilerinde yoğunlaşmaktadır. Bu yaklaşımlardan biride proje tabanlı öğrenme yaklaşımıdır. Bu çalışmanın amacı sınıf öğretmeni ve sınıf öğretmeni adaylarının proje temelli eğitime bakış açılarını ve uygulama düzeylerini karşılaştırmalı olarak incelemektir. Bu çalışma özel durum çalışması kapsamında gerçekleştirilmiştir. Veri toplama aracı olarak araştırmacılar tatarından hazırlanan ve geçerlik çalışması yapılmış olan 15 sorudan oluşan yarı yapılandırılmış mülakat formu kullanılmıştır. Çalışmanın örneklemini 20 sınıf öğretmeni adayı ve 21 sınıf öğretmeni oluşturmaktadır. Çalışmadan elde edilen veriler NVIVO programı kullanılarak analiz edilmektedir. Çalışmadan elde edilen veriler kullanılarak öğretmen adayları ve öğretmenlerin proje temelli öğrenmeye ilişkin bilgi ve farkındalık düzeyleri arasında anlamlı bir ilişki olup olmadığı tartışılacaktır.

Anahtar sözcükler: eğitimde yeni yaklaşımlar, proje temelli öğrenme, sınıf öğretmeleri, öğretmen adayları

GİRİŞ

Günümüzde eğitim alanında yapılan araştırmalar, öğrencilerin ilgilerini, isteklerini, becerilerini ve ihtiyaçlarını dikkate alacak biçimde öğretim yaklaşımlarını düzenleyen öğrenci merkezli eğitimde, öğrencilerin daha iyi öğrendiklerini ortaya koymaktadır (Köroğlu ve Yeşildere, 2004; Başbay 2005; Bulumenfeld, Soloway, Marx, 1991). Son yıllarda ülkemizde fen ve matematik eğitimi alanında yapılan çalışmalar, çeşitli öğrenme yaklaşımlarının öğrencilerin öğrenmeleri üzerindeki etkilerinde yoğunlaşmaktadır. Bu yaklaşımlardan biride proje tabanlı öğrenme(PTÖ) yaklaşımıdır. Proje tabanlı öğrenme; disiplinler arası çalışmayı gerektiren, bireysel olarak ve grup içinde sorumluluk alan öğrencilerin gerçek yaşama dayalı problemler üzerinde, belirlenen konuya bağlı kalarak oluşturdukları içerikte, işbirliğine dayalı olarak ve kendi ilgi ve yetenekleri çerçevesinde araştırmaya dayalı çalışmalarını gerçekleştirdikleri, öğretmenin ise çalışmaları kolaylaştırıcı, öğrencileri yönlendirici rolünün temelde yer aldığı, gerçekçi ürünlerle veya sunumlarla sonuçlanan ve farklı yaklaşımları kendi bünyesinde birleştiren bir yaklaşımdır (Demirhan, 2002).

Ülkemizde uygulanan müfredat yaklaşımları geçmişten günümüze incelendiği zaman genel olarak geleneksel yaklaşım uzun süre hâkim olmuştur. Ancak 2000 yılından beri uygulanan ilköğretim fen programları incelendiğinde öğrenci merkezli programlar olduğu görülmekte ve bu programlar öğrencilerin birer küçük bilim adamı gibi araştırmalar, deneyler, projeler yaparak bilgiye ulaşmalarını önermektedir (Akpınar ve Ergin, 2005). Son yapılan değişiklerle birlikte mevcut müfredat yapısı yapılandırmacı ve aynı zamanda argümantasyona daha fazla ağırlık veren bir yapıya bürünmüştür. Özellikle yapısalcı yaklaşım olarak bilinen ve uygulamada olan müfredat yapısın içerisinde proje kavramı da önemli bir yer tutmaktadır. Yaparak yaşayarak öğrenmenin öğrenme ortamlarındaki uygulaması olan proje temelli eğitimin etkili bir şekilde uygulanması hem öğrencilerin bilime ve öğrenmeye olan merak düzeyini arttıracak hem de öğrenmenin verimini arttıracaktır. Bu süreçte öğretmenlere oldukça önemli görevler düşmektedir. Proje temelli öğrenme süreci hakkında yeterli bilgiye sahip olmayan ve önemine inanmayan bir öğretmenin proje temelli eğitimi etkili bir şekilde uygulaması mümkün olmayacaktır. Büyük maddi ve manevi çabalarla hazırlanan ve uygulanmaya çalışılan müfredatın başarıya ulaşmasında önemli bir role sahip olan sınıf öğretmenlerinin proje temelli öğrenme yaklaşımı ile ilgili bilgi düzeyleri ve önemine inanma durumlarının belirlenmesi mevcut müfredatın uygulanma düzeyinin başarı seviyesi ile ilgili önemli veriler elde etmemize vesile olacaktır.

Bu çalışma sınıf öğretmeni ve sınıf öğretmeni adaylarının proje temelli eğitime bakış açılarını,uygulama düzeylerini karşılaştırmalı olarak incelemek ve öneriler geliştirmek adına bu çalışma yapılmıştır.

YÖNTEM

Araştırmanın Yöntemi

Öğretmen ve öğretmen adaylarının proje tabanlı öğretim hakkındaki görüş ve farkındalık düzeylerini belirlemek için gerçekleştirilen bu çalışma nitel bir çalışmadır. Nitel araştırma yöntemi sosyal deneyimin nasıl oluştuğuna ve nasıl anlamlandırıldığına cevap verir (Denzin ve Lincoln, 2003). Bu yüzden nitel araştırmada konuya yoğunlaşabilmek ve konuyu daha iyi anlamlandırabilmek için sorulan sorular esnektir ve araştırma sürecine göre değişebilir. Bu durum, araştırmada katılımcılarının deneyimlerini, tepkilerini ve yorumlarını derinlemesine anlamada yararlı olmaktadır (Creswell, 2003). Çalışmada nitel araştırma desenlerinden olgu bilim deseni kullanılmıştır.Olgu bilim farkında olunan ancak derinlemesine ve ayrıntılı bir anlayışa sahip olunmayan olgulara odaklanmaktır(Çepni,2005).

Örneklem

Bu araştırmanın örneklemini Amasya Üniversitesi bünyesinde yapılan sınıf öğretmenliği çalıştayına katılanlar arasından gönüllülük esasına göre seçilen 21 sınıf öğretmen ile 20 sınıf öğretmeni adayı oluşturmaktadır.Örneklemde yer alacak kişilerin belirlenmesinde araştırmanın amacına uygun olarak amaçlı örneklem seçim yöntemlerinden olan tipik durum örneklemesi yöntemi kullanılmıştır.Tipik durum örneklemesi,araştırmacının yeni bir uygulamayı veya bir yeniliği tanıtmak istediğinde,bu uygulamanın yapıldığı veya yeniliğin olduğu bir dizi durum arasından,bir veya birkaç tanesinin seçilmesidir.(Yıldırım ve Şimşek,2011)

.Veri Toplama Araçları

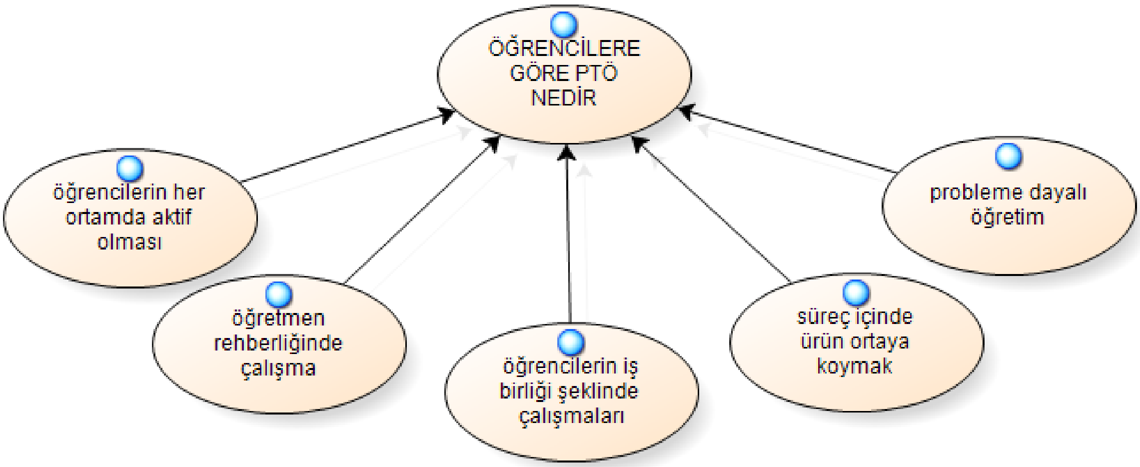
Bu çalışmada nitel veri toplama araçlarından birisi olan mülakat(görüşme) kullanılmıştır. Görüşmenin bir tanımı, önceden belirlenmiş ve ciddi bir hedefe yönelik yapılan, karşıdakine soru sorma yöntemiyle yanıtlar alan etkileşime dayalı bir iletişim sürecidir. Görüşmede kullanılan soru ve cevap yöntemi de veri toplarken bir ilişkiyi kurma ve veriye ulaşma yolu olarak nitelendirilebilir(Yıldırım &Şimşek, 2005). Yarı yapılandırılmış görüşme tekniği, yapılandırılmış görüşme tekniğinden biraz daha esnektir. Bu teknikte, araştırmacı önceden sormayı planladığı soruları içeren görüşme protokolünü hazırlar. Buna karşın araştırmacı görüşmenin akışına bağlı olarak değişik yan ya da alt sorularla görüşmenin akışını etkileyebilir ve kişinin yanıtlarını açmasını ve ayrıntılandırılmasını sağlayabilir (Türnüklü, 2000).

Bu çalışmada tercih edilmiş olan yarı yapılandırılmış mülakatta;sınıf öğretmeni ve sınıf öğretmeni adaylarının proje temelli öğrenme hakkındaki bilgileri,görüşleri ve farkındalık düzeylerini belirlemek amaçlanmıştır.Bu amaçla 15 sorudan oluşan mülakat formu geliştirilip, kapsam geçerliliği çalışmacılar tarafından sağlanmıştır.

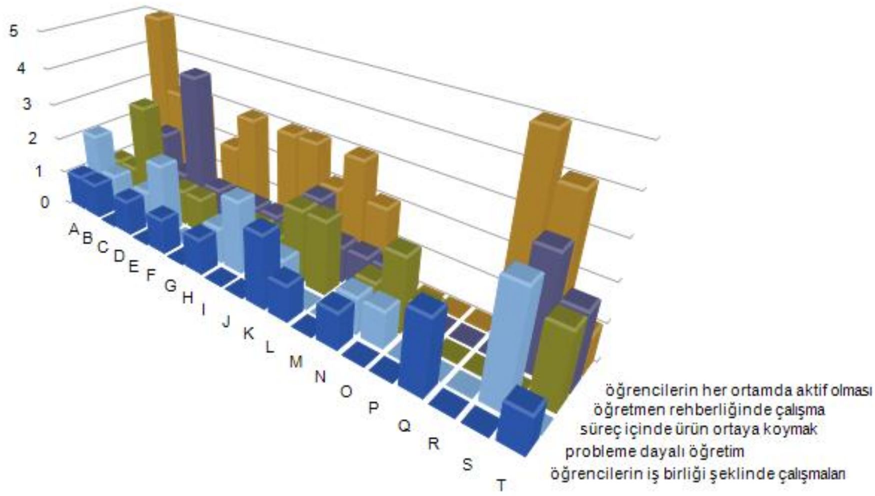
Verilerin Analizi

Olgu bilim araştırmaları, farkında olunan ancak derinlemesine ve ayrıntılı bir anlayışa sahip olunmayan olgulara odaklanılması olarak tanımlanmaktadır (Yıldırım ve Şimşek,2011). Görüşme sonunda elde edilen veriler benzer ve farklılıklarına göre gruplandırılıp, kategorilendirilmiş, kodlanmıştır..NVIVO programı ile kategoriler kodlanmış, cinsiyet, yaş gibi demografik verilerin tamamı ve tercih edilenleri aralarındaki ilişkileri daha rahat görmek mümkün olmuştur. Bu çalışmada verilerin altında yatan kavramları ve bu kavramlar arasındaki ilişkileri ortaya çıkarmak için içerik analizi yöntemi kullanılmıştır (Yıldırım & Şimsek,2011).

İçerik analizinde ilk basamak olan kodlama şeması için ses kayıtlarında yer alan öğrenci konuşmaları bilgisayarda yazılı hale getirilmiştir. Bunun ardından yazılı dokümanlar NVIVO programına aktarılmış, kodlamalar yapılarak ortak temalardaki kodlar gruplandırılıp organize edilerek bulgular programda işlenmiştir.

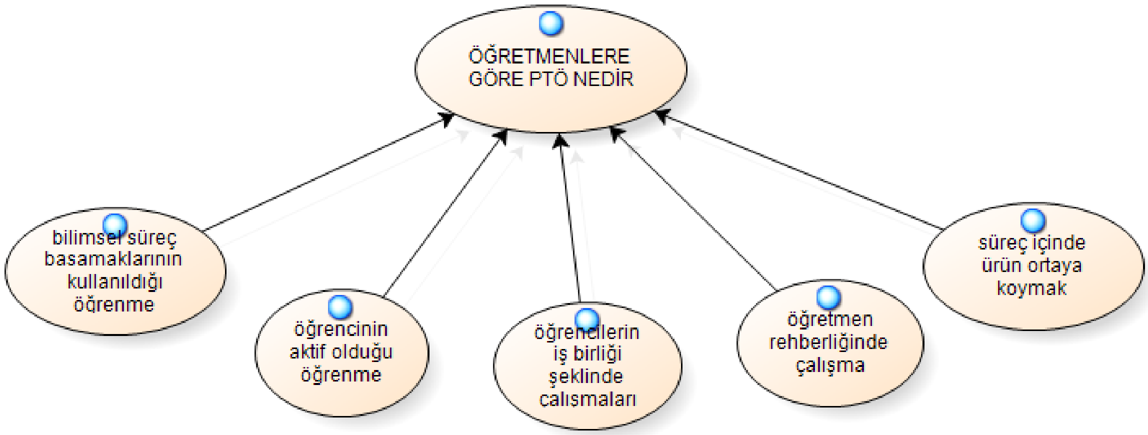


Şekil 1:Sınıf Öğretmeni Adaylarına Göre PTÖ Nedir?

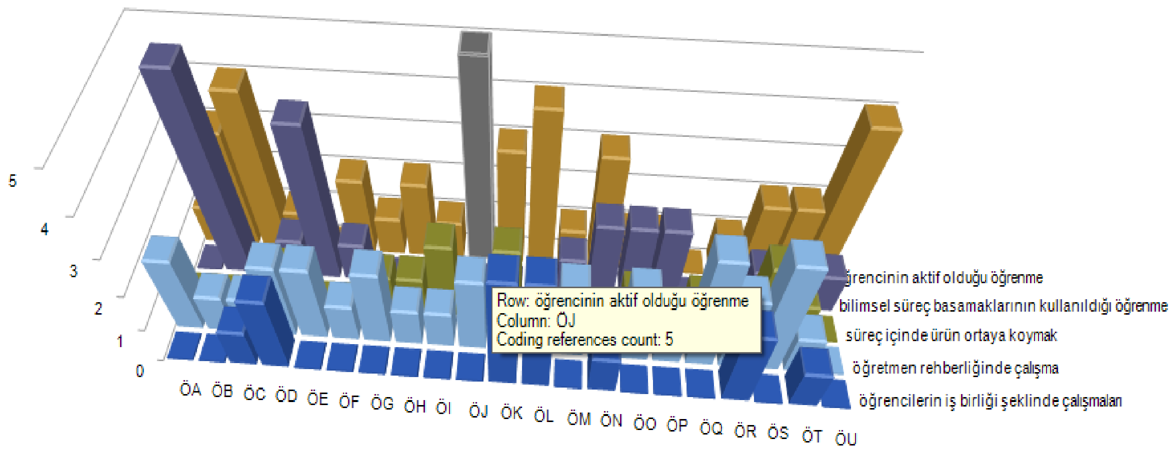


Grafik1: Sınıf Öğretmeni Adaylarına Göre PTÖ Nedir?

Sınıf öğretmeni adaylarına sorulan "Proje tabanlı öğrenme nedir?" sorusuna sınıf öğretmeni adaylarının verdiği cevaplara bakıldığında Şekil 1' de görüldüğü üzere "Öğrencinin her ortamda aktif olması,öğretmenin rehberliğinde çalışma,süreç içerisinde ortaya ürün koyma,probleme dayalı öğretim ve öğrencilerin iş birliği içinde çalışmaları" cevaplarının verildiği görülmektedir.Grafik 1 incelendiği zaman sınıf öğretmeni adaylarına göre "Proje tabanlı öğrenme nedir?" sorusuna sınıf öğretmenlerinin verdiği cevaplar incelendiğinde en çok verilen cevabın "öğrencinin her ortamda aktif olması" cevabının verildiği görülmektedir.Yine diğer verilen cevaplara bakıldığında ise "öğrencilerin her ortamda aktif olması" cevabından sonra en çok verilen cevabın "öğretmen rehberliğinde çalışma" gelmekte bunu da "süreç içerisinde ürün ortaya koymak" cevabı geldiği görülmektedir.Sınıf öğretmeni adaylarının verdiği cevaplara bakıldığın da ise en az verilen cevabın "öğrencilerin iş birliği şeklinde çalışmaları" cevabını verdikleri görülmektedir.



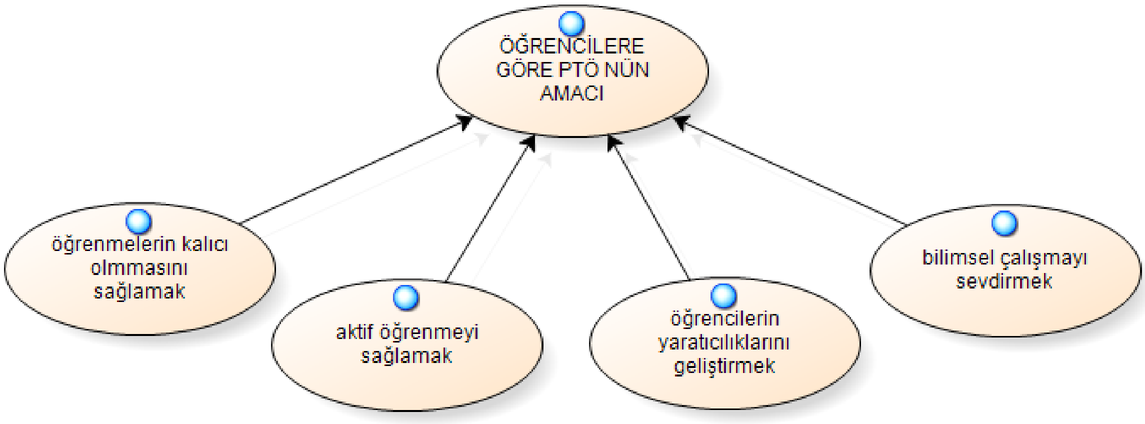
Şekil 2:Sınıf Öğretmenlerine Göre PTÖ Nedir?



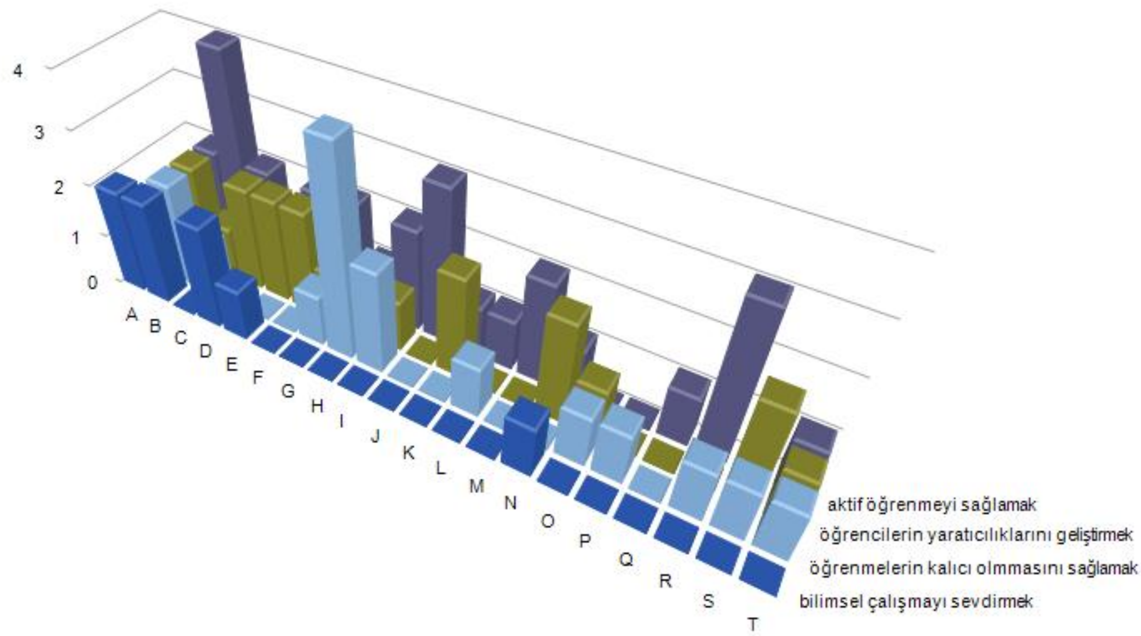
Grafik 2: Sınıf Öğretmenlerine Göre PTÖ Nedir?

Sınıf öğretmenlerine sorulan "Proje tabanlı öğrenme nedir?" sorusuna verilen cevaplara bakıldığında Şekil 2' de görüldüğü üzere "öğrencinin aktif olduğu öğrenme,bilimsel süreç basamaklarının kullanıldığı öğrenme,süreç içinde ürün ortaya koymak,öğretmen rehberliğinde çalışma ve öğrencilerin iş birliği şeklinde çalışmaları" olduğu görülmektedir.Grafik 2 incelendiğinde sınıf öğretmenlerine göre " Proje tabanlı öğrenme nedir?" sorusuna verilen cevaplara bakıldığında en çok verilen cevabın "öğrencinin aktif olduğu öğrenme" olduğu görülmektedir.Verilen diğer cevaplarda ise "öğrencinin aktif olduğu öğrenme" den sonra "öğretmen rehberliğinde çalışma" nın öğretmenler tarafından daha fazla verilen cevaplar arasında olduğu görülmektedir.Öğretmenlerin verdiği cevaplara bakıldığında en az verilen cevabın "öğrencilerin iş birliği şeklinde çalışmaları" olduğu görülmektedir.

Sınıf öğretmeni adayları ve sınıf öğretmenlerinin " Proje tabanlı öğrenme nedir?" sorusuna verdikleri cevaplar karşılaştırmalı olarak incelendiğinde en çok verilen cevabın "öğrencinin aktif olduğu" öğrenme olduğu görülmektedir.En az verilen cevabın ise her iki tarafta da "öğrencilerin iş birliği" şeklinde çalışmaları olduğu görülmektedir.Her iki tarafın verdiği cevaplarda ise sınıf öğretmeni adaylarının "probleme dayalı öğretim" cevabını verdiği,sınıf öğretmenlerinin ise "bilimsel süreç basamaklarının kullanıldığı öğrenme" cevabının iki taraf arasındaki verilen cevaplara göre farklılık gösterdiği görülmektedir.

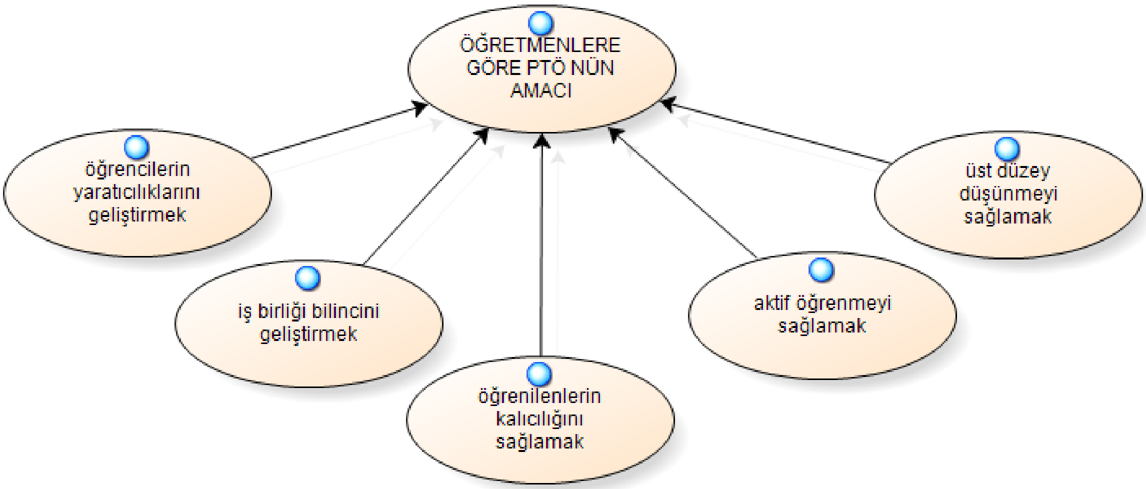


Şekil 3:Sınıf Öğretmeni Adaylarına Göre PTÖ'nün Amacı

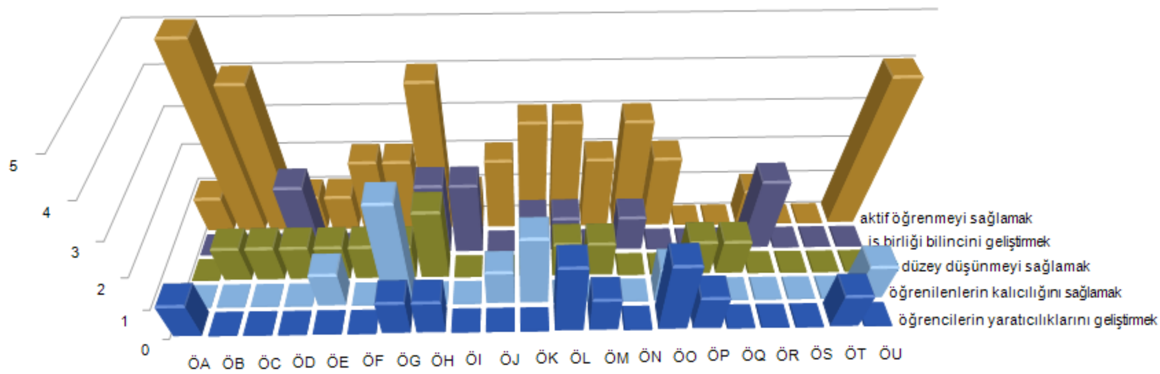


Grafik 3: Sınıf Öğretmeni Adaylarına Göre PTÖ'nün Amacı

Sınıf öğretmeni adaylarının "Proje tabanlı öğrenmenin amacı nedir?" sorusuna verdikleri cevaplar Şekil 3'te görüldüğü gibi "bilimsel çalışmayı sevdirmek,öğrenmelerin kalıcı olmasını sağlamak,öğrencilerin yaratıcılıklarını geliştirmek ve aktif öğrenmeyi sağlamak" olduğu görülmektedir.Grafik 3 incelendiğinde mülakata katılan sınıf öğretmeni adaylarının verdiği cevaplarda "aktif öğrenmeyi sağlamak" cevabının en çok verilen cevap olduğu görülmekte,daha sonrasında ise bunu "öğrencilerin yaratıcılıklarını geliştirmek" ve "öğrenmelerin kalıcılığını sağlamak" cevaplarının izlediği görülmektedir.En az verilen cevabın ise "bilimsel çalışmayı sevdirmek" olduğu Grafik 3'te görülmektedir.



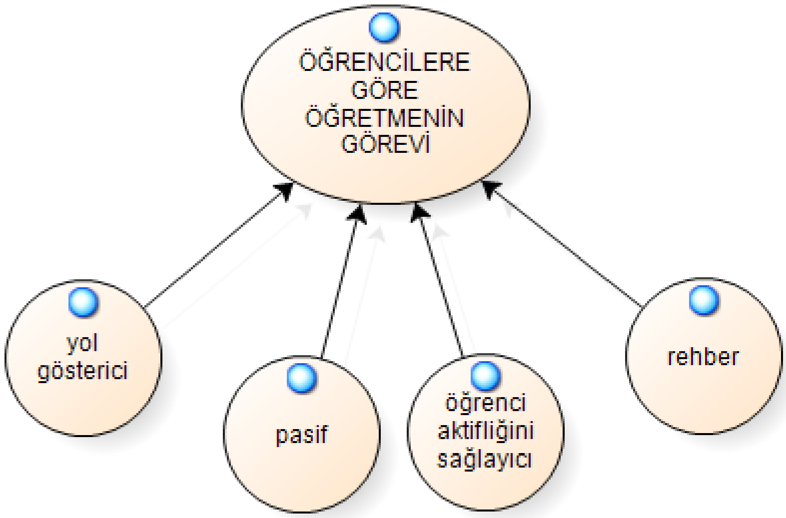
Şekil 4:Sınıf Öğretmenlerine Göre PTÖ'nün Amacı



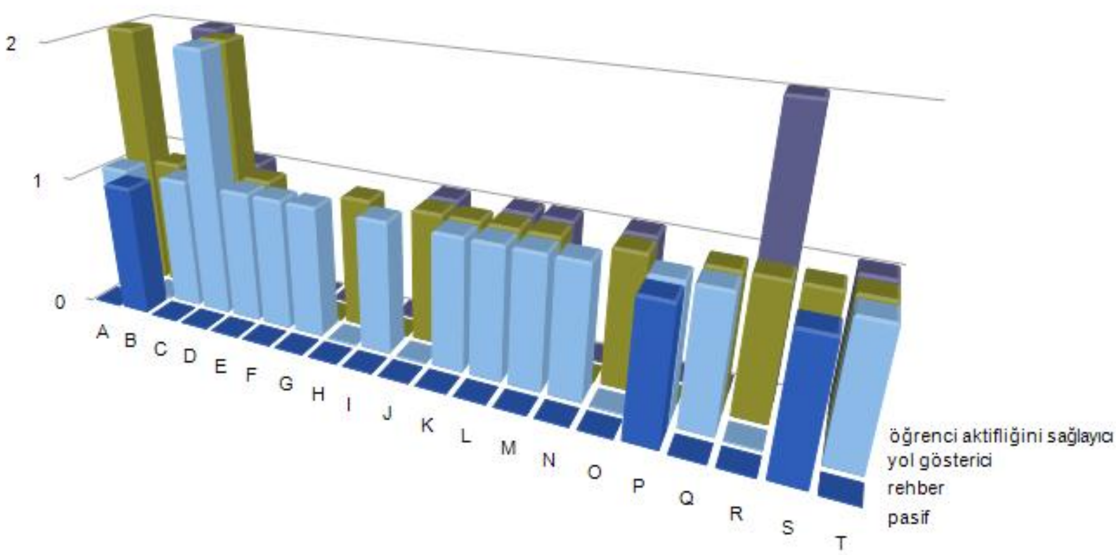
Grafik 4:Sınıf Öğretmenlerine Göre PTÖ Nün Amacı

Mülakata katılan öğretmenlerin "Proje tabanlı öğrenmenin amacı nedir?" sorusuna verdikleri cevaplar Şekil 4'te görüldüğü gibi "öğrencilerin yaratıcılıklarını geliştirmek,öğrenilenlerin kalıcılığını sağlamak,üst düzey düşünmeyi sağlamak,iş birliğini geliştirmek ve aktif öğrenmeyi sağlamak" tır.Grafik 4 incelendiğinde öğretmenlerin "Proje tabanlı öğrenmenin amacı nedir?" sorusuna verdikleri cevaplarda en fazla verdikleri cevabın "aktif öğrenmeyi sağlamak" olduğu görülmektedir.

Grafik 3 ve Grafik 4'e bakıldığında sınıf öğretmeni adayları ve sınıf öğretmenlerinin "Proje tabanlı öğrenmenin amacı nedir?" sorusuna cevap olarak en fazla "aktif öğrenmeyi sağlamak" cevabının verildiği görülmektedir.Şekil 3 ve Şekil 4 incelendiğinde ise öğretmenlerin sınıf öğretmeni adaylarından farklı olarak "üst düzey düşünmeyi sağlamak" cevabını verdikleri görülmektedir.

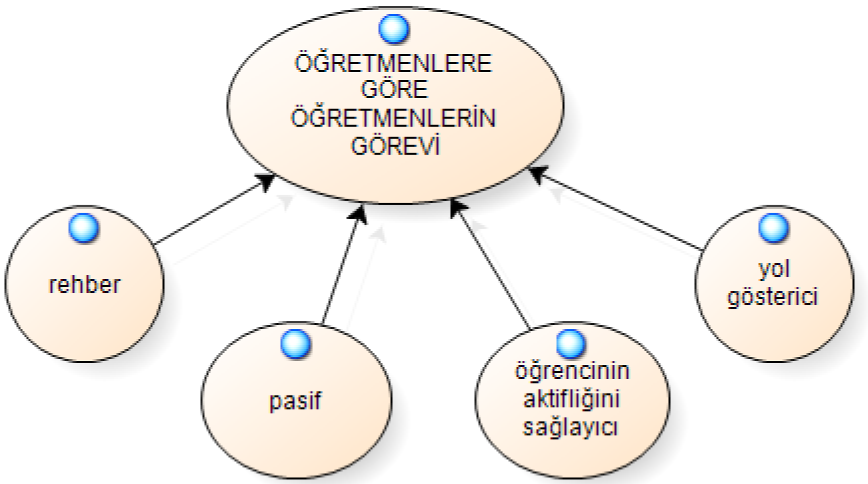


Şekil 5:Sınıf Öğretmeni Adaylarına Göre PTÖ'de Öğretmenin Görevi

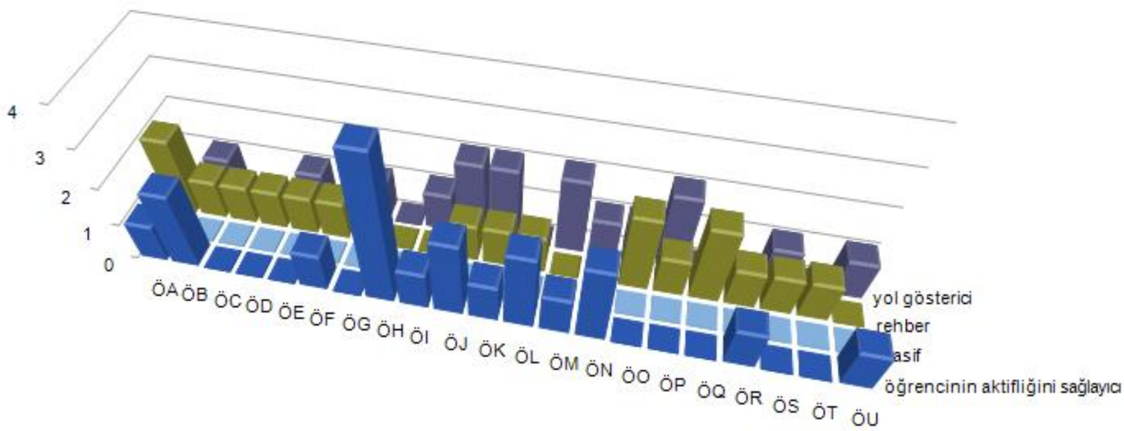


Grafik 5: Sınıf Öğretmeni Adaylarına Göre PTÖ'de Öğretmenin Görevi

Sınıf öğretmeni adaylarına sorulan "Proje tabanlı öğrenmede öğretmenin görevi nedir?" sorusuna verilen cevaplar Şekil 5'de görüldüğü gibi " öğrencinin aktifliğini sağlayıcı,yol gösterici,pasif ve rehber" olduğu görülmektedir.Grafik 5'e baktığımızda ise soruya verilen en fazla cevabın "yol gösterici" olduğu görülmektedir.En az verilen cevabın ise "pasif" olduğu görülmektedir.



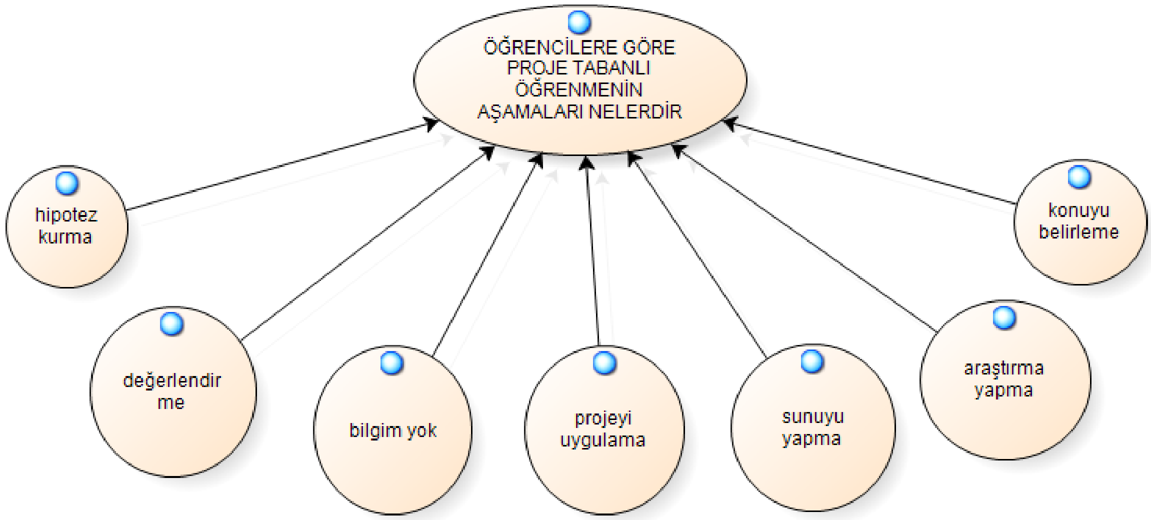
Şekil 6:Sınıf Öğretmenlerine Göre PTÖ'de Öğretmenin Görevi



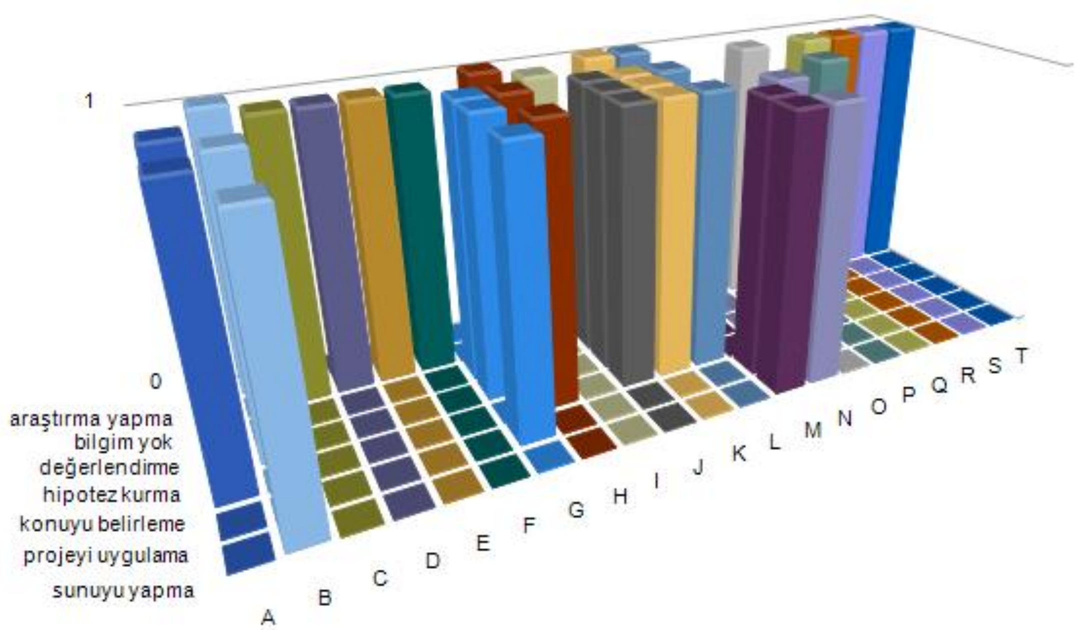
Grafik 6: Sınıf Öğretmenlerine Göre PTÖ De Öğretmenin Görevi

Sınıf öğretmenlerine sorulan "Proje tabanlı öğrenmede öğretmenin görevi nedir?" sorusuna verilen cevaplara bakıldığında Şekil 6'da görüldüğü gibi "yol gösterici,pasif,öğrencinin aktifliğini sağlayıcı ve pasif " olduğu görülmektedir.Grafik 6'ya bakıldığında da soruya verilen en fazla cevabın " öğrencinin aktifliğini sağlayıcı ve rehber " olduğu görülmektedir.Grafik 6 incelendiğinde ise dikkat çeken nokta sınıf öğretmenlerinin "pasif" cevabını vermemiş olmalarıdır.

Grafik 5 ve Grafik 6 birlikte incelendiğinde sınıf öğretmeni adaylarının soruya "pasif" cevabını verdikleri görülürken sınıf öğretmenlerinin ise "pasif" cevabını vermedikleri görülmektedir.En fazla verdikleri cevaplara bakıldığında ise sınıf öğretmeni adaylarının" yol gösterici" cevabını verdikleri,sınıf öğretmenlerinin ise "öğrencinin aktifliğini sağlayıcı ve rehber" cevabını verdikleri görülmektedir.

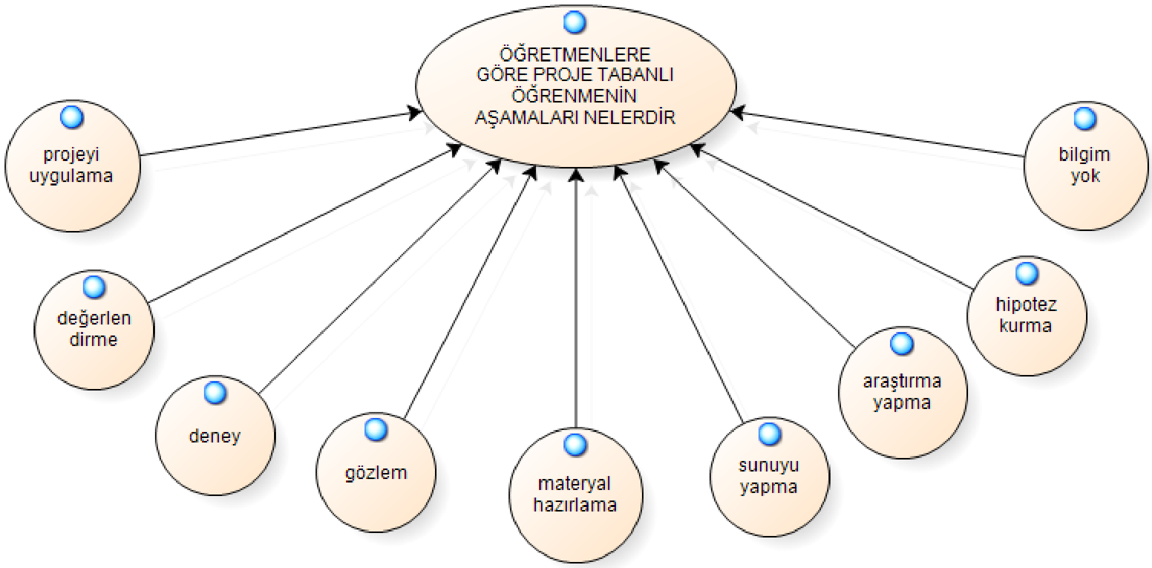


Şekil 7:Sınıf Öğretmeni Adaylarına Göre PTÖ'nün Aşamaları

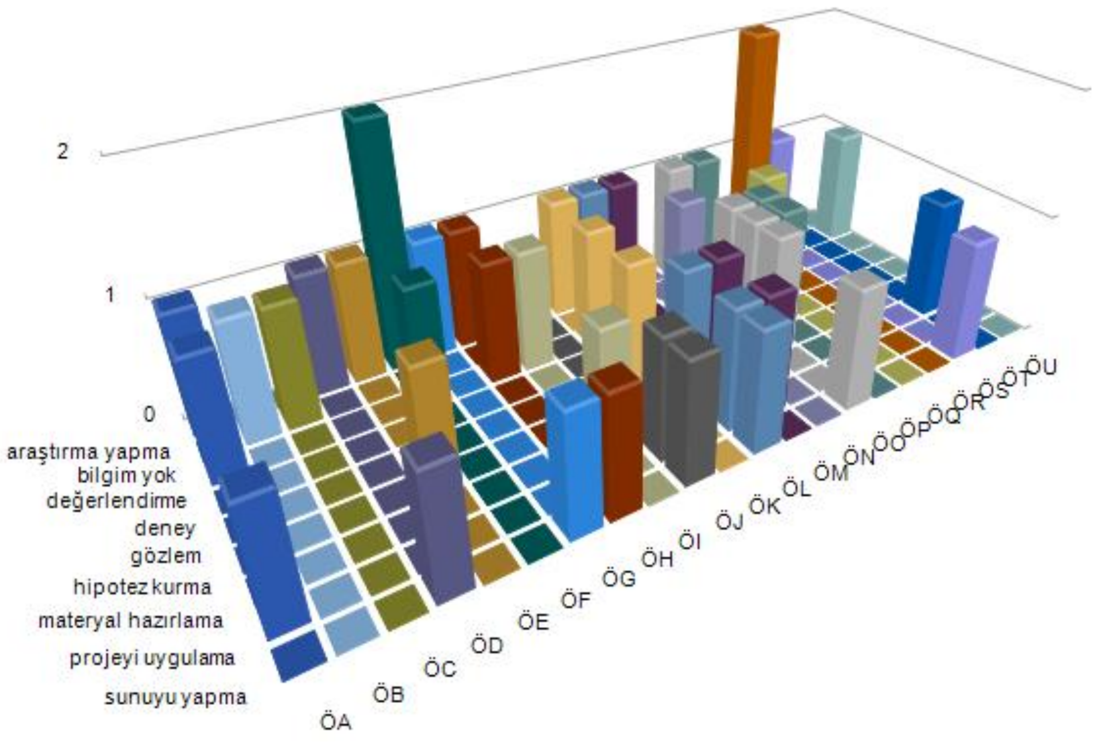


Grafik 7:Sınıf Öğretmeni Adaylarına Göre PTÖ'nün Aşamaları

Sınıf öğretmeni adaylarına sorulan "Proje temelli öğrenmenin aşamaları nelerdir?" sorusuna öğretmen adayları Şekil 7'de görüldüğü gibi "konuyu belirleme,araştırma yapma,hipotez kurma,projeyi uygulama,sunuyu yapma,değerlendirme" gibi cevaplar vermişlerdir.Ayrıca "Proje temelli öğrenmenin aşamaları nelerdir?" sorusuna sınıf öğretmeni adaylarından" bilgim yok" şeklinde cevap verenlerinde olduğu görülmektedir.Grafik 7'ye baktığımızda sınıf öğretmeni adaylarının verdiği cevaplara göre "bilgim yok" diyen kişi sayısı 10'dur.



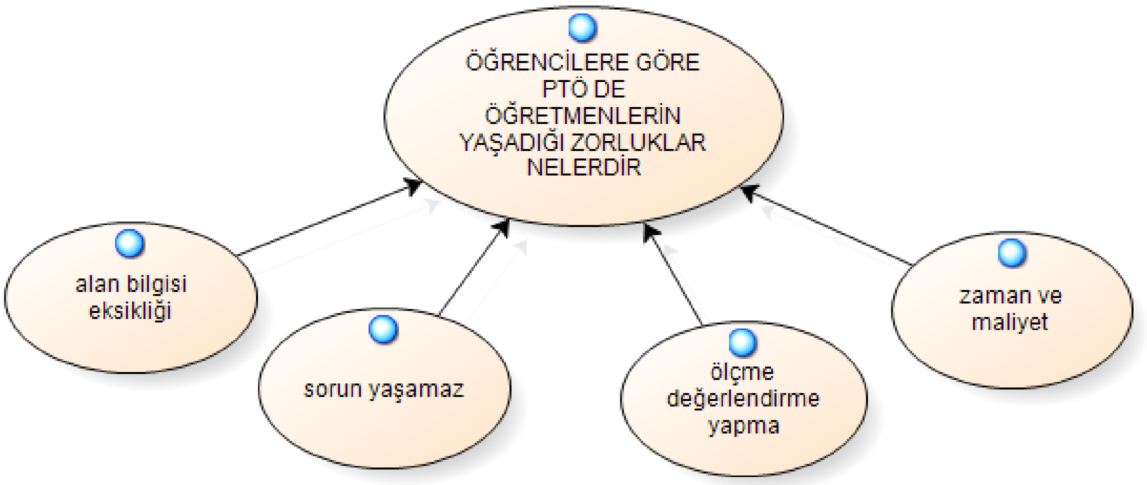
Şekil 8:Sınıf Öğretmenlerine Göre PTÖ Nün Aşamaları



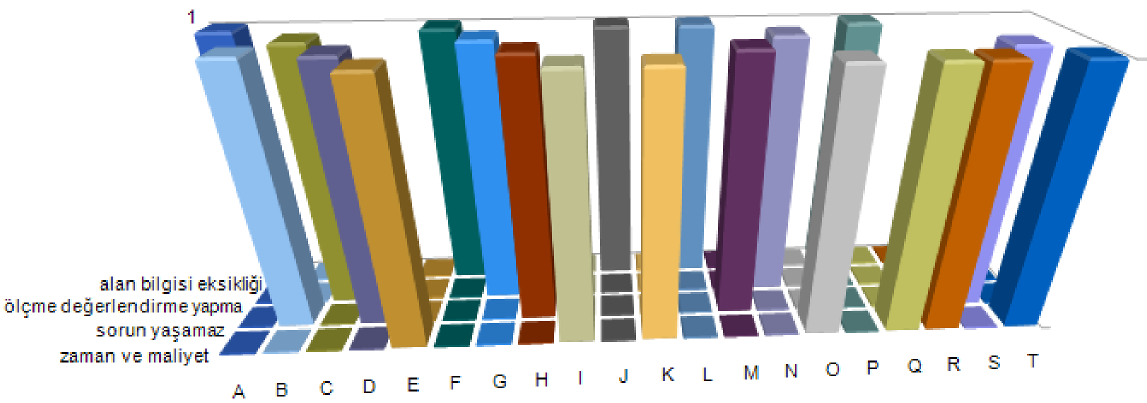
Grafik 8:Sınıf Öğretmenlerine Göre PTÖ'nün Aşamaları

Öğretmenlere sorulan "Proje temelli öğrenmenin aşamaları nelerdir?" sorusuna Şekil 8'e baktığımızda "deney,gözlem,araştırma yapma,hipotez kurma,materyal hazırlama,projeyi uygulama,sunuyu yapma ve değerlendirme" cevaplarının verildiği görülmektedir.Ayrıca sorulan soruya karşın " bilgim yok" şeklinde cevap veren öğretmenlerde bulunmaktadır.Grafik 8 incelendiğinde "bilgim yok" şeklinde cevap verenlerin sayısının 3 olduğu görülmektedir.Yine Grafik 8 incelendiğinde sorulan soruda öğretmenlerin çoğu proje temelli öğrenmenin aşamalarından biri olarak "araştırma yapma" yı söyledikleri görülmektedir.

Şekil 7 ve Şekil 8 incelendiğinde öğretmenlerin sınıf öğretmeni adaylarından farklı olarak "Proje temelli öğrenmenin aşamaları nelerdir?" sorusuna verdiği cevapların "deney,gözlem,materyal hazırlama" olduğu görülmektedir.Grafik 7 ve Grafik 8 incelendiğinde "bilgim yok" diyen kişilerin sayısına bakıldığında bu sayının sınıf öğretmeni adaylarında fazla olduğu görülmektedir.

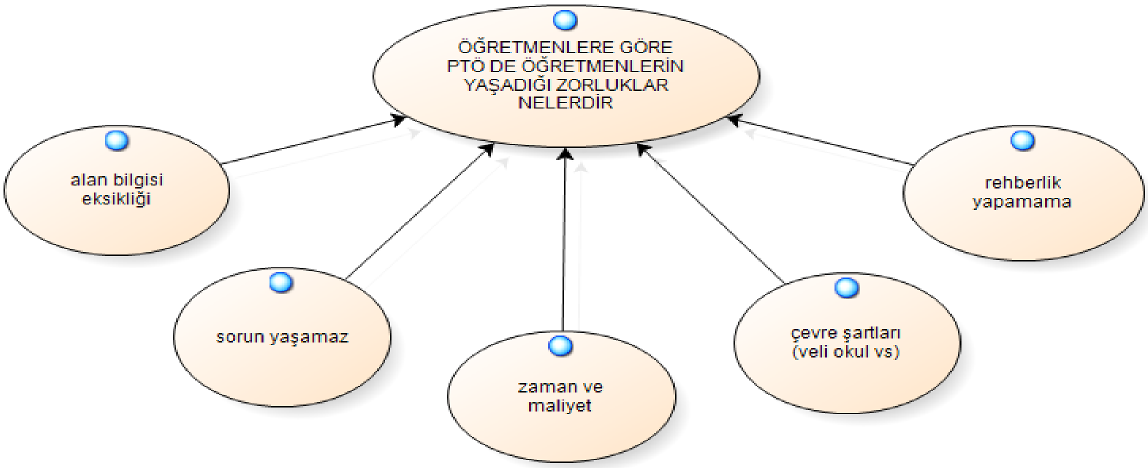


Tablo9:Sınıf Öğretmeni Adaylarına Göre PTÖ'de Öğretmenlerin Yaşadığı Zorluklar

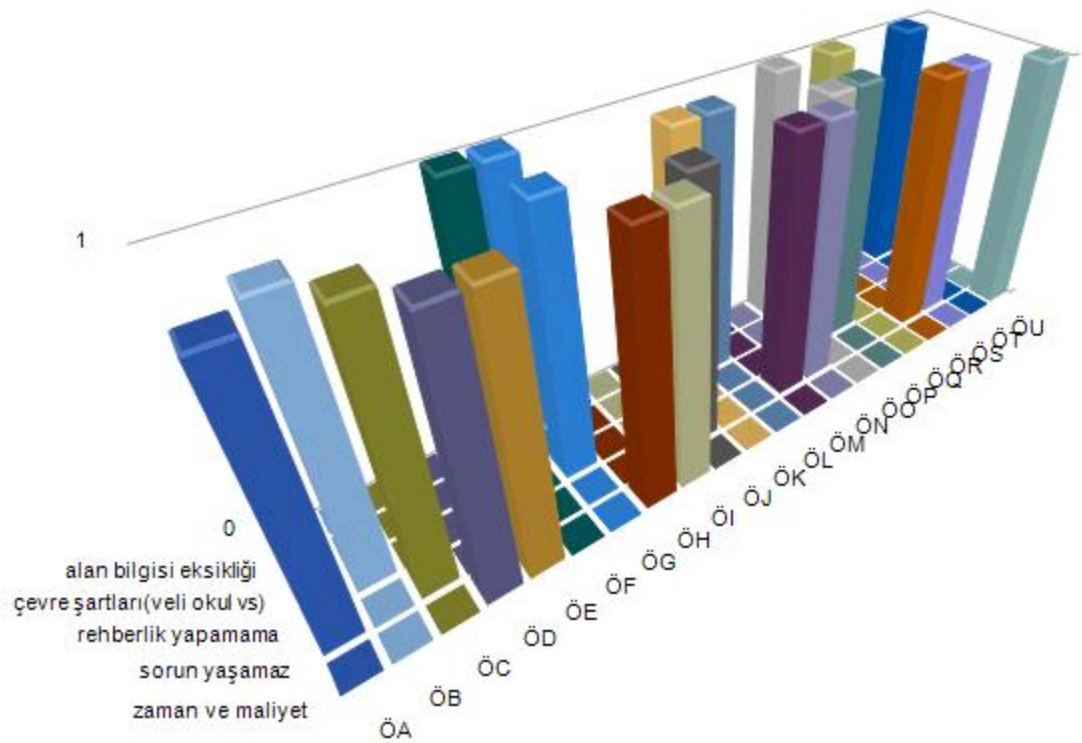


Grafik9: Sınıf Öğretmeni Adaylarına Göre PTÖ'de Öğretmenlerin Yaşadığı Zorluklar

Mülakatta sorulan "Proje tabanlı öğretimde öğretmenlerin yaşadığı zorluklar nelerdir?" sorusuna sınıf öğretmeni adaylarının verdiği cevaplar Şekil 9'da görüldüğü gibi "zaman ve maliyet,alan bilgisi eksikliği,ölçme değerlendirme yapma" şeklinde olduğu görülürken; "sorun yaşamaz" diyen öğretmen adaylarının olduğu da görülmektedir.Grafik 9 incelendiğinde sınıf öğretmeni adayları tarafından en çok söylenen öğretmenlerin yaşadığı zorluklar arasında "zaman ve maliyet"in yer aldığı görülmektedir.Yine grafiğe akıldığında "sorun yaşamaz diyen" 5 öğretmen adayının olduğu görülmektedir.



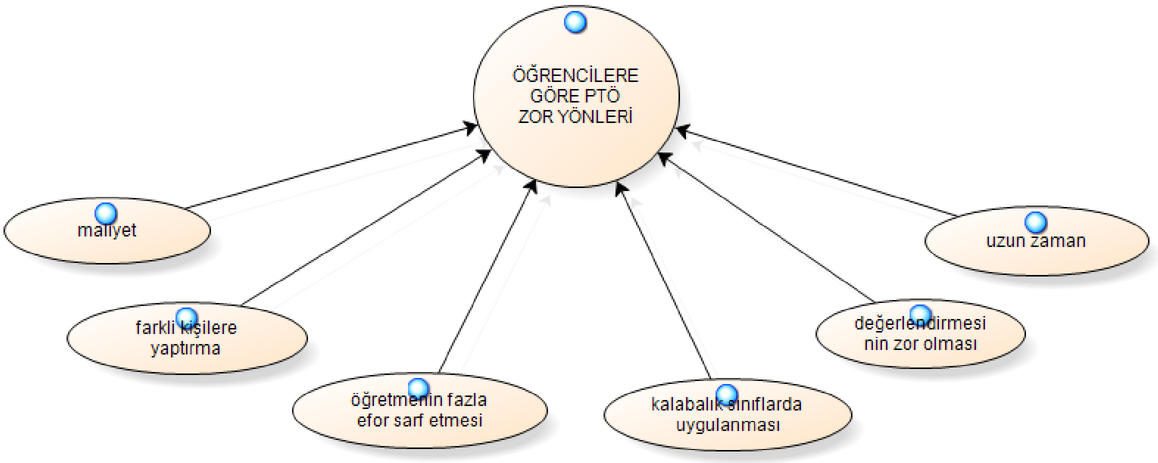
Şekil 10:Sınıf Öğretmenlerine Göre PTÖ'de Öğretmenlerin Yaşadığı Zorluklar



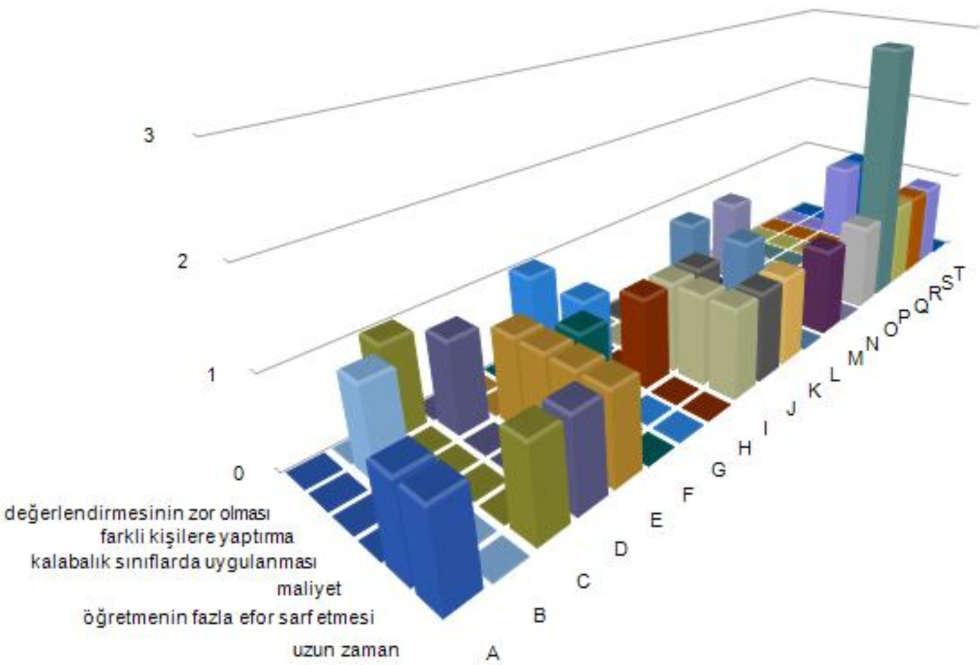
Grafik 10: Sınıf Öğretmenlerine Göre PTÖ'de Öğretmenlerin Yaşadığı Zorluklar

Sınıf öğretmenlerine sorulan "Proje tabanlı öğretimde öğretmenlerin yaşadığı zorluklar nelerdir?" sorusuna öğretmenlerin verdiği cevaplar Şekil 10'da görüldüğü gibi "zaman ve maliyet,alan bilgisi esikliği,rehberlik yapamama ve çevre şartları(veli,okul vs.)" olduğu görülmektedir.Ayrıca sorulmuş olan soruya "sorun yaşamaz" diyen öğretmen adaylarının da olduğu görülmektedir.Grafik 10 incelendiğinde "sorun yaşamaz" diyen sınıf öğretmenlerinin sayıca çok olduğu görülmektedir.

Şekil 9 ve Şekil 10 incelendiğinde sınıf öğretmenlerinin sınıf öğretmeni adaylarına göre verdiği cevaplar arasında "çevre şartları(veli,okul vs) bulunduğu görülmektedir.

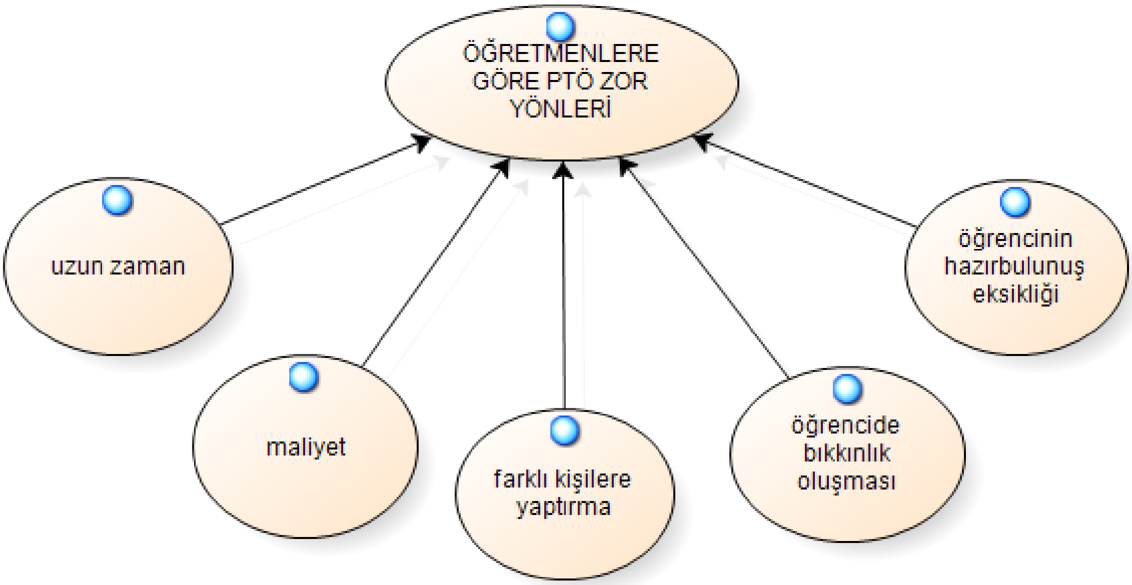


Şekil 11:Sınıf Öğretmeni Adaylarına Göre PTÖ'nün Zor Olmasının Nedenleri

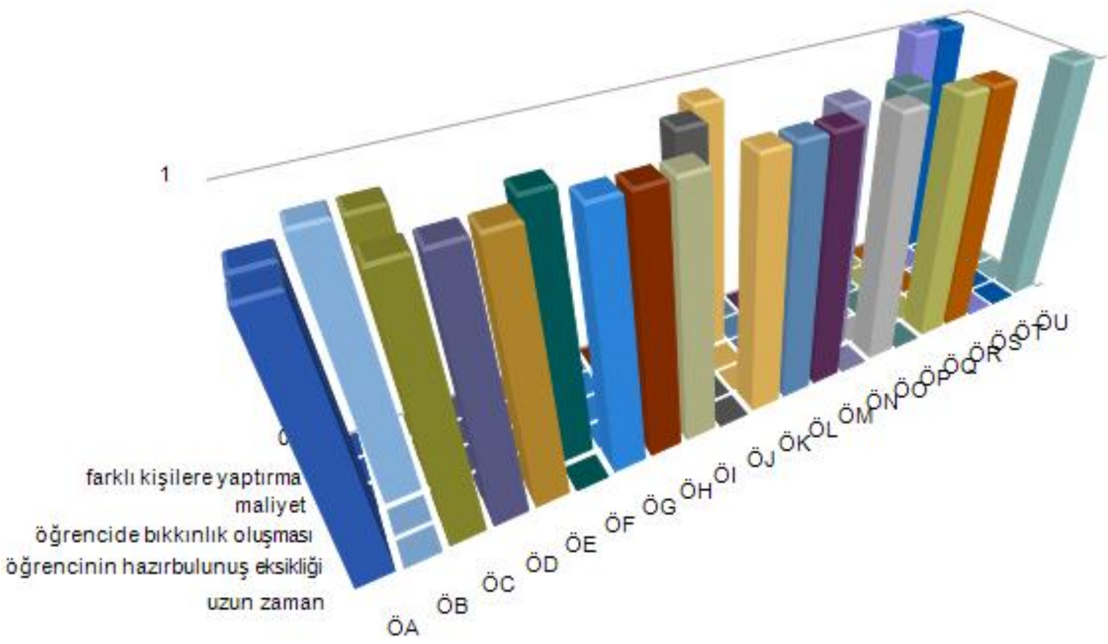


Grafik 11: Sınıf Öğretmeni Adaylarına Göre PTÖ'nün Zor Olmasının Nedenleri

Öğretmen adaylarına yönlendirilen "Proje tabanlı öğrenmenin zor olmasının nedenleri nelerdir?" sorusuna öğretmen adaylarının vermiş oldukları cevaplar Şekil 11'de görüldüğü gibi "uzun zaman,öğretmenin fazla efor sarf etmesi,maliyet,farklı kişilere yaptırma,değerlendirilmesinin zor olduğu ve kalabalık sınıflarda uygulanması" olduğu görülmektedir.Grafik 11 incelendiğinde ise öğretmen adaylarının "proje tabanlı öğrenmenin zor olmasının nedenleri nelerdir?" sorusuna saydıkları nedenler arasından "uzun zaman" nedeninin daha fazla söylendiği görülmektedir.



Tablo 12:Sınıf Öğretmenlerine Göre PTÖ'nün Zorlukları



Grafik 12: Sınıf Öğretmenlerine Göre PTÖ'nün Zorlukları

Öğretmenlere yönlendirilen "Proje tabanlı öğrenmenin zor olmasının nedenleri nelerdir?" sorusuna öğretmenlerin vermiş oldukları cevaplar Şekil 12'de görüldüğü gibi "farklı kişilere yaptırma,öğrencide bıkkınlık oluşması,uzun zaman,maliyet ve öğrencinin hazır bulunuş eksikliği" olduğu görülmektedir.Grafik 12 incelendiğinde de öğretmen adaylarının "proje tabanlı öğrenmenin zor olmasının nedenleri nelerdir?" sorusuna saydıkları nedenler arasından "uzun zaman" nedeninin daha fazla söylendiği görülmektedir.

Şekil 11 ve Şekil 12 incelendiğinde öğretmen adaylarının,öğretmenlerin belirttiği nedenlerden farklı olarak "kalabalık sınıflarda uygulanması ve öğretmenin fazla efor sarf etmesi" nedenleri bulunurken; öğretmenlerin belirttiği nedenler arasında olan "öğrencinin hazır bulunuş eksikliği" nedeni öğretmen adaylarına göre farklılık göstermektedir.Grafik11 ve Grafik 12'yi incelediğimiz zaman ise "uzun zaman" nedeni her iki grupta da diğer nedenlere göre daha fazla söylendiği görülmektedir.

TARTIŞMA

Proje tabanlı öğrenme, öğrenciyi merkeze alan bir öğrenme yaklaşımıdır. Batıda uzun yıllardan bu yana uygulanmakta olan bu yaklaşım, disiplinler arası çalışmayı gerektirdiği için fen ve matematik kavramlarının bütünleştirilmesine olanak sağlar (Lewis ve ark., 2002). Bu da, okulda öğrenilenlerle günlük yaşam arasında bağlantı kurulabilmesini kolaylaştırır. Öğrenciler, çalıştıkları bir projeyi başarılı bir şekilde sonlandırıp bir ürün ortaya koyarlar. Bu durum da, öğrenmenin özünü teşkil eder (Bickel, 1994).

Proje konularının öğrencilerin merakları ve ilgileri sonucu ortaya çıkması ve aynı zamanda dersin amaçlarına uygun olması, proje tabanlı öğrenme yaklaşımının etkililiğini artıracaktır. Öğretmenlerin, öğrencilerin ilgilerini ve yeteneklerini tanıması, onlara seçenekler sunması ve öğrencilerini bilimsel araştırma yapmaya teşvik etmesi önemlidir.

Proje tabanlı öğrenmenin gerçekleştirilebilmesi için zaman kavramının iyi ayarlanması gerekmektedir.Zaman projeye başlamadan önce öğretmenler ve öğrenciler tarafından planlanmalı ve ortaya bir iş takvimi konulmalıdır.Zaman mevzu hem öğretmenler hem de öğrenciler tarafından önem arz eden bir husustur.Zamanın gereksiz,plansız bir şekilde kullanılması sonucu öğretmenler işlemesi gereken konuları işleyememekte,öğrencilerde öğrenmesi gerekli olan konularda geride kalmaktadırlar.

Yine bu yaklaşımda karşılaşılabilecek olan sorunlar arasında öğrenci ve öğretmenin rollerindeki değişimler gelmektedir.Öğretmen klasik görünümünden sıyrılarak öğreten konumundan,öğrencileriyle birlikte öğrenen,onlara yol gösteren öğrenen rolünü üstlendiği görülmektedir.Öğrenenler ise öğretmenlerinden bir dersi dinleyerek not eden öğrenciler yerine,problemi araştıran,onların çözümü için hipotezler üreten ve bir ürün ortaya koyan araştırmacı rolünü üstlenmektedir(Demirel,2007).

ÖNERİLER

Bu araştırmadan elde edilen sonuçlara dayanılarak gerçekleştirilen öneriler aşağıda yer almaktadır:

- Öğretmenler, proje tabanlı öğrenme yaklaşımını uygularken genel kuralların yanı sıra konu, öğrenci, kendi niteliği ve çevresel koşulları dikkate alarak genel planlamasını yapmalıdır.
- Proje tabanlı öğrenme yaklaşımını uygulayan öğretmenler, öğrencilere her bir adımın önemini süreç başlamadan ayrıntılı biçimde açıklamalı, nasıl yapacakları konusunda öğrencileri bilgilendirmeli ve bu konuda onlara rehber olup,onları güdülemelidir.
- Öğretmen adaylarına üniversite eğitimlerinde yani Yükseköğretimde proje tabanlı öğrenme yaklaşımı detaylı şekilde anlatılıp uygulamaları yaptırılmalıdır.
- Öğretmenlerin proje tabanlı öğrenme yaklaşımını iyi anlayıp sınıflarında uygulamaları Milli Eğitim Bakanlığı tarafından tavsiye edilip,bu noktada öğretmenlerin kendilerini geliştirebilmeleri adına hizmet içi eğitimler,çalıştaylar vb. programlar düzenlenmelidir.
- Proje tabanlı öğrenme yaklaşımında gerçekleştirilecek olan eğitimlerde öğrenci ve öğretmenler için yaklaşımla ilgili yeterli alt yapı sağlanmalıdır.
- Proje tabanlı öğrenmenin hem öğretmen adayları hem öğretmenler hem de öğrenciler tarafından zor algılanmasının sebepleri belirlenerek bu sebepleri yok edebilmek adına neler yapılıp yapılamayacağı eğitimciler tarafından tartışılmalıdır.
- Ülkemizde ve diğer ülkelerde uygulanan proje tabanlı öğretim karşılaştırmalı olarak incelenmeli ve gerekli katkılar sağlanmalıdır.
- Okullarda uygulanacak eğitim programları hazırlanırken öğrencinin aktifliğini sağlayıcı,yaparak yaşayarak öğrenmesini sağlayan proje tabanlı öğrenme yaklaşımına oldukça yer verilmelidir.

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SUSTAINABLE DEVELOPMENT IN MEDITERRANEAN SMALL ISLAND DEVELOPING COUNTRIES: CASE OF CYPRUS

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ABSTRACT: This research study investigates and higlights the developments of education sector and developments that exposed due to education sector's sustainable impacts on development of country's economy. Additionally, the impact of education and development of this sectors' leaded variety of changes in small island developing states. North Cyprus, which categorized as one of the SIDS country, is investigated in this research. Since the education sector becomes a part of the global market, positive and negative impacts of education sector and this sector's impacts are discussed in details. The impact of variety of fluctatiaons in national and international level on educational institutions is investigated qunatitaviely that has singificant effect on sustainable impact of education sector in North Cyprus to highlight impact of education in country's development.

Key words: education, economy, education sector, sustainable development, economic development, small island developing states, North Cyprus**.**

GELİŞMEKTE OLAN AKDENİZ ADA ÜLKELERİNDE SÜRDÜRÜLEBİLİR KALKINMA: KIBRIS ÖRNEĞİ

ÖZET: Bu araştırma, eğitim sektörünün sürdürülebilir kalkınmadaki rolüne ışık tutarken, sürdürülebilir kalkınmanın eğitim alanındaki etkisine ve eğitim sektöründe oluşan gelişmelere değinerek, gelişmekte olan bir ada ülkesi olan Kuzey Kıbrıs'ın mevcut eğitim sisteminde oluşan gelişmelerin sonucunda oluşan sürdürülebilir kalkınma çalışmaları hakkında detaylı bilgiler vermektedir. Çalışmada ortaya çıkarılan bilgiler, sektörel ve ekonomik durum dağılımlarına yönelik bulgular temelinde oluşturulmuş, eğitim sektörünün uluslararası boyut kazanması ile gelişmekte olan ülkelerin eğitim politikalarına sürdürülebilirlik konusunu da ekleyerek yön verdikleri ortaya çıkmıştır. Kuzey Kıbrıs sürdürülebilir ekonomi politikaları arasında bulunan eğitim sektörünün ülkeye olan etkisi, çalışmada nicel olarak araştırılmış, yükseköğretim kurumlarının yerel ve ulusal alanlardaki ekonomik dalgalanmalardan ve meydana gelen çeşitli sosyo-ekonomik bulgulardan yararlanarak, eğitim sektörünün kalkınmadaki etkisi nicel olarak sayısal veriler ışığında incelenmiştir.

Anahtar Kelimeler; eğitim, ekonomi, eğitim sektörü, sürdürülebilir kalkınma, ekonomik gelişim, Kuzey Kıbrıs

GİRİŞ

Günümüzde dünya üzerinde hızlı küreselleşme ile rekabetçilik ortamı hızlı bir artış göstermektedir. Gelişmiş ve gelişmekte olan birçok ülke, kendi kaderlerini belirlemek adına, ekonomik, sosyal ve çevresel kalkınma planları oluşturmaktadır. Dünyanın içinde bulunduğu küresel sorunların sadece ekonomik alanlarda olmadığı öngörülmektedir. Küreselleşen dünyanın karşılaştığı sorunlara çözüm bulmak için sadece ekonomik alanlara değil birçok alan incelenmektedir. Bu nedenle, sorunlara sürdürülebilir çözümler aranmaktadır. Gerekli alanlarda öngörülen kalkınma politikaları sürdürülebilirlik ile yürütülmektedir. Oluşturulan kalkınma planları devletlerin sürdürülebilir kalkınma politikaları ile yürütülmektedir. Eğitimin gençler üzerinde yeniden şekillenmesinin en önemli unsur olduğu öngörülmektedir. Gelişmiş ve gelişmekte olan ülkeler sürdürülebilir kalkınma politikalarını eğitim yönünde değiştirmektedir. Sürdürülebilir kalkınma ile eğitim alanındaki değişimler ve yapılan yenilikler, ülkenin ekonomik sektörünü de dolaylı olarak etkilemektedir. Sürdürülebilir kalkınma için eğitim genel olarak, ülkeler adına yeni vizyon geliştirme, dünya üzerinde bulunan eğitsel kavramların keşfedilip uygulanması, eğitim alanında yeni metotların ve keşif edilen metotlar yardımıyla, yeni araçların geliştirilmesi için gerekli düşünce farklılığı, sorgulama yeteneği, durumlar karşısında farkındalık yaratma gibi imkanların sağlanabilirliği görülmektedir.

1.Sürdürülebilir Kalkınma

Çalışmanın bu kısmında sürdürülebilir kalkınma ve sürdürülebilir kalkınmanın gelişiminden bahsedilmektedir. Sürdürülebilirlik kavramı, dünya üzerinde oldukça fazla gündeme gelmektedir. Enerji, Eğitim ve Ekonomi gibi alanlarda dünya genelinde sıkça kullanılmaktadır. Sürdürülebilirliğin hemen hemen her alanda kurgulanması günümüzde vurgulanmaktadır.

Kalkınma;
Kalkınma en temel anlamıyla bir konu veya alanda gelişme / ilerleme, ulusal ekonominin bütüncül olarak ele alınarak istenilen düzeye ulaşmasıdır. Kalkınmanın az gelişmiş ülkelerde ortaya çıkan büyük ölçülerde beşeri acıların azaltılması ve maddi refahın artırılmaya yönelik potansiyelin harekete geçirilmesi [1] açıklaması ile kalkınmanın genel tanımı yapılabilmektedir.

Kalkınmayı sağlayan unsurlar vardır. Bu unsurlar, kalkınma hızını ve düzeyini değiştirmesinde rol oynamaktadır. Yapılan araştırmalar doğrultusunda, kalkınmanın sağlanabilmesi için çeşitli unsurlar şunlardır; sermaye, hammadde, teknoloji, yetişmiş insan gücü, istikrarlı yönetim, uygun sosyal ve kültürel ortam [2] gibi birçok etken, kalkınmayı sağlayanlar arasında yer almaktadır.

Sürdürülebilir kalkınma;
Bugünün ihtiyaçlarını gelecek nesillere ödün vermeden, kendi ihtiyaçlarını karşılaması durumudur [3] şeklinde tanımı yapılmaktadır. Ayrıca yapılan açıklamalara göre sürdürülebilir kalkınmanın beraber düşünülmesi gereken ‘‘üç temel direği’’ bulunur. Bunlar; toplum, ekonomi ve çevredir. Koşullar ne olursa olsun ana fikirler değişmemektedir. İnsanlar, doğal yaşam alanları ve ekonomik sistemler ile birbirlerine bağlıdır [4], şeklinde açıklanmaktadır. Sürdürülebilir kalkınma için gerekli koşullar öngörülmektedir. Dünya genelinde kabul görmüş, bazı durum ve koşular aşağıda yer almaktadır [5];

Kritik Hedefler;
- Büyümeyi canlandırmak.
- Büyüme kalitesini geliştirme.
- Kaynak tabanın artması ve korunması.
- Teknoloji ve risk yönetimi.
- Karar verme, çevre ve ekonomiyi birleştirmek.

Sürdürülebilir Kalkınmanın Getirileri;
- Uyumsuz gelişmelerden kaynaklanan gerilimlere çözüm sağlayabilecek bir ekonomik sistem.
- Yükümlülüklerle gelişen bir üretim sistemi için ekolojik tabanın korunması.
- Ticaret ve Finans için sürdürülebilir modellerin teşvikini sağlayan bir teknolojik sistem.
- Ticaret ve Finans için sürdürülebilir modellerin teşvikini sağlayan uluslararası bir sistem.
- Esnek, düzeltilebilir ve kendi kapasitesine sahip bir idari sistem.

Çevre ve Kalkınma Dünya Komisyonu (WCED) tarafından açıklanmaktadır.

1.1 Sürdürülebilir Kalkınmanın Boyutları;

Sürdürülebilir kalkınmanın uygulanması durumunda bazı boyutları bulunmaktadır. Boyutlar, dolaylı olarak birbirleri ile iletişim halindedir. Bunlar; ekonomik, sosyal ve çevresel boyutlar şeklinde değerlendirilebilmektedir. Aşağıda sürdürülebilir kalkınmanın boyutları hakkında bilgiler verilmektedir[6];

Ekonomik Boyut;
Kullanımı kısıtlı olan kaynakların kullanımı ile ilgilidir. Ekonomik olarak sürdürülebilir bir sistem, mal ve hizmetlerin devamlılık esaslarına göre üretilebilen, tarımsal ve endüstriyel üretime zarar veren sektörel dengesizliklerden sakınan, iç ve dış borçlarını yönetebilir düzeyde sürdürülebilirliğini sağlayan sistemdir.

Sosyal Boyut;
Daha çok insan odaklıdır. Sosyal nitelikte sürdürülebilirlik, eğitim ve sağlık gibi sosyal hizmetlerin yeterliliği, eşit dağılımı, cinsiyet eşitliği, politik sorumluluk ve katılımı sağlayabilen sistemdir.

Çevresel Boyut;
Ekosistemlerin değişen koşullarına adapte olmasının sağlanması amaçlanmıştır. Çevresel düzeyde sürdürülebilirlik, kaynak temelini sabit tutarak, yenilenebilir kaynak sistemlerinin ya da çevresel yatırım fonksiyonlarının istismarından kaçmalı ve yenilenemeyen kaynaklardan yalnızca yatırımlarla yerine yeterince konulmuş olanları tüketmektir.

Sürdürülebilir kalkınmanın sağlanabilmesi için stratejiler geliştirilmiştir. Stratejik gelişmeler, sürdürülebilir kalkınmanın sürekliliğini sağlamaktadır. Yapılan açıklamalara göre, 2013 Dünya Ekonomik ve Sosyal Araştırma Merkezi, sürdürülebilir kalkınmanın 2015 yılı sonrası için yerel, ulusal ve küresel politikalarda yapılan gerekli değişiklikler açıklamıştır. Özellikle, gelişmiş ülkelerde sürdürülemez tüketim ve üretim şekilleri, bunların çevresel etkileri, gelişen ve gelişmekte olan ekonomiler için ihtiyaçların çevre dostu olması istenmiştir. Sürdürülebilir politikası kararına sahip birçok ülkede bölgesel ve genellikle küresel yankıları, şu anda popüler hale gelmiştir. Yerel ve ulusal stratejiler arasında uyum çok önemlidir [7] açıklamasında bulunulmuştur.

Bazı sürdürülebilirlik ilkeleri aşağıda verilmiştir [8];

- Doğanın korunması.
- Uzun vadeli düşünme
- Yaşadığımız sistemi anlama
- Sınırların tanınması
- Adil uygulama
- Yaratıcılığı kucaklama

Sürdürülebilir kalkınma politikaları ile gelişmekte olan küçük ada ülkeleri birçok alanda, büyüme ve gelişme göstermektedir. Yakın tarihli açıklamalara göre, Gelişmekte olan küçük ada ülkeleri, bazı sosyal kalkınma hedeflerine ulaşması yönünde birçok alanda önemli ilerleme kaydetmişlerdir. Bunlar, su ve sanitasyon, sağlık, eğitim, cinsiyet dengesi gibi konulardır. Bunlarla birlikte, birçok gelişmekte olan küçük ada ülkelerinde mali kriz öncesinde deneyimli ve istikrarlı bir ekonomik büyüme oranı geliştirirken, çoğu ülke için yoksulluk sistematik olarak sorun halinde kalmaya devam etmiştir [9].

Sürdürülebilir kalkınma ile gelişmekte olan küçük ada ülkelerinin sağladıkları gelişmeler[9];

- Gelişmekte olan küçük ada ülkelerinin çocuk ölümlerini azaltmada önemli ilerlemeler kaydetmektedir;

Haiti ve Komorlar yarı yarıya çocuk ölümlerini azaltmıştır. Kendi ölüm oranları yine de diğer ülkelere göre yüksek kalmaktadır. %76 ve %66 arasındadır. Gine-Bissau, Sao Tome ve Principe ve Doğu Tome 2007 yılına oranla, diğer küçük ada ülkelerinde ölümlerin yüksek olduğu görülmektedir.

- Bilgi ve iletişim teknolojilerinin birçok alanda gelişmesine önemli bir rol oynamaktadır;

Gelişmekte olan küçük ada ülkelerinin hükümetler, özel sektörler, gelişmiş kurumsal kapasitesi ekonomik çeşitlendirme ve yenilikçi gelişim için fırsatlar açan İnterneti bağlar hale geldiler. Özellikle, Karayipler ve Güney Çin Denizi bölgelerinde pek çok ülkede, veri girişi, manipülasyon, bilgi yönetimi, çağrı merkezleri ve finansal hizmetler dahil olmak üzere bilgi tabanlı hizmet endüstrilerini geliştirmiştir. Ülkeler, eğitim, ticaret, sağlık ve kültürel gelişimi için vatandaşların bilgi ve iletişim teknolojilerini kullanmak için, e-devlet, e-öğrenme gibi sistemlerini geliştirmişlerdir.

- Gençler arası işsizlik birçok ülkede sorun olmaya devam ederken, genel olarak gelişmeler iyi yönde olmaktadır.

Gençlerin toplumla entegrasyonu eğitim sistemi ile iş gücü piyasasındaki bağlantı eksikliği sık sık meydana gelmektedir. Gençlerde işsizlik oranı %41'e ulaşmıştır. İşsizlik gelişmekte olan küçük ada ülkeleri ve Saint Luca, Karayipler gibi ülkelerin önemli konusu olmuştur.

2. Sürdürülebilir Kalkınma için Eğitim;

Hızla gelişen dünya da sürdürülebilir kalkınma, gelişmiş ve gelişmekte olan ülkeler için önemlidir. Sürdürülebilir kalkınmanın gelişimi için eğitim alanındaki yatarımlar büyük önem taşımaktadır. Sürdürülebilir kalkınmanın uzun süre sürdürülür hale gelebilmesi için eğitim alanında çeşitli politikalar uygulanmaktadır. Çalışmanın bu kısmında sürdürülebilir kalkınmanın eğitim için önemine değinilmektedir.

Sürdürülebilir kalkınma için eğitimin amacı, sürdürülebilir bir gelecek ve her yaştan insanı kucaklamak istemekte ayrıca sorumluluk yükümlülüğünü kapsamaktadır, eğitimde zevkli yeni bir vizyon yaratmayı kapsayan dinamik bir kavramdır[10]. Sürdürülebilir kalkınmanın eğitim için rolleri bulunmaktadır. Bunlar, koruyucu çevre yönetimi, yaşam kalitesini artırma, daha iyi yarınlar için yaratıcılık ve yenilikçiliği geliştirme [11], gibi başlıklar halinde sıralanabilmektedir.

Dünya Zirvesi, sürdürülebilir kalkınma için eğitim alanında çeşitli çalışmalar ve faaliyetlerde bulunmuştur. Bu faaliyet ve çalışmaların kapsamı, uluslararası eğitim girişimleri, bilgisizliğin azaltılması, herkes için eğitimin sağlanabilmesi, eğitime odaklanmak şeklinde sıralanabilir. Sürdürülebilir Kalkınma Eğitimi, eğitim amacıyla ve içerik aracılıyla temel ilke ve değerlerini belirtmiştir[12]. Ayrıca, eğitim düzeyinin yükselmesi ile bilimsel araştırmalar artmakta, birçok az gelişmiş ülkede nitelikli insan gücü darboğazı aşılmakta ve bilgi stoku yükselmektedir[13].

Sürdürülebilir kalkınma eğitimi, öncelikle her öğrencinin düzeyine uygun olmalıdır. Uygun ortamlar, hedefler doğru belirlenmeli, sürdürülebilir ilerleme gözlemlenebilmelidir. Okul öncesi okullarında, sürdürülebilirliğin öğrenilmesi adına temel kavramlar hakkında hizmet verilmelidir. Temel değerler, tutum ve bilgi gibi konular üzerinde durulmalıdır. Ayrıca ilk ve ortaokullar düzeyinde, sürdürülebilir kalkınma eğitimi, bilinçlendirme, yeterliliklerin geliştirilmesi, öğrenim hayatından sonraki aşamaların üzerinde dikkat çekilmelidir [14].

Sürdürülebilir Kalkınma Eğitiminin yeterli ve etkili şekilde verilebilmesi için bazı sorumlulukları içermektedir. Öncelikle, eğitimi verecek olan okutman ve öğretmenlerin yetiştirilmesi için kısa vadeli kurumların açılması ve hizmete geçmesi gerekmektedir. Yapılan araştırmalara göre, sürdürülebilir kalkınma eğitimi yapılması gereken bazı işlevler bulunmaktadır. Bunlar [15];

- Eğitim kurumlarının sürdürülebilir kalkınma felsefesini etkin bir şekilde öğretim programlarına yansıtılmalıdır.
- Ulusal ve yerel düzeyde iklim, ekonomi ve toplumsal konulara dikkat eden politikalar geliştirilmelidir.
- Sistematik ve eleştirel öğrenmenin yanında yaratıcı düşünme, hayat boyu öğrenme desteklenmelidir.

Sürdürülebilir kalkınma eğitimi için uygulanan çeşitli planların olduğu öngörülmektedir. Yapılan açıklamalar neticesinde, bu eğitim için uygulanan uygulamalar, öğrencilerin öğrendikleri ile ilgili oldukları alana odaklanıp, yeteneklerini geliştirip, onları çalıştırmaktır [16].

2.1 Sürdürülebilir Kalkınmanın Eğitimdeki Rolü;

Sürdürülebilir kalkınmanın eğitim alanındaki yerinin sağlanabilmesi için genel olarak kabul edilen bazı rolleri bulunmaktadır. Çalışmanın bu bölümü kabul edilen rollerin, eğitim alanındaki şekillenmeleri incelenmektedir. Basit bir şekilde sıralamak gerekirse; Temel Eğitim, Sürdürülebilir Kalkınma Eğitimi, Kamuda Farkındalık, isimleri ile nitelendirilebilmektedir.

2.1.1 Temel Eğitimi Geliştirmek;

Temel eğitim birçok ülke de 5, 8 ya da 12 yıl olmak koşulu ile hazırlanmıştır. Bir başka ifade ile temel eğitim, zorunlu eğitim olarak da adlandırılmaktadır.

Temel eğitimin sürdürülebilir bir hal ala bilmesi için temel eğitim yeniden yönlendirilmesi gerekmektedir. Yönlendirmelerin ve gerekli düzenlemelerin yapılması, bilgi ve becerilerin yorumlanması, düşünme becerilerin geliştirilmesi, toplumla karşı karşıya kalınan sorunların analiz edilebilmesi gibi birçok alanı kapsayacak şekilde genişletilmesi gerekmektedir [17].

2.1.2 Sürdürülebilir Kalkınmaya Yön Değiştiren Eğitim;

Yön değiştirilen eğitim, temel eğitimin içinde yer almaktadır. Sürdürülebilir kalkınmanın sağlanabilmesi için var olan temel eğitim statüsünün, gelişmeye açık halde yön değişmesi sağlanmıştır.

Eğitimde yeniden yön değiştirme terimi, sürdürülebilir kalkınma eğitimi için gerekli değişiklikleri anlatmak için her düzeyde yönetici ve eğitimcilere yardımcı olan güçlü bir terim halini almıştır. Eğitimin yeniden yönlendirme ile öğretim ve öğrenme bilgi, beceri, bakış açıları ve demokratik topluma katılma gibi sürdürülebilir gelişim, sürdürülebilir yaşam için insanlara rehberlik yapar ve motive etmektedir [17].

2.1.3 Kamu Alanlarında Farkındalığı Geliştirmek;

Sürdürülebilir Kalkınmanın eğitim sektöründe belirli kitlelere ulaşmasındaki engel, kamu alanlarında yaratılacak olan farkındalık ile geniş kitlelere ulaştırılması hedeflenmektedir. Bunun yanında toplumun hemen hemen her kesiminde bilinci bireyler yetiştirilmesi istenmektedir.

Sürdürülebilirlik, sürdürülebilir hedeflerin farkında olan bir toplumu gerektirir. Bilgiye ve becerilerine sahip bir toplum sürdürülebilir kalkınma hedeflerine ulaşmak için katkıda bulunur. Aydınlanmış politikalar ve hükümetlerin girişimlerinde, bilinçli toplum hükümetlerin sürdürülebilir kararnamelerini oylama yardımıyla, hükümetlere yardımcı olabilir. Kamusal alanlarda reklam ve medya ile farkındalık oluşturulabilir. İnsanlar medya okurluğu ve kurumsal reklamlar ile sürdürülebilirlik mesajlarını analiz edebilirler[17].

2.2 Sürdürülebilir Kalkınmanın Genel İlkeleri;

Sürdürülebilir kalkınma için eğitim, öğrenme yaşının ilk dönemlerinden başlanmalı, yükseköğretim kurumlarına kadar sürmelidir. Çocuklara erken yaşta kazandırılacak olan sürdürülebilir eğitim anlayışı ile hayat boyu devam eden eğitim ve mesleki alanlarda, sürdürülebilirlik statüsü kazandırılmak istenmektedir. Sürdürülebilir Kalkınma Eğitimi etkin bir durumda küresel sorunları ele almaktadır, aynı zamanda hem yerel hem de küresel sorumluluk duygusunu, geleceğe dönük eleştirisel düşünme ve geleneksel bilgilerin küresel karşılıklı bağımlılığının tanınmasını oluşturmaktadır. Sürdürülebilir kalkınma eğitimi, yaşam için refahı ve saygı kalitesini birleştiren yeni yaşam tarzları üzerinde doğa ve diğer insanları teşvik eden bir eğitim sistemidir [18].

Yapılan araştırmalar ile verilecek olan sürdürülebilir kalkınma eğitimlerin, kabul edilmiş ilkeleri vardır, bunlar [19];

Her seviyede öğrenme;

Yerel ve küresel birçok alanda sistematik ve eleştirisel düşünmenin, yaratıcılığın teşvik edilmesi sağlanmalıdır.

Eğitim erişimini artırma;

Kırsal ve Kentsel alanlarda eğitim eşitliliğinin sağlanması, eğitim kalitesinin yükseltilmesi, böylelikle bölgesel olarak kalkınmanın hızının artırılması sağlanabilir.

Çok taraflı iş birliği;

Eğitim, bilim, sağlık, ulaşım, ticaret, endüstriyel sektörlerin ulusal ve uluslararası boyut kazandırılarak, eğitim alanında uluslararası bakış açısını geliştirme sağlanabilir.

Aynı zamanda, sürdürülebilir kalkınma eğitimi, kaliteli eğitim sunmak ve öğrenmeyi teşvik etmek, insanın öğrenmeyle birlikte yaşamasını sağlamak, sürdürülebilir kalkınmasın tanınmasını sağlamak, kendini ve toplumu dönüştürmeyi öğrenmek gibi beş temel türü desteklemektedir [20].

UNESCO'nun Sürdürülebilir Kalkınma Eğitimi için benimsemiş olduğu 4 temel unsur bulunmaktadır. Bunlar;
- Kaliteli temel eğitimin erişimi ve yapılan iyileştirmelerin korunması,
- Mevcut eğitim programlarını yeniden yönlendirmek sürdürülebilirliği ele alması,
- Kamu alanlarında sürdürülebilirlik anlayışının artırılması,
- Eğitimlerin verimli şekilde sunulması, şeklinde açıklamada bulunmaktadır [21].

2.3 Sürdürülebilir Kalkınma Eğitimi ve Kıbrıs;

2008 yılında başlayan Kıbrıs Eğitim Reformu sonucunda, her okulun kendi sürdürülebilir Çevre Eğitim Politikasının hazırlanması ve bu aşamada ilköğretim kurumlarında çevre ve sürdürülebilir kalkınma sorunları anlatılmaya başlanmıştır. Kıbrıs eğitim sistemine ilk kez Milli Eğitim Müfredat programı ile tanınmıştır [22].

Eğitim reformunun ilk hedefi sürdürülebilir kalkınma eğitimini vermekle yükümlü olan öğretmen adaylarıdır. Kıbrıs, öğretmen adayları için Eğitim Reformları bünyesinde çeşitli programlar başlatmıştır.

Kıbrıs'ta hükümet öncülüğünde, eğitim sisteminde etkin bir sürdürülebilir kalkınma için eğitim planı sağlayan örgün ve yaygın olan eğitimi birleştirmeye çalışmıştır. Çevre eğitimi merkezlerinde toplum ağı kurulmuştur. Kıbrıs pedagoji enstitüsü olarak eğitim kurumları, yöntem ve yaklaşımları eğitimcilerle tartışmak için deneyimsel eğitim kursları finanse etmektedir[20].

Kıbrıs'ta Liderlik ve Özel konularda hizmet içi öğretmen ve yöneticilere eğitim kursları tanımaktadır. Kıbrıs Pedagoji Enstitüsü, yönetici ve liderlere aynı zamanda öğretmenlere sürdürülebilir kalkınma konusu için belirli konularda eğitim kursları tanımaktadır. Tüm eğitim düzeylerinden gelen lider ve yöneticilere sürdürülebilir okul oluşturma kapsamında 8 saatlik seminere katılmak için okul yönetimi sürdürülebilir programları desteklemektedir[20].

2.3.1 Sürdürülebilir Kalkınma için Öğretmen Eğitimi;

Sürdürülebilir kalkınma eğitimi için öğretmen eğitimi öncelik olarak öngörülmektedir. Öğretmen eğitiminde sürdürülebilir kalkınma eğitimi için gerekli olan programlar ve kurslar yürütülmektedir. Öncelikle, ulusal müfredatlarına son derece yenilikçi ve radikal, sürdürülebilir kalkınma konuları eklenmiştir.

Kıbrıs Pedagoji Enstitüsü olarak sunulan eğitim ve öğretim programları [22];

- Sürdürülebilir Okul
- Sürdürülebilir Kalkınma Eğitimi Stratejileri
- Sürdürülebilir Kalkınma Eğitimi'nin Dış Ortamlarda Kullanılması için Çeşitli Anahtar Bilgiler
- Sürdürülebilir Kalkınma Eğitimi için Yeni Teknolojilerin Kullanılması Konusunda Eğitim
- Öğretmen Grupları Tarafından Üretilen Eğitim Materyallerinin, Kullanımı ve Uygulanması

Verilen eğitim programları ile Kıbrıs'ta sürdürülebilir kalkınma eğitiminin temelleri atılmaya başlanmaktadır.

3. Sürdürülebilir Kalkınma için Eğitimin Ekonomiye Katkısı;

Eğitim alanın, ekonomik sektöre katkısı bulunmaktadır. Fakat bunu katkının sürdürülebilir hale gelebilmesi için çeşitli çalışmalar yapılmaktadır. Sürdürülebilir Eğitim anlayışında sadece eğitim alanlarına bağlı kalınmayıp tüm sektörlerde sürdürülebilir bir boyut kazandırılması istenmektedir. Çalışmanın bu kısmında, sürdürülebilir kalkınmanın eğitimin ekonomiye etkisinden bahsedilmektedir.

Çevresel sistemlerin daha iyi anlaşılması ile çevresel değişiklerin ve oluşan etkilerin gelecekte katlanarak artabilmesi ve geri dönülmez bir durum halini alabilir. Değişen jeopolitik manzaralar yeni fırsatları ve daha politik kamusal direncin aşılması için teşvikler sunmaktadır. Bu teşviklere örnekle, sürdürülebilir üretim araçları ve tüketim kalıplardır [23].

Sürdürülebilir Kalkınma Eğitimi, çevresel, kültürel, ekonomik ve sosyo-politik bağlamlarla alakalıdır. Eğitim yoluyla, küresel ekonomik sorunlar ele alınır, bölgesel ölçülümler yapılabilir ve bu ölçümler sonucu çıkan zorluklar için somut bir araç sağlamaktadır [18]. İyi yetiştirilmiş ve beceri kazandırılmış insan kaynağı, üretim alanında verimliliği artırmakla beraber, yeni teknolojik icatların rasyonel şekilde kullanılmasını sağlamaktadır [13]. Böylelikle, üretimde nitelikli elamanların yetişmesi, ekonomik dalgalanmaların önüne geçilmesini sağlamakta, maliyet giderlerini istikrarlı hale getirmektedir.

3.1 Sürdürülebilir Kalkınma için Eğitim Ekonomiye Katkısı;

Sürdürülebilir Kalkınma Eğitimi sayesinde; Güçlü ekonomik değerler, Gıda güvenliği, Ekolojik bütünlük, Sürdürülebilir geçim gibi yaşam tarzları elde edilir [18].

Sürdürülebilir Kalkınma Eğitimi, istihdam alanlarını artırmak için gerekli olan yeterlilik seviyelerinin gelişmesinde rol oynamaktadır [14].

Ekonomik alandaki etkileri basit şekilde sıralanabilir [11];

- Yolsuzluğu azaltmak,
- Eğitimli iş gücü yaratmak,
- Daha adil ve eşitlikçi işlerin yapılması,
- Bilgili tüketicilerin olması,

Sürdürülebilir kalkınma eğitimi ile kırsal alanlardaki eğitim faaliyetleri, bu alanlardaki beceri ve faaliyetleri olumlu yönde etkilemektedir. Kırsal alanlardaki beceri ve faaliyetlerin kapasitesinde ekonomik fırsatlar yaratabilir. Sürdürülebilir Kalkınma Eğitimi ile kırsal alanların yaşam kalitesi artar, sosyal ve ekonomik gelişme hızlanabilmektedir.

Sürdürülebilir Kalkınma için Eğitim'in Kırsal alanlarda bulunan faaliyet getirileri şu şekilde sıralanabilir [24];

- Çiftlik planlanması ve yönetimi,

- Tüketim Bilinci,
- Çevre Bilinci,
- Gelişmiş tarım uygulamaları,
- Belirli mal ve hizmetler için geçerli yeni ve teknolojik beceriler,
- Yönetim Becerileri (Maliyet Muhasebesi, İç Planlama, Stok Denetimi)

Ekonomik alandaki gelişmeleri [2];

- Mesleki ve Teknik iş gücü geliştirir.
- Toplumun girişimci, yeniliklere açık, bilinçli tüketimin farkında sanayileşmeyi destekleyici yönde oluşması,
- Teknik, ekonomik ve siyasi kararların etkilenmesi,
- Uluslararası alanda daha hareketli bir iş gücü oluşturur.

Aşağıda verilen şekil 'de devletlerin yürütmüş olduğu sürdürülebilir eğitim politikasının sanayi kuruluşlarına direkt ve dolaylı olarak etkisi, şematik olarak gösterilmektedir.

Devletler ⟷ Eğitim Sistemi (Sürdürülebilir) ⟷ Sanayi Kuruluşları

Şekil 1. Eğitim ve Devlet Politikası

4. Uluslararası Öğrenciler;

Sürdürülebilir Kalkınma Eğitimi, uluslararası bir boyut kazanmaktadır. Uluslararası öğrenci anlayışı ile ekonomik, kültürel ve sosyal açıdan sürdürülebilir bir anlam kazanan eğitim sektörünün yön değiştirmesi, sayısal bilgiler aracılıyla incelenmektedir.

Uluslararası öğrenciler genellikle az gelişmiş ülkelerde, ekonomik kalkınmaya ve uluslararası rekabet gücüne büyük ölçüde katkı sağlayan insan kaynağı olarak değerlendirilmektedir[25]. Uluslararası öğrenciler, öğrenim gördükleri üniversiteye ödedikleri ücret ve yaşamlarını sürdürebilmeleri için yaptıkları çeşitleri harcamalar ile ev sahibi ülkenin ekonomisine doğrudan ve dolaylı katkıda bulunmaktadırlar[26].

Dünya'da dolaşımda olan en çok uluslararası öğrenciler sırasıyla Çin, Hindistan ve Kore'ye aittir. Yapılan açıklamalar ile dünya da kayıtlı uluslararası öğrencilerin %52'si Asya öğrencileridir[27].

Yapılan araştırmalara göre, ABD bütün uluslararası öğrencilerin %18'ine ev sahipliği yapmaktadır. İngiltere %10, Avustralya %7, Almanya %7 ve Fransa %6,5 şeklinde dağılımlar söz konusudur. OECD ülkelerinin toplamında ise uluslararası öğrencilerin yüzdelik değeri %5.95'dir [25].

Uluslararası öğrenciler, üniversitelerde bulundukları sürede, okul içi ve dışında çeşitli faaliyetler göstermektedir. Ev sahibi ülkenin kültür ve sanat dünyasını olumlu yönde etkilemektedir.

Uluslararası öğrencilerin dolaşımını etkileyen faktörler;

- Coğrafi Yakınlık
- Öğrenim Ücretleri, Yaşam Giderleri, Seyahat Giderleri ve Sosyal Maliyetler,
- Gidilen Üniversitelerin Uluslararası Eğitime Yaklaşımı, Kontenjanları,
- Öğrenci Hareketliliği ve Öğrenci Değişim İmkânları,
- Seyahat İmkânın Artması ve Ucuzlaması,
- Uluslararası Kabul Edilmiş Eğitim Müfredatları,

Yukarıda yer alan faktörler sıralanmaktadır[27].

4.1 Uluslararası Öğrencilerin Ekonomiye Katkısı

Uluslararası öğrenciler, ev sahibi ülkenin ekonomik alanlarda dolaylı olarak katkıları mevcuttur. Öğrencilerin, aile fertleri, arkadaşları ve akrabaları da ziyaret ve turizm amacı ile ev sahibi ülkeyi ziyaret ederek, ülkenin ekonomisine katkı sağlamaktadır.

ABD'de uluslararası öğrenciler, 2012 – 2013 akademik yılında, 24 milyar dolar harcama yapmıştır. 313 bin kişi için iş kaynağı olmuştur [26]. Ayrıca, Uluslararası Eğitimciler Derneği, 2012-2013 eğitim-öğretim yılında, NAFSA uluslararası öğrencilerin ABD ekonomisine $24 milyar katkıda bulunmuştur [28], şeklinde bir değerlendirme yapılmaktadır.

Yapılan açıklamalara göre 2010-2011 akademik yılında, Avustralya'da uluslararası eğitim faaliyetlerinden 16,3 milyar dolar ihracat geliri elde edilmiştir. Avustralya'da uluslararası eğitim faaliyetleri, ihracat kayıtları içerisinde birinci sırada yer almaktadır [25]. Sadece 2011 akademik yılında Avusturalya'da eğitim gören uluslararası öğrencilerin sayısı 426.748'dir [29]. Avustralya'da yakın bir zaman içerisinde 2012 yılı ve sonrası için uluslararası öğrenci ücretleri %16'lık seviyelerde artış öngörülmektedir [30].

Kanada'da %37sini Güney Kore ve Çin uyruklarının oluşturduğu uluslararası öğrenciler bulunmaktadır. Kanada 'da bulunan uluslararası öğrenciler 2010 yılında yaklaşık 7.7 milyar dolar harcama yapmış ve 81 bin kişi için iş kaynağı, aynı zamanda devlet için 445 Milyar dolar mali kaynak oluşturmuştur [26]. Ayrıca, Kanada'da uzun vadeli uluslararası eğitim hizmetleri, iş gücü piyasasında 64.940 iş katkı da bulunmuştur[31].

5. Yükseköğretim Sektörünün Sürdürülebilir Değerlendirilmesi;

Mesleki Eğitim ve Yüksek Öğretimde, Sürdürülebilir Kalkınma Eğitiminin güçlendirilmesi gerekmektedir. Çeşitli mesleklere daha spesifik beceri ve yeteneklerin geliştirilmesi, bireylerin toplumsal ve kurumsal sorumlulukları ile kişisel sorumlulukları gibi konulara odaklanması gerekilmektedir[14].

Yakın zamandaki açıklamalara göre, OECD ortalama olarak, eğitime ayırdığı kamu harcamalarının GSYİH' ya oranı %5,7'dir. OECD ortalama olarak, öğrenci başına yapılan yıllık kamusal harcamaları $7840 olarak açıklamıştır[13].

5.1 Kıbrıs Değerlendirilmesi;

Kıbrıs üniversitelerinde toplam 47.063 öğrenci öğretim görmekte ve 1829 akademisyen görev yapmaktadır.2011 – 2012 akademik döneminde Kıbrıs' da öğrenim gören 47.063 öğrencinin bir yıl içerinde yapmış olduğu yaklaşık 1,1 milyar TL harcama yaptığı tahmin edilmektedir. Bu tahmin yalnızca öğrencilerin temel harcamalarını kapsamaktadır [32]. Bunun yanında öğrencilerin, bireysel tüketimleri düşünüldüğünde tahmin edilen toplam harcamanın yükselmesi öngörülmektedir.

Üniversitelere ödenen eğitim ücretlerinin yıllık yaklaşık 416 milyon TL tutarında olduğu tahmin edilmektedir. Kıbrıs ekonomisine yaptıkları toplam katkı yaklaşık 1,5 milyar TL olduğu öngörülmektedir. Bu tahmine göre öğrenci başına yıllık harcama tutarı yaklaşık olarak 31.532 TL olduğu öngörülmektedir [32].

Uluslararası Öğrencilerin Ekonomik Katkısı Üzerinde Sektörel Durum [32];

Verilen tabloda, Kıbrıs'ta bulunan uluslararası öğrencilerin, ekonomik alanlardaki kurumsal dağılımlarını içermektedir.

Tablo 1. Uluslararası Öğrencilerin Sektördeki Ekonomik Dağılımları

Sektörler Bazda Giderler	Toplam Tutar
Kırtasiye Gideri	39,878.038
Sosyal Faaliyet Giderleri	33,726.609
Ulaşım Giderleri	126,536.275
Yeme-İçme Giderleri	356,284.36
Barınma Giderleri	223,677.336

İletişim Giderleri	56,099.886
Kılık-Kıyafet Giderleri	56,099.886
TOPLAM	**892,302.39 TL/YILLIK**

Ayrıca, Kıbrıs da bulunan uluslararası öğrencilerin eğitimden yeni stratejiler geliştirilmekte, eğitimin ve ekonominin sürdürülebilirliği hedeflenmektedir. Kıbrıs Eğitim Turizmini benimsemiş gelişmekte olan küçük ada ülkelerinden biridir

.

Eğitim Turizmi; Dünyada eğitim farklı türleri için yabancı öğrenci çekme stratejisini yürüten ülkeler eğitimin ve turizm sektörlerinden elde edikleri ekonomik ve sosyal kazanımları artırmak için eğitim turizmi benimsemişleridir[32]. Edinilen bu bilgiden yola çıkılarak, eğitim turizmin yabancı öğrenci odaklı olduğu anlaşılmaktadır.

Uluslararası eğitimin, yükseköğretim sektöründen ve yeni geliştirilecek olan eğitim turizminden elde edilecek faydalar aşağıda sıralanmaktadır [32];

- Turizm yatırımları artışı,
- Kurulan işletme sayısı artışı,
- İşletmelerin cirosu artışı,
- Toplam turizm geliri artışı,
- İstihdam artışı,
- Ülkeye gelecek olan ziyaretçi sayısı artışı,

Yukarıda sayılan faktörler, eğitim turizmi için birer fayda sağlamaktadır.

SONUÇ ve ÖNERİLER

Çalışmada yapılan incelemeler doğrultusunda, kalkınma ve sürdürülebilir kalkınmanın önemi vurgulanmaktadır. Sürdürülebilir kalkınmanın yeterli ve uygun düzeylerde sağlanabilmesinin yolunda sürdürülebilir kalkınma eğitiminin önemi çalışmamızdaki veriler ışığında anlaşılmaktadır. Sürdürülebilir Kalkınma Eğitimini uygulayan ülkelerdeki çeşitli sosyal, ekonomik, kültürel politikaların ülkelere fayda sağladığı anlaşılmaktadır. Uluslararası sürece giren eğitimin, sürdürülebilir bir kalkınma modeli olduğu, çalışma aracılığı ile görülmektedir. Gelişmekte olan küçük ada ülkelerinin, kalkınma planları dâhiline alınan sürdürülebilir kalkınma eğitimi, ülkelerin sosyo-ekonomik yapısını olumlu yönde etkilediği anlaşılmaktadır. Ülkelerin, tek bir alana bağlı kalmadan geniş yelpazeli bir kalkınma modeli çizdiği çalışmamız neticesinde anlaşılmaktadır. Verilen sayısal bilgiler doğrultusunda, sürdürülebilir kalkınma eğitimleri, ülkelerin ekonomik yapılarına dolaylı ve doğrudan etkileşimde bulunduğu bu çalışma aracılığı ile anlaşılmaktadır.

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TEACHING THE LINES, ANGLES AND POLYGONS ACCORDING TO CONSTRUCTIVISIM SUPPORTED BY CONCEPT CARTOONS

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ABSTRACT: The purpose of this research is to put forward applicability of subjects of lines, angles and polygons in a contructivist learning environment which is supported by concept cartoons. Since the research aims at putting forward constructivist learning process which is supported by concept cartoons, it is conducted as an action research. The research is implemented with the participation of students studying at 7th grade of a secondary school situated in Karacasu town of Aydın province during the spring semester of 2012-2013 academic year. Data were gathered by problem scenarios and performance assignments students completed. In the research, the qualitative data is analysed by using content analysis technique. In consequence of analysis of the research data, it is seen that constructivist learning implementations which is supported by concept cartoons improves problem solving abilities of students and that they can display knowledge they learnt through concept cartoons in performance assignments. Also, according to findings obtained from interviews with students, it is determined that learning process supported by concept cartoons contribute learners' affective, cognitive and social attributes, learning-teaching processes and teacher attributes.

Key words: teaching mathematics, concept cartoon, constructivist learning environment

DOĞRULAR, AÇILAR VE ÇOKGENLER KONULARININ KAVRAM KARİKATÜR DESTEKLİ YAPILANDIRMACI ÖĞRENME YAKLAŞIMINA GÖRE İŞLENMESİ

ÖZET: Bu araştırmanın amacı, ortaokul 7. sınıf matematik dersinde doğrular, açılar ve çokgenler konularının kavram karikatürleriyle desteklenmiş yapılandırmacı öğrenme ortamında uygulanabilirliğini ortaya koymaktır. Araştırma, kavram karikatür destekli yapılandırmacı öğrenme sürecini ortaya koymayı amaçladığından eylem araştırması olarak desenlenmiştir. Araştırmanın uygulaması 2012-2013 öğretim yılının bahar döneminde Aydın ili Karacasu ilçesinde bulunan bir ortaokulun 7. Sınıf öğrencileriyle matematik dersinde gerçekleştirilmiştir. Araştırmanın belirlenen amacına ulaşması için gerekli olan veriler öğrencilerle yapılan görüşmelerden, problem senaryolarından ve performans görevlerinden elde edilmiştir. Araştırmada nitel veriler içerik analizi tekniği kullanılarak çözümlenmiştir. Araştırma verilerinin analizi sonucunda, kavram karikatürleriyle desteklenmiş yapılandırmacı öğrenme uygulamalarının öğrencilerin problem çözme becerilerini geliştirdiği ve kavram karikatürleri ile ilgili öğrendikleri bilgileri performans görevlerinde sergileyebildikleri görülmüştür. Ayrıca uygulama sonunda öğrencilerle yapılan görüşmelerden elde edilen bulgulara göre kavram karikatür destekli öğrenmelerin öğrenenlerin duyuşsal, bilişsel, sosyal özelliklerine, öğrenme-öğretme sürecine ve öğretmen özelliklerine katkı sağladığı belirlenmiştir.

Anahtar sözcükler: matematik öğretimi, kavram karikatürü, yapılandırmacı öğrenme ortamı

GİRİŞ

Bilginin hızla geliştiği ve karmaşıklaştığı günümüzde araştıran, sorgulayan, keşfeden, problem çözebilen bireylere duyulan ihtiyaç artmaktadır. Bireylerin bilgiye erişiminin kolay ancak gerekli ve gereksiz bilginin ayrımının zor olması da eğitim programlarının düzenlenmesini gerektirmektedir. Bu çerçevede eğitim sistemlerinin geliştirilmesi ve değişime ayak uyduracak nitelikte olması önemli görülmektedir.

Kalabalık, alt yapı ve araç-gereç sıkıntısı yaşanan sınıflarda geleneksel yöntemler öğretmenlerin tercih sebebi olmaktadır. Öğrencilerin arkalarına yaslanıp dinlemeleri ve kendilerine sunulan konuyu ezberlemeleri öğrenme açısından yeterli görülmektedir. Ezberlenen bilgiler öğrenciler tarafından içselleştirilemediği için anlamlı olmamaktadır. Ezbere dayalı kalıp bilgi aktarımının tercih edildiği ve öğrenenin pasif olduğu geleneksel sınıf ortamlarında öğrenenler bilgiye ulaşma yollarını bilmemekte ve kendi öğrenmelerinin sorumluluğunu alamamaktadır.

Geleneksel anlayış, öğrencileri pasif ve geri planda bırakarak öğrenmenin kalıcılığını düşürmektedir. Ayrıca bu tür yöntemler öğrencilerin yaratıcılığını ve yorumlama becerilerini sınırlandırarak eğitimin niteliğini düşürmektedir. Yapılandırmacılık ise bireyin ne öğrendiğiyle değil neden ve nasıl öğrendiğiyle ilgilenmektedir. Bu açıdan yapılandırmacılık hem öğrenmenin niteliğini arttırmakta hem de kalıcılığını sağlamaktadır.

Yapılandırmacılık; Savery ve Duffy'e (1995) göre nasıl anlamak ve bilmek gerektiğine ilişkin felsefi bir bakış açısı, Marlowe ve Page'e (2005) göre insanın nasıl öğrendiğiyle ilgilenen bir yaklaşımdır. Öğrenmenin anlam oluşturma etkinliği olarak görüldüğü yapılandırmacı yaklaşımda, bireyler önceki yaşantılarından ve çevrelerinden etkilenerek bilgiyi etkin bir şekilde oluştururlar (Philips, 2000). Öğrenen yeni bir bilgi ile karşılaştığında, dünyayı tanımlamak ve açıklamak için kendi mevcut kurallarını kullanır. Kurallar yetersiz kaldığında ise bilgiyi daha iyi açıklamak için kendisi yeni kurallar oluşturur (Brooks ve Brooks, 1999). Yani öğrenme, öğrencilerin yeni bilgileri var olan bilgileriyle karşılaştırıp yeniden yapılandırdıkları bir süreçtir.

Her ne kadar bilgiyi yapılandırma sürecinde zihinsel faaliyetler önemli yer tutsa da, öğrenme sık sık diğer bireylerle karşılıklı etkileşime ve iletişime dayanır. Öğrenme sürecinde sınıftaki akranların ve çevrenin önemi büyüktür (Harris ve Graham, 1994; Taber, 2001). Bu noktada yapılandırmacı öğrenme ortamlarının düzenlenmesinde öğretmenlere önemli görevler düşmektedir. Bireyin öğrenme sürecini desteklemek ve zengin öğrenme yaşantıları geçirmesini sağlamak için bilginin birlikte keşfedileceği, tartışılacağı sınıf ortamları oluşturulmalı, bireylerin öğrenmeleri kolaylaştırılmalı ve merak duygularını öne çıkarılmalıdır.

Bilimde olduğu kadar günlük yaşayışımızdaki problemlerin çözümünde kullanılan matematik, insan zihninin yarattığı bir sistemdir ve soyuttur (Baykul, 1999). Matematiğin soyut olması ise matematiksel kavramların ve yapıların öğrenenler tarafından içselleştirilmesini güçleştirmektedir. Matematik öğretim faaliyetleri planlanırken konuların somutlaştırılması bu güçlüğü en aza indirilebilmektedir. Matematiğin doğasına uygun öğretim teknikleri seçilemediği takdirde öğrenciler matematiğe ilgi duymamakta, eğlenceli olabilecek konular ise sıkıcı hale gelmektedir (Köroğlu ve Yeşildere, 2004).

Yapılandırmacı yaklaşımda, öğrenenlerin matematik öğrenme sürecine aktif katılmalarını sağlayacak ortamların oluşturulması öğrenmenin niteliği açısından faydalı olmaktadır. Öğrenenler bu tür ortamda, öğrenme yaşantıları arasındaki ilişkileri kendisi keşfedebilmekte, var olan bilgilerindeki eksiklikleri tamamlayabilmekte ve yanlış bilgilerini değiştirip düzenleyebilmektedirler. Tiryaki'ye (2009) göre yapılandırmacı yaklaşımın uygulandığı sınıflarda, öğrenenleri süreçte aktif kılan 5E modeli, işbirlikli öğrenme yöntemi, probleme dayalı öğrenme yöntemi, buluş yoluyla öğretim stratejisi, beyin fırtınası tekniği gibi birçok yöntem ve teknikten yararlanılır. 1990'lı yıllarda Brenda Keogh ve Stuart Naylor tarafından geliştirilen, bilginin görsel sunumunu sağlayan kavram karikatürleri de matematik öğretim yöntem ve teknikleri ile birlikte kullanılarak öğrencilerin matematiğin eğlenceli yönünü keşfetmesine yardımcı olur (Güler, 2010).

Özetle yapılandırmacı anlayışta öğrenme, yaşam boyu devam etmektedir. Birey, çevresinde olup biten her şeye bir anlam yüklemektedir. Geçirilen yaşantılarla birlikte olaylara yüklenen anlamlar değişmektedir. Yani birey için bilgi, kendi deneyimleri ve çevresiyle geçirdiği yaşantılar sonucunda oluşmaktadır. Matematik öğretiminde de öğrenenlerin geçirdiği yaşantılarda aktif olması önemlidir. Kavram karikatürleri de öğrenciyi aktif kılan bir tekniktir. Türkiye'de fen bilimleri alanında kullanımı yaygın olmasına rağmen matematik alanında kullanılmasına yönelik yapılan araştırmaların sayıca az olması araştırmanın başlangıç noktasını oluşturmuştur.

1.1.Çalışmanın Amacı ve Önemi

Matematik eğitiminin amacı, bireylere günlük hayatlarında karşılaşabilecekleri problemleri çözmelerine yardımcı olabilecek neden sonuç ilişkisi kurma, eleştirel düşünme, akıl yürütme gibi becerileri kazandırmaktır (Yazıcı, 2004). Öğrencilerin bu tür becerileri kazanabilmesi ezberci anlayışta mümkün değildir. Bu yüzden 2005 yılında eğitim anlayışında değişiklik yapılmış ve programlar yapılandırmacı yaklaşım temel alınarak hazırlanmaya başlanmıştır.

Matematik derslerinde zengin öğrenme ortamlarının oluşturulması, farklı öğretim yöntem ve tekniklerin kullanılması öğrencilerin matematiğin eğlenceli ve zevkli yönlerini keşfetmeleri için önemlidir. Görselliğin ön plana çıktığı araçlardan biri olan kavram karikatürlerinin öğrencilere matematiği sevdirebilecek araçlardan biri olduğu düşünülmektedir.

İngiltere başta olmak üzere Tibet, Avustralya, Norveç, Rusya, Slovenya ve İsveç gibi birçok ülkede eğitim alanında kavram karikatürlerinden yararlanılmaktadır (Uğurel ve Moralı, 2006). Ancak Türkiye'de eğitim-öğretimde karikatürlerin kullanımına yönelik yeterli çalışma bulunmamaktadır. Var olan çalışmaların büyük çoğunluğu fen bilimleri alanındadır. Araştırmanın başlangıç noktasını matematik eğitimi alanında kavram karikatürlerinin kullanımının yaygınlaştırılması oluşturmuştur.

Bu araştırmanın amacı, ortaokul 7. sınıf matematik derslerinde doğrular, açılar ve çokgenler konularının kavram karikatürleriyle desteklenmiş yapılandırmacı öğrenme ortamında uygulanabilirliğini ortaya koymaktır. Doğrular, açılar ve çokgenler gibi geometri konuları görselleştirmeye daha müsaittir. Geometri konularının kavram karikatürleri sayesinde görselleştirilerek somutlaştırılması bu konunun daha kolay anlaşılmasını sağlayacaktır. Öğrenme sürecinde öğrencilerin kendi kavramlarının ve becerilerinin gelişmesine fırsat veren deneyimlerin yaşandığı 5E modelinin ve öğrencileri aktif kılan kavram karikatürlerinin kullanıldığı bu çalışma öğretmenlere alternatif bir kaynak sunması bakımından önemli görülmektedir. Bu araştırma, kavram karikatürlerinin matematik eğitimi alanında da kullanılması, zor denilen matematik konularının kavram karikatürleri aracılığıyla görselleştirilmesi ve öğrencilerin ilgisini çekmesi açısından da önem taşımaktadır.

YÖNTEM

2.1. Araştırma Modeli

Bu araştırma, uygulama sürecinde gerçekleştirilen yapılandırmacı yaklaşım temelli çalışmaların niteliğini artırmayı ve araştırmacının kendi uygulamalarını geliştirmeyi amaçladığından eylem araştırması olarak desenlenmiştir. Eylem araştırmaları toplumsal hareketleri temele alan uygulamalı nitel araştırmalardandır (Bogdan ve Biklen, 2007). Bir problemi çözmek ya da bir uygulama hakkında bilgi toplamak amacıyla kişi ya da gruplar tarafından gerçekleştirilebilir (Fraenkel ve Wallen, 2010).

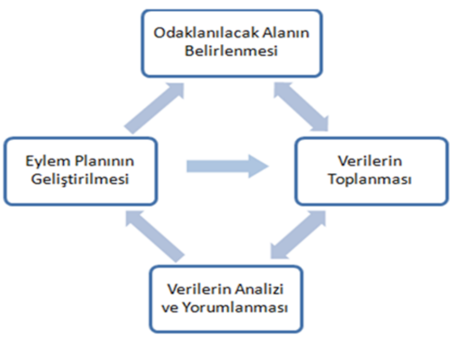
Eylem araştırması, "bir öğretim sürecinde öğrencinin öğrenmesini etkileyen ortamın verimini artırmak için neler yapılabileceğinin ilgililer tarafından (öğretmenler, yöneticiler vb.) araştırılması sürecidir" (Mills, 2003, s.4). Son yıllarda gerek akademisyenler gerekse öğretmen araştırmacılar tarafından oldukça kabul gören araştırma türüdür (Yıldırım ve Şimşek, 2008). Öğretmenler kendi öğretim uygulamalarının niteliğini anlamak ve iyileştirmek için çalışmalarında eylem araştırmalarını tercih etmektedirler (Johnson, 2014). Bu araştırmalar öğretmenlerin mesleki gelişimlerine katkı sağladığı gibi yeni fikirlere açık olmalarına da olanak sağlar (Schoen, 2007; Aksoy, 2003). Eylem araştırmasına katılan öğretmenler kendi uygulamalarına, yöntemlerine, algılarına ve anlayışlarına daha eleştirel ve titiz eğilebilmektedir (Köklü, 2001). Kuzu'ya (2005) göre eylem araştırmasının eğitim alanındaki en önemli amacı, "eğitim dünyasında ortaya çıkan gerçekleri sistematik olarak anlamak ve onu değiştirerek geliştirmeye çalışmaktır" (s.32).

2.2. Katılımcılar

Araştırmanın katılımcıları bir ortaokuldaki 7. sınıf öğrencileridir. Uygulamanın gerçekleştirildiği okulda iki tane 7. sınıf şubesi vardır. Sınıflardan A şubesi 20, B şubesi 21 kişiliktir. Araştırma boyunca yapılandırmacı yaklaşım temelli yöntem ve tekniklerin grup çalışması şeklinde yürütülmesi planlandığı için sınıf mevcudunun eşit sayıda gruplara ayrılacak şekilde olmasına dikkat edilmiştir. Bu nedenle 11 kız, 9 erkek toplam 20 kişiden oluşan 7/A şubesindeki öğrenciler araştırmanın katılımcılarını oluşturmuştur. Konular, Matematik Programı'nda ayrılan süre ve ders saati ile sınırlı kalınarak 6 hafta (23 ders saati) içerisinde öğrencilere sunulmuştur. Ayrıca derslerde 5E modelinin aşamaları dikkate alınarak hazırlanan 19 adet ders planı kullanılmıştır.

2.3. Eylem Araştırması Süreci

Eylem araştırmaları, problem çözmeye yönelik, döngüsel sürece odaklı araştırmalardır (Cavkaytar, 2009). Bu döngü, sorunla ilgili bilgi toplama, kaynak tarama, sorunu çözücü eylemlerle gelişme ve iyileştirmeyi sağlama biçiminde dört aşamadan oluşmaktadır. Mills (2003) eylem araştırmasının diyalektik döngüsünü Şekil 1'deki gibi dört aşamada ele almıştır.



Şekil 1. Eylem Araştırmasının Diyalektik Döngüsü

Odaklanılacak Alanın Belirlenmesi

Eylem araştırması sürecinin başında çalışılacak alanın belirlenmesi, araştırılacak problemin ya da sorunun belirtilmesi çok önemlidir (Mills, 2003). Araştırmacı, araştırmak için bir alan/konu belirler ve tam olarak ne çalışacağına karar verir (Mertler, 2009). Bu çalışma "yeni bir yaklaşımın denenmesi" başlığı kapsamında kavram karikatürleri ile desteklenmiş yapılandırmacı sınıf ortamının geliştirilmesi ve iyileştirilmesine yöneliktir.

Verilerin Toplanması

Eylem araştırmalarında problemi daha ayrıntılı tanımlamak ve çözüme yönelik öneriler elde etmek için ilgili alanda veriler hem nitel hem de nicel yollarla toplanabilmektedir (Kuzu, 2005; Yıldırım ve Şimşek, 2008). Araştırmada daha geçerli ve güvenilir sonuçlara ulaşmak için birbirini tamamlayacak veri toplama yöntemlerinin yani yöntem çeşitleme stratejisinin kullanılması daha uygun olmaktadır (Büyüköztürk ve diğ., 2010). Yöntem çeşitlemesinde, çalışılan bir problem ya da programla ilgili olarak görüşme, gözlem, doküman ve anket gibi çoklu veri toplama yolları kullanılmaktadır (Patton, 1987; Akt. Köksal, 2006). Bu bağlamda, çalışmada problem senaryoları uygulanmış, öğrenciler ile yarı yapılandırılmış görüşmeler yapılmış, öğrenenlerin uygulama sonrasında performans görevleri toplanmıştır.

Verilerin Analizi ve Yorumlanması

Döngünün bu aşamasında, toplanan veriler anlamlandırılmaya çalışılır. Uygulama sürecinde ortaya çıkan sorunlar, bu sorunların kaynakları ve çözüm önerileri belirlenir. Araştırma sürecinin ana temaları ve eğilimleri de şekillenmeye başlar (Yıldırım ve Şimşek, 2008). Araştırmanın uygulama sürecinin iyileştirilmesi amacıyla iki program geliştirme uzmanı, bir matematik alan uzmanı ve araştırmacının katıldığı geçerlik komitesi toplantısı düzenlenmiştir. Uygulama süreci 6 hafta olduğu için geçerlik komitesi toplantıları 2 haftada bir olacak şekilde toplamda 2 tane planlanmıştır.

Eylem Planının Geliştirilmesi

Eylem araştırmaları her an değişebilen dinamik bir süreçtir. Elde edilen veriler uygulanan yöntemde değişiklik yapılmasına, yeni veri kaynaklarının eklenmesine ya da araştırmanın odağının değişmesine neden olabilir. Uygulama sürecinin çözümleme ve yorumlama aşamasındaki değerlendirmelerin sonucunda, gerekiyorsa yeni eylem planları oluşturulur. Eylem ve uygulama planı geliştirme, eylem araştırmalarının ayrılmaz bir parçasıdır (Yıldırım ve Şimşek, 2008).

2.4. Verilerin Çözümlenmesi ve Yorumlanması

Eylem araştırmalarında veri toplamayla veri analizi birlikte yürütülmektedir (Johnson, 2014). Verilerin çözümlenmesinde, içerik analizi tekniği kullanılmıştır. İçerik analizinde temel amaç, toplanan verileri açıklayabilecek kavramlara ve ilişkilere ulaşmaktır (Yıldırım ve Şimşek, 2008). Bu araştırmada birbirine benzeyen veriler belirli kavramlar ve temalar altında bir araya getirilmiş ve yorumlanmıştır.

Problem senaryolarının analizi araştırmacı ve bir matematik öğretmeni tarafından yapılmıştır. Senaryolar ayrı ayrı puanlanmıştır. Her bir problem senaryosuna ilişkin birinci ve ikinci puanlayıcının dört puan üzerinden bağımsız olarak verdiği puanlar dikkate alınarak puanlayıcılar arası güvenirlik belirlenmeye çalışılmıştır.

Görüşmelerin analizi; verilerin dökümünün yapılması, verilerin kodlanması, verilerin derlenip kategorileştirilmesi, geçerlik ve güvenirliğin sağlanması olmak üzere dört adımda gerçekleştirilmiştir. İlk önce görüşmelere ilişkin ses kayıtlarının hepsi yazılı metin haline getirilmiştir. Dökümü yapılan görüşmeler önce satır satır okuma tekniği ile kodlanmış, sonra elde edilen kodlar tümevarımcı bir yaklaşımla bir araya getirilerek kategoriler oluşturulmuştur. Araştırmacı ve matematik öğretmeni tarafından gerçekleştirilen kodlamalarda Miles ve Huberman'ın önerdiği (1994) "görüş birliği ve görüş ayrılığı" formülü kullanılmıştır.

Performans görevlerini değerlendirmek için geliştirilen dereceli puanlama anahtarının güvenirlik çalışması puanlayıcılar arası uyum indeksine bakılarak yapılmıştır. On tane performans görevi beş ayrı matematik öğretmeni tarafından birbirinden bağımsız olarak değerlendirilmiştir. Performans görevlerini değerlendirmek için geliştirilen ölçeğin güvenilirlik çalışmasından sonra 20 öğrencinin performans görevleri araştırmacı ve bir matematik öğretmeni tarafından ayrı ayrı değerlendirilmiştir. Puanlayıcıların dereceli puanlama anahtarı üzerinde her bir ölçüte ilişkin ayrı ayrı işaretlemiş oldukları ölçümlerin ortalaması alınarak, bu ortalamaların hangi aralığa girdiği belirlenmiştir.

Geçerlik ve güvenirlik bir araştırmanın inandırıcılığı açısından en yaygın olarak kullanılan iki ölçüttür (Yıldırım ve Şimşek, 2008). İlgili alanyazın incelendiğinde nitel araştırmaların geçerlik ve güvenirliğini sağlamada farklı stratejilerin ve sınıflamaların kullanıldığı görülmektedir. Bu çalışmada verilerin geçerliği ve güvenirliği için alınan önlemler aşağıda verilmiştir.

İnandırıcılık/ İç Geçerlik

Araştırmada inandırıcılığı artırmak için, veri toplama, verileri çözümleme ve yorumlama süreçlerinde tutarlılık sağlanmaya çalışılmıştır. Görüşme ile ilgili veriler ses kaydı olarak kayıt altına alınmıştır. Araştırmacı, araştırmanın tüm aşamalarında mümkün olduğu kadar nesnel olmaya dikkat etmiş ve araştırma süreci boyunca farklı uzmanların yardımına başvurmuştur. Farklı veri kaynaklarına ve veri toplama yöntemlerine göre elde edilen bulguların anlamlı bir bütün oluşturup oluşturmadığı kontrol edilmiştir.

Aktarılabilirlik/ Dış Geçerlik:

Araştırmanın aktarılabilirliğini sağlamak için, araştırma süreci ve bu süreçte yapılanlar (araştırmanın modeli, katılımcılar, veri toplama araçları, veri toplama süreci, verilerin çözümlenmesi ve yorumlanması) ayrıntılı bir şekilde açıklanmaya çalışılmıştır. Ayrıca araştırma raporu ayrıntılı olarak yazılmış ve bulgular bölümünde yorum katmadan doğrudan alıntılara yer verilmiştir.

Tutarlık/ İç Güvenirlik:

Bu araştırma süreci boyunca kullanılan tüm veri toplama araçlarının hazırlanması, verilerin toplanması ve analizi aşamalarında, araştırmacı tutarlı davranmaya çalışmıştır. Araştırmanın tüm aşamalarında gerçekleşen süreçler ve bu süreçler sonunda ortaya konulan ürünler, birbiriyle tutarlığı açısından incelenmiş ve bunun için uzman yardımı alınmıştır.

Teyit Edilebilirlik/ Dış Güvenirlik:

Araştırma kapsamında kullanılan veri toplama araçları ve toplanan ham veriler başka araştırmalarda kullanılabilecek ya da başka araştırmacılar tarafından incelenebilecek biçimde saklanmıştır.

BULGULAR VE YORUM

Bulgular ve yorum sunulurken içerik analizi sonucunda ulaşılan temalar, araştırmanın alt problemleriyle ilişkilendirilerek sunulmuştur. Bulgular açıklanırken temalar dikkate alınmış ve temayı en iyi açıklayan alıntılara yer verilmiştir.

3.1. Kavram Karikatürleri ile Desteklenen Yapılandırmacı Öğrenme Ortamında Öğrenenlerin Problem Çözme Becerilerinin Gelişimi

Çözümleme sonucunda kavram karikatür destekli yapılandırmacı öğrenme uygulamalarının öğrenenlerin problem senaryolarına verdikleri doğru cevap ortalamalarını arttırdığı görülmüştür. Senaryolardan elde edilen veriler öğrenen görüşleri ile de desteklenmektedir. Öğrenenler her konu sonunda verilen ve gerçek yaşamla ilişkilendirilen problem senaryolarını, yapılandırmacı öğrenme uygulamaları süresince daha iyi çözdüklerini belirtmişlerdir. Buna ilişkin öğrenenlerin görüşleri şu şekildedir:

> *"…Problemler ilk derslerde bana zor gibi görünmüştü. Yanlış çözdüğüm sorular da oldu. Ama konular ilerledikçe problemleri daha anlayarak çözmeye başladım. İlk başlarda yaptığım hataları tekrar etmemeye çalışıyordum. Önce soruyu anlıyordum sonra çözmeye başlıyordum…"* (Görüşme kaydı: Ö6)

> *"…Etkinliği dikkatli yaptıysam problemin çözümünü daha kolay yapıyordum. Sonra doğru olup olmadığını kontrol ediyordum. Aklıma hiç çözüm yolu gelmiyorsa bir daha ki derslerde etkinlikleri daha iyi anlamaya çalışıyordum. Zaman geçtikçe problemleri daha iyi çözmeye başlamıştım…"* (Görüşme kaydı: Ö7)

3.2. Kavram Karikatürleri ile Desteklenen Yapılandırmacı Öğrenme Yaklaşımı Uygulamalarının Öğrenenlerin Performans Görevlerine Yansıması

Öğrencilerin performans görevlerinin değerlendirilmesinde kullanılan ölçütlere göre belirlenen "çok iyi (3.26-4.00)" puan aralığında 8 öğrenci (Ö4, Ö6, Ö7, Ö8, Ö9, Ö11, Ö13, Ö19), "iyi (2.51-3.25)" puan aralığında 6 öğrenci (Ö1, Ö5, Ö10, Ö12, Ö14, Ö16), "orta (1.76-2.50)" puan aralığında 4 öğrenci (Ö2, Ö15, Ö17, Ö20) ve "geliştirilmeli (1.00-1.75)" puan aralığında 2 öğrenci (Ö3, Ö18) bulunmaktadır. Bu verilere göre sınıftaki öğrencilerin yarıdan fazlasının hazırladığı performans görevinin iyi ve çok iyi nitelikte olduğu görülmektedir. Bu da öğrenenlerin uygulamada kullanılan kavram karikatür etkinliklerini öğrendiklerini, görülen konulara ilişkin kendilerinin de kavram karikatürleri hazırlayabildiğini göstermektedir.

3.3. Kavram Karikatürleri ile Desteklenen Yapılandırmacı Öğrenme Yaklaşımı Uygulamalarına Yönelik Öğrenen Görüşleri

Görüşme ile ilgili verilerin analizi sonucunda, öğrencilerin kavram karikatür destekli 5E modeline ilişkin görüşleri "öğrenenin duyuşsal özelliklerine katkıları", "öğrenenin bilişsel özelliklerine katkıları", "öğrenenin sosyal özelliklerine katkıları", "öğrenme-öğretme süreci" ve "öğretmen özellikleri" olarak beş tema altında toplanmıştır.

Öğrenenlerin kavram karikatürleri ile desteklenen öğrenme sürecine ilişkin görüşlerinden elde edilen veriler analiz edilirken öğrenenin duyuşsal özelliklerine katkıları teması altında dokuz adet kod belirlenmiştir. Bu kodlar Tablo 1'de verilmiştir.

Tablo 1. Öğrenenin Duyuşsal Özelliklerine Katkıları Temasına İlişkin Kodlar

a. Kavram Karikatür Etkinliklerine Yönelik Olumlu Görüşler
b. Grup Etkinliklerine Yönelik Olumlu Görüşler
c. Grup Etkinliklerine Yönelik Olumsuz Görüşler
d. Matematik Dersine Yönelik Olumsuz Görüşler
e. Çalışma Kağıtlarına Yönelik Olumsuz Görüşler
f. Öğrenenin Derse Merakı ve İlgisi
g. Öğrenme Çaba ve İsteği
h. Hoşgörü
i. Öz güven

Öğrenenlere matematik dersinin onlarda ne tür duygular uyandırdığı sorulmuştur. Verilen cevaplar incelendiğinde, öğrenenlerin matematiğe ilişkin olumlu düşüncelere sahip olduğu, özellikle de derslerde uygulanan kavram karikatür etkinlikleri ile grup etkinliklerinin bu olumlu görüşleri arttırdığı belirlenmiştir. Öğrenenlerin bir kısmı kavram karikatürünü daha önce hiç duymadıklarını belirtmiş ve normal karikatür olarak algılamıştır. Bu etkinlikler öğrenenlerin hoşuna gitmiş ve derslerin eğlenceli geçmesine katkı sağlamıştır. Kavram karikatür destekli yapılandırmacı öğrenme uygulamaları 5E modelinin aşamalarına göre planlandığı için grup çalışmalarına uygundur. Etkinlikler planlanırken öğrenenlerin bireysel çalışma becerilerinin yanı sıra grupla çalışma becerilerinin gelişmesi de desteklenmiştir. Aşağıda öğrenenin duyuşsal özelliklerine katkıları temasına ilişkin görüşlerden bazılarına yer verilmiştir:

> "*…Grupta arkadaşlarımızla bazen aramızda tartışmalar yaşanıyordu. Etkinlikleri yaparken arkadaşlarımızın bazıları doğru bazıları yanlış cevaplıyordu, herkes kendi düşüncesini savunuyordu. Bu yüzden tartışmalar çıkıyordu…"* (Görüşme kaydı: Ö1)
>
> *"…Birbirimize karşı anlayışlıydık, yoksa grup olarak çalışamazdık. Birbirimizi kırmadan, aramızda anlaşmaya çalışarak etkinlikleri yaptık…"* (Görüşme kaydı: Ö4)
>
> *"…kavram karikatürünün ne olduğunu bilmiyorduk. Karikatür denilince komik yazılar olacak gibi düşünmüştüm. Ama hikâye gibi bir olay anlatılıyordu, orda yaşanan sıkıntıyla ilgili düşünceleri okuyorduk. Doğru olanı bulmaya çalışıyorduk. Konuları böylece daha zevkli işleyebiliyorduk…"* (Görüşme kaydı: Ö6)

Kavram karikatürleri ile desteklenen yapılandırmacı öğrenme sürecine ilişkin görüşme verilerinin analizi sonucunda öğrenenin bilişsel özelliklerine katkıları teması altında yedi adet kod belirlenmiştir. Bu kodlar Tablo 2'de verilmiştir.

Tablo 2. Öğrenenin Bilişsel Özelliklerine Katkıları Temasına İlişkin Kodlar

a. Sorgulama Yapma
b. Problem Çözme Becerisinin Gelişmesi
c. Tartışma Yapma
d. Düşüncelerin Karşılaştırılması
e. Çalışma Kağıtlarına Yönelik Olumsuz Görüşler
e. Farklı Düşünceleri Analiz Etme
f. Derse Hazırlıklı Gelme/ Ön Hazırlık
g. Öğrenilenleri Tekrar Etme/Pekiştirme Çalışmaları

Öğrenenlere sınıf içinde ya da sınıf dışında, grup veya bireysel olarak yapılan etkinlikler sonucunda neler kazandıkları sorulmuştur. Alınan cevaplar sonucunda kavram karikatür destekli yapılandırmacı öğrenme uygulamalarının öğrenenlerin etkinlikleri nasıl yapacaklarını düşünmelerine, verilen karikatürlerde veya problemlerde nasıl bir çözüm yolu izleyeceklerine karar vermelerine, yaptıkları çözümleri karşılaştırmalarına katkı sağladığı belirlenmiştir. Ayrıca öğrenenler uygulama süreci ilerledikçe problemleri daha iyi çözdüklerini, yaptıkları hataları tekrarlamamayı öğrendiklerini belirtmişlerdir. Bu tema altındaki öğrenen görüşleri şu şekildedir:

> *"…Önce herkes problemi nasıl çözebileceğini düşünüyordu. Sonra çözüm yollarımızı karşılaştırıyorduk. Yanlış yapan kişi neden yanlış yaptım, nerde yanlış yaptım diye düşünüyordu. Sonra doğrusuna hep birlikte karar veriyorduk…"* (Görüşme kaydı: Ö3)

> *"…Konuyla ilgili verdiğiniz farklı düşüncelerden doğru olanı bulmaya çalışıyorduk. Zihnimiz sürekli aktifti. Neden bu düşünce doğru olabilir ya da neden yanlış olabilir diye kendi kendime soruyordum. Çünkü bizim verdiğimiz cevapların açıklanmasını istiyordunuz. Derslerde çok düşündüm ama çok da öğrendim…"* (Görüşme kaydı: Ö9)

Öğrenenler ile uygulama sonrasında yapılan görüşmede öğrenenin sosyal özelliklerine katkıları teması altında yedi adet kod belirlenmiştir. Bu kodlar Tablo 3'de verilmiştir.

Tablo 3. Öğrenenin Sosyal Özelliklerine Katkıları Temasına İlişkin Kodlar

a. Grup Arkadaşlarıyla İşbirliği İçinde Olma
b. Grup Arkadaşlarıyla Olumlu İletişim Kurma
c. Sorumluluk Paylaşımı
d. Öğrenenler Arası Etkileşim
e. Bilgi Paylaşımı
f. Uzlaşma
g. Kendini İfade Etme

Matematik derslerinde öğretmen-öğrenci ve öğrenci-öğrenci etkileşimlerinden öğrencilerin nasıl etkilendiği sorulduğunda elde edilen cevaplar öğrenenlerin sosyal özelliklerine katkı temasının oluşmasını sağlamıştır. Öğrenenler etkinlikleri yaparken gruptaki arkadaşlarıyla yardımlaştıklarını ve birlikte çalıştıklarını dile getirmişlerdir. Öğrenenler grup çalışmaları sayesinde birbirleriyle daha iyi anlaşmaya başladıklarını, aralarındaki birlik ve beraberliğin arttığını belirtmişlerdir. Uygulama süresince öğrenme sorumluluğu tek bir öğrencinin üzerinde olmamıştır. Öğrenciler sorumluluk bilinciyle hareket etmişler, etkinlikleri yürütürken görev dağılımı yapmışlar ve herkes üzerine düşen görevi yerine getirmeye çalışmıştır.

> *"…Arkadaşlarımızla birbirimize önceden çok fazla yardım etmezdik. Herkes soruları kendi yapar beklerdi. Şimdi ise yapamadığımız zaman birbirimize yardım ediyoruz. Mesela ben ilk başta pergeli kullanmada zorluk yaşadım, ama arkadaşlarımın yardımıyla daha iyi kullanabildim…"* (Görüşme kaydı: Ö2)

> *"…etkinliklerde herkes kendine düşen görevi yerine getirirse etkinliği yapmak kolay oluyordu. (…) Mesela geometri tahtasında şekilleri oluşturacağımızda birimiz kareyi yapıyordu, birimiz paralelkenarı yapıyordu. Birimiz açıları ölçüyordu, birimiz kenar uzunluklarını hesaplıyordu. (…) Ama gruptaki bir arkadaşımız sorumluluğunu yapmazsa etkinliği yetiştirmekte sıkıntı yaşıyorduk. Zamanla herkes sorumluklarını yerine getirmeyi öğrendi…"* (Görüşme kaydı: Ö5)

Öğrencilere, "Matematik dersinde gerçekleştirilen uygulama sürecini arkadaşlarına ya da ailene anlatacak olsan neler anlatırdın?" diye sorulmuş ve alınan cevaplar doğrultusunda öğrenme öğretme süreci teması oluşturulmuştur. Bu tema altında on iki adet kod belirlenmiştir. Bu kodlar Tablo 4'te verilmiştir.

Tablo 4. Öğrenme Öğretme Süreci Temasına İlişkin Kodlar

a. Etkin Katılım
b. Farklı Etkinliklere Yer Verme
c. Farklı Materyalleri Kullanma
d. Etkinliklerin Anlaşılır Olması
e. Çalışma Kağıdının İşlevselliği
f. Çalışma Kağıdının Görselliği
g. Dersin Eğlenceli Geçmesi
h. Rahat ve Güven Verici Öğrenme Ortamı
i. Öğrenme Görevleri
j. Problem Senaryolarının Gerçek Yaşama Yakınlığı

k. Problem Senaryolarının İşlevselliği
l. Derse İlişkin Öneriler

Öğrenciler süreç boyunca etkinliklerde görev almaya çalıştıklarından bahsetmişlerdir. Öğrenenlerin süreçte aktif olmalarını sağlamak için farklı etkinlikler hazırlanmış ve farklı materyaller kullanılmıştır. Etkinliklerin ve materyallerin çeşitliliği öğrenenlerin hoşuna gitmiş, derslerin eğlenceli geçmesine katkıda bulunmuştur. Bu konudaki öğrenenlerin görüşleri şu şekildedir:

> *"…Derse katılıp soru sorduğumda daha kolay öğreniyordum. Eğer derste hiçbir şey yapmadan oturursam öğrenemezdim. Bunun için herkes gibi ben de etkinliklerde aktif olmaya çalıştım…"* (Görüşme kaydı: Ö4)

> *"…Sınıfımızda hem kendi grubumuzdaki hem de diğer gruplardaki arkadaşlarımızla rahatça tartışabildiğimiz, birbirimizin fikirlerini öğrenebildiğimiz bir ortamda ders işliyoruz…"* (Görüşme kaydı: Ö6)

> *"…Etkinliği siz yapıp bize sonucunu söylerseniz konuyu iyi anlayamayız. Tahtada ya da kâğıtlarımızda kendimiz yaptığımızda daha iyi anlarız. (…) Çokgenlerle, doğrularla ilgili bilmediğim birçok özelliği etkinliklerden kendim keşfettim ve çok mutlu oldum. Sizden ya da kitaplardan direk öğrenseydim konuyu çabuk unutabilirdim…"* (Görüşme kaydı: Ö8)

Son tema olan öğretmen özellikleri beş adet koddan oluşmuştur. Bu kodlar Tablo.5'te gösterilmiştir.

Tablo 5. Öğretmen Özellikleri Temasına İlişkin Kodlar

a. Rehber/ Yol Gösterici Olma
b. Derse Hazırlıklı Gelme
c. Öğrenme Ortamını Hazırlama
d. Etkinliklerle İlgili Açıklamalar Yapma
e. Öğrenenlerin Dikkatini Derse Çekme

Öğrenenler, öğretmeni rehber/yol gösterici olarak nitelendirmişlerdir. Öğretmenin derse hazırlıklı gelmesi, öğrenme ortamını hazırlaması ve etkinliklerle ilgili açıklamalar yapması önemli olarak görülmüştür. Öğrencilerin bu temayla ilgili dile getirdiği düşüncelerden bazıları aşağıdaki gibidir:

> *"…Yapamadığımız kısımlarda sizden yardım alıyorduk. Siz de bizi yönlendiriyordunuz. Biraz daha düşünmemizi istiyordunuz. Biz de doğru cevabı sizin yönlendirmenizle daha kolay buluyorduk…"* (Görüşme kaydı: Ö2)

> *"…Çoğunlukla grup olarak sizden yardım aldık. Önce kendi içimizde problemi çözmeye çalışıyorduk, eğer zorlanırsak yanınıza gelip yol göstermenizi istiyorduk. Siz de bize ipucu veriyordunuz. Sizden aldığımız yardımın çok faydası oluyordu…"* (Görüşme kaydı: Ö9)

Sonuç olarak öğrenciler kavram karikatür destekli öğrenme uygulamalarına ilişkin yapılan görüşmelerde öğretmen rehberliğine değinmişlerdir. Öğretmenin öğrenme ortamı ile ilgili yaptığı düzenlemeler, etkinlikler sırasında yaptığı açıklamalar ve yönlendirmeler öğrenme sürecinin sorunsuz yürütülmesini sağlamıştır. Ayrıca öğretmenin dersin girişinde öğrenenlerin konuya ilişkin fikir edinmelerini sağlamak ve dikkatini çekmek için yaptığı açıklamalar öğrenciler açısından önemli görülmüştür.

SONUÇ VE TARTIŞMA

Araştırmanın ilk alt problemi kavram karikatürleri ile desteklenen öğrenme ortamında öğrenenlerin problem çözme becerilerinin nasıl bir gelişim gösterdiğini belirlemektir. Bu alt probleme yanıt aramak amacıyla konu sonlarında 20 adet problem senaryosu kullanılmıştır. Her bir senaryoya ilişkin puan değerleri incelendiğinde senaryoların doğru cevaplanmasının arttığı görülmektedir. Bu sonuç kavram karikatür destekli öğrenme uygulamalarının öğrenenlerin problem çözme becerilerini geliştirdiğini göstermektedir. Ersoy ve Türkkan (2010) yaptığı çalışmada öğrencilerin yaşadıkları problemlerin çözümünde kavram karikatürlerinin kullanılmasının yararlı olduğunu söylemiştir. Evrekli (2010) ise çalışmasında kavram karikatürlerinin öğrencilerin bilimsel yöntemi kullanarak problemlere çözüm bulmalarını sağladığını belirtmiştir.

Araştırmanın bir diğer alt problemi kavram karikatürleri ile desteklenen öğrenme ortamında yapılandırmacı öğrenme yaklaşımı uygulamalarının öğrenenlerin performans görevlerine nasıl yansıdığını belirlemektir. Bu alt probleme yanıt aramak amacıyla bütün öğrencilerden uygulama sonunda performans görevi hazırlaması istenmiştir. Daha önce kavram karikatür destekli etkinlikleri kullanmayan öğrenciler uygulama boyunca karikatürlere ilgi göstermişler ve öğrencilerin büyük çoğunluğu karikatürleri değerlendirme ölçütlerine uygun şekilde hazırlamıştır. Aslan-Yolcu (2013) da performans görevinin uygulanabilirliği ile ilgili öğrenci görüşlerini aldığı çalışmasında benzer bir sonuca ulaşmış ve öğrencilerin süreçteki öğrenmelerinin ürünlere olumlu yansıdığını belirtmiştir.

Araştırmanın sonuncu alt problemi kavram karikatürleri ile desteklenen öğrenme ortamında yapılandırmacı öğrenme yaklaşımı uygulamalarına yönelik öğrenenlerin görüşlerini belirlemektir. Bu alt probleme yanıt aramak amacıyla uygulama bittikten sonra öğrenenlerle görüşme yapılmıştır. Görüşmeler sonucunda kavram karikatür destekli yapılandırmacı öğrenme uygulamalarının öğrenenlerin duyuşsal özelliklerine olumlu katkı sağladığı bilgisine ulaşılmıştır.

Kavram karikatür destekli yapılandırmacı öğrenme uygulamaları sayesinde öğrenenlerin grup etkinliklerine yönelik olumlu görüşler geliştirdikleri, derslere merak ve ilgilerinin arttığı, öğrenme çaba ve isteğinin geliştiği, hoşgörülü oldukları ve öz güvenlerinin gelişiminin desteklendiği görülmüştür. Alanyazın incelendiğinde kavram karikatürlerinin öğrencilerin görüşlerini açıkça dile getirebilecekleri bir ortam sağladığı ve öğrencilerin derse katılmasını sağlamada yararlı olduğunu belirten çalışmalar yer almaktadır (Keogh ve Naylor, 1999; Greenwald ve Nestler, 2004; Çiğdemtekin, 2007; Chin ve Teou, 2009; İnel, Balım ve Evrekli, 2009; Chen ve diğ., 2009; Şengül ve Aydın, 2013).

Ayrıca öğrenciler uygulama süresince grup arkadaşlarıyla işbirliği içinde olmuşlardır. Birbirleriyle olumlu iletişim kurmuşlar, bilgi ve sorumluluk paylaşımında bulunmuşlardır. Özalp'in (2006) kavram karikatürlerinin kullanımına ilişkin öğrenci görüşlerini aldığı çalışmada da benzer sonuçlara ulaşılmış, karikatürlerin işbirliği ve grup çalışmasını desteklediği sınıf içi etkileşimi sağlayarak öğrencilerin fikirlerini birbirleriyle paylaşmalarına yardımcı olduğu görülmüştür.

Elde edilen bulgular incelendiğinde kavram karikatür destekli yapılandırmacı öğrenme uygulamalarının yürütüldüğü derslerde öğretmenlerle ilgili birtakım sonuçlara ulaşılmıştır. Öğretmenlerin rehber/yol gösterici olma, derse hazırlıklı gelme, öğrenme ortamını hazırlama ve öğrenenlerin dikkatini derse çekme ile ilgili özellikleri ön plana çıkmıştır. Alanyazında öğretmenlerin öğrencilerle olan etkileşimlerinde rehber konumunda olmalarını vurgulayan ve öğretmenin öğrencilerin kendilerini rahat hissedecekleri öğrenme ortamları düzenlemesi gerektiğine değinen çalışmalar da bulunmaktadır (Açıkgöz, 2003; Aksoy, 2004; Karakuş, 2006). Bunun yanı sıra Altrichter, Kemmis, McTaggart ve Zuber-Skerritt'in (2002) eylem araştırmalarının doğasını inceledikleri çalışmada, bu araştırmaları gerçekleştiren öğretmenlerin mesleki bilgi ve deneyimlerinin arttığı belirlenmiştir.

Araştırmadan ulaşılan sonuçlar doğrultusunda aşağıda yer alan öneriler geliştirilmiştir:

Öğrenenlerin problemleri anlamaları, uygun strateji kullanarak çözmeleri ve problemleri çözerken hatalarını en aza indirmeleri için öğrenme sürecinde kavram karikatür destekli etkinliklerin kullanılması teşvik edilebilir.

Öğrenme-öğretme sürecinin 5E modeline göre tasarlanarak öğrenenlerin bireysel ve grup olarak çalışmaları desteklenebilir.

Öğrenenlerin öğrenme sürecinde öğrendiklerini gözlemlemek için performans görevleri kullanılabilir.

Fen Bilimleri ders ve çalışma kitaplarında yer verilen kavram karikatür destekli etkinlikler matematik kitaplarında da yer alabilir.

Öğretmenlerin sınıf içindeki uygulamalarının niteliğini arttırmak ve mesleki gelişimlerine katkı sağlamak amacıyla eylem araştırmaları kullanılabilir.

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ACCORDING TO THE TEACHERS' OPINIONS, TEACHING MATHEMATICS IN THE 5TH GRADES IN NEW 4+4+4 EDUCATION SYSTEM

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ABSTRACT: The aim of this paper is to investigate the teachers' opinions about mathematics education in the 5th grade students and to identify the difficulties. The data were gathered by using semi-structured interviews conducted with 8 classroom teachers and 8 mathematics teachers. All of the interviews were recorded on a tape recorder and in the interpretation of the data, typological analysis, which is one of the technique of qualitative data analysis, was used.

Key words: teaching mathematics in the 5th grades, 4+4+4 education system, teachers' opinions.

ÖĞRETMEN GÖRÜŞLERİNE GÖRE 4+4+4 YENİ EĞİTİM SİSTEMİNDE İLKÖĞRETİM BEŞİNCİ SINIFTA MATEMATİK ÖĞRETİMİ

ÖZET: Bu çalışmanın amacı, ilköğretim matematik ve sınıf öğretmenlerinin gözüyle, 4+4+4 yeni eğitim sisteminin beşinci sınıfta matematik öğretimine ilişkin etkilerini araştırmak ve yaşanan zorlukları tespit etmektir. Veriler, 8 sınıf öğretmeni ve 8 ilköğretim matematik öğretmeni ile yapılan görüşmelerle elde edilmiş, bunun için yarı yapılandırılmış görüşme formları kullanılmıştır. Yapılan tüm görüşmeler, ses kayıt cihazı ile kayıt altına alınmış ve yorumlama sürecinde veri analizi tekniklerinden olan tipolojik analiz kullanılmıştır.

Anahtar sözcükler: ilköğretim matematik öğretimi, 4+4+4 eğitim sistemi, öğretmen görüşleri

GİRİŞ

Bir ülkenin gelişmişlik derecesi, şüphesiz, eğitim sistemindeki başarı ile doğru orantılıdır. Ülkede meydana gelen politik, ekonomik ve daha birçok alandaki değişimler, eğitim sisteminde de reformların yapılmasını gerekli kılmaktadır. (Cetkovic, Knezevic, Vujovic & Cerovic, 2012) Zamanın getirdiği ihtiyaçlara cevap veremeyen bir eğitim sistemi işlevini yitirir ve teorinin gerektirdiği uygulamaları ortaya koymakta çaresiz kalır. (Çakır, 2010) Bunun farkına varan ülkeler, eğitime çok daha fazla önem vermektedir. Bu amaç doğrultusunda, 18. Millî Eğitim Şûrası'nda alınan kararla 2012-2013 eğitim öğretim yılından itibaren ülkemizde 4+4+4 eğitim sistemine geçilmiştir. Bu sistemle birlikte daha önce 5+3 kesintisiz 8 yıl olarak uygulanan zorunlu eğitim 4+4+4 eğitim sistemine dönüştürülmüştür. Buna göre 4 yıl ilkokul, 4 yıl ortaokul ve 4 yıl lise şeklinde düzenleme yapılmıştır. Ayrıca öğrencilerin okula başlama ve mezun olma yaşı değiştirilmiş, öğretmenlerin özlük hakları ile ilgili düzenlemeler yapılmış ve yeni seçmeli dersler oluşturulmuştur.

Günümüzde uygulama alanlarının genişliği bakımından matematik tüm bilim dalları için vazgeçilmez bir kaynaktır. (H. H. Aksu, 2008) Her ülkede, her düzeydeki eğitim kurumunda matematik öğretiminin gerekliliği tartışılmaz bir kanı olarak yerleşmiş ve bir ulusun eğitim programında matematiğe ayrılan yer, o ulusun kendi dilini öğretmek için ayrılan yere eşdeğerdir kanısına varılmıştır. (Çoban, 2002)

Son yıllarda, toplum içinde hayatını sürdüren insanlar için okulda verilen matematik eğitimi, onların yaşamı boyunca alacağı matematik öğretiminin önemli bir bölümünü oluşturur. Bu bağlamda, günlük hayatta matematiği kullanabilen, problem çözebilen, çözümlerini ve düşüncelerini paylaşabilen, ekip çalışması yapabilen, matematikte öz güven duyabilen ve matematiğe yönelik olumlu tutuma sahip bireylerin yetiştirilmesi gerekmektedir. (Baki, 2006) Buna göre, beşinci sınıf matematik derslerinin verimliliğinin, 4+4+4 yeni eğitim sistemi ile birlikte nasıl değiştiğinin araştırılması bir ihtiyaç halini almıştır.

Eğitimde yapılan değişikliklerden etkilenenlerin en başında, pek tabiidir ki, sistemin uygulayıcısı olan öğretmenler gelmektedir. Öğretmenlerin uygulamayı anlaması başarıyı etkileyen en önemli faktörlerdendir. (Eurydice, 2008: 54) Bunun için uygulama öncesinde etkili bir hizmet içi eğitim ile hazırlık dönemi tamamlanmalıdır. Yeni sistemle birlikte değişim yapılan alanlardan birisi de daha önce sınıf öğretmenleri tarafından yürütülen Matematik, Fen Bilgisi gibi derslerin yeni sistemle birlikte branş öğretmenleri tarafından yürütülmeye başlamasıdır. Öğrencilerin okula başlar başlamaz sınıf öğretmenleri ile tanışması, uzun yıllar sınıf öğretmeni ile birlikte eğitimine devam etmesi sebebiyle öğrencinin gözünde sınıf öğretmeninin yeri tartışılmazdır. Öğrencinin karakteri de bir anlamda bu yıllarda şekillenmektedir. Çocukların sınıf öğretmenlerinden aldıkları bilgi ve becerileri eğitim yaşamları boyunca devam ettirdikleri görülmektedir. Öğrencilerin hangi dersi sevip sevmediği, hangi derste başarılı olup olmadığı bile sınıf öğretmeninin ders anlatımına göre değişmektedir. Eğitimin genel işlevi, bireyin topluma uyumuna yardımcı olmak, bireyde var olan yeteneklerin üst sınıra kadar gelişmesini sağlamak amacıyla gerekli olan davranış biçimlerini bireye kazandırmaktır. (Varış, 1998: 17) Diğer bir deyişle, çocukların fiziksel, zihinsel ve ahlaksal varlığında bir değişim ve gelişim sağlamaktır. (Tezcan, 1992: 48) Bu durumda, yeni sistemde matematik öğretimine dair sınıf öğretmenlerinin de görüşlerini almak oldukça önemlidir. Bu bağlamda, matematik öğretiminin aktörlerinin kimler olacağının tartışılması önemli görülerek bu araştırmaya gereksinim duyulmuştur.

YÖNTEM

Bu başlık altında araştırmanın amacı, modeli, çalışma grubu, verilerin toplanması ve çözümlenmesi konuları ele alınmıştır.

Araştırmanın Amacı

Bu çalışmanın temel amacı, beşinci sınıfta matematik derslerini daha önce yürütmekte olan sınıf öğretmenleri ve yeni sistemle birlikte yürütmeye başlayan ilköğretim matematik öğretmenlerinin görüşleri doğrultusunda hazırlık ve uygulama sürecinde yaşanan sorunları belirlemektir. Bunun için aşağıdaki sorulara cevap aranmıştır:

1) İlköğretim matematik öğretmenleri beşinci sınıfta matematik derslerini kimlerin yürütmesinin daha yararlı olacağına dair neler düşünmektedirler?

2) Sınıf öğretmenleri beşinci sınıfta matematik derslerini kimlerin yürütmesinin daha yararlı olacağına dair neler düşünmektedirler?

3) İlköğretim matematik öğretmenleri ve sınıf öğretmenlerinin bu zorluk ve sıkıntılara dair çözüm önerileri nelerdir?

Araştırmanın Modeli

İlköğretim matematik öğretmenleri ve sınıf öğretmenlerinin matematik dersinin öğretimine ilişkin görüşlerini inceleyen bu araştırma, nitel araştırma yöntemine göre desenlenmiştir. Nitel araştırma; gözlem, görüşme ve doküman analizi gibi veri toplama araçlarının kullanıldığı, algıların ve olayların doğal ortamda gerçekçi ve bütüncül bir biçimde ortaya konulmasına yönelik bir sürecin izlendiği araştırma desenidir (Yıldırım ve Şimşek, 2005)

Çalışma Grubu

Araştırmanın çalışma grubunu, Konya ili, Ereğli ilçesinde görev yapmakta olan 8 sınıf öğretmeni ve 8 ilköğretim matematik öğretmeni oluşturmaktadır. Katılımcıların her iki sistemde de görev yapmış olmalarını sağlamak amacıyla her birinin hizmet yılı en az 5 yıl olarak seçilmiştir. Katılımcılar, kolay ulaşılabilir örnekleme yöntemi kullanılarak belirlenmiştir. Gönüllülük esas alınmıştır. Seçilen okulların sosyoekonomik düzeyleri birbirine denktir. Katılımcılara ait temel bilgiler, Tablo 1'de verilmiş olup sınıf öğretmenleri için S, ilköğretim matematik öğretmenleri için M rumuzları kullanılmıştır.

Tablo 1

Rumuz	Cinsiyet	Mezun olduğu fakülte	Hizmet süresi	Görev yeri
S1	Bayan	Eğitim Fakültesi	15	İlçe merkezi
S2	Erkek	Ziraat Fakültesi (Ziraat Müh.)	18	İlçe merkezi
S3	Bayan	Eğitim Fakültesi	20	İlçe merkezi
S4	Erkek	Eğitim Fakültesi	23	İlçe merkezi
S5	Erkek	Eğitim Fakültesi	20	İlçe merkezi
S6	Erkek	Eğitim Fakültesi	20	İlçe merkezi
S7	Bayan	Eğitim Fakültesi	15	İlçe merkezi
S8	Erkek	Fen Edebiyat Fakültesi (Fizik)	16	İlçe merkezi

M1	Erkek	Eğitim Fakültesi	15	İlçe merkezi
M2	Erkek	Eğitim Fakültesi	13	İlçe merkezi
M3	Bayan	Eğitim Fakültesi	13	İlçe merkezi
M4	Bayan	Eğitim Fakültesi	10	İlçe merkezi
M5	Bayan	Fen Edebiyat Fakültesi	15	İlçe merkezi
M6	Erkek	Eğitim Fakültesi	13	İlçe merkezi
M7	Erkek	Eğitim Enstitüsü	36	İlçe merkezi
M8	Erkek	Eğitim Enstitüsü	32	İlçe merkezi

Veri toplama aracı

Araştırmada açık uçlu sorulardan oluşan yarı yapılandırılmış görüşme formu kullanılmıştır. Buna göre, görüşme soruları araştırmacı tarafından önceden hazırlanmış, ilk bölümde öğretmenlerin kişisel bilgilerinden oluşan sorular yer almış, görüşme esnasında katılımcılara kısmî esneklik sağlanarak sorular yeniden düzenlenmiştir. (Patton, 2002)

Hazırlanan taslak görüşme formları, eğitim bilimleri alanında uzman bir öğretim üyesi tarafından değerlendirilmiş, ifade bozukluğu bakımından ise alanında uzman bir Türkçe Eğitimi Bölümü öğretim üyesi tarafından gözden geçirilmiş ve gerekli düzeltmeler yapılmıştır.

Katılımcılar arasında bulunmayan 1 sınıf öğretmeni ve 1 ilköğretim matematik öğretmeni ile pilot uygulamalar yapılmış, bu görüşmeden elde edilen sonuçlar doğrultusunda gerekli görülen değişiklikler yapılmıştır. Görüşmeler, yaklaşık 15-20 dakika sürmüş ve okulda uygun olan bir derslik veya öğretmenler odasında gerçekleştirilmiştir.

Katılımcıların tamamına görüşme formundaki tüm sorular sorulmuş ve görüşme sırasında ortaya çıkan durumlara göre farklı sorular da yöneltilmiştir.

Verilerin Analizi

Görüşmelerde elde edilen verilerin analizinde nitel veri analizi tekniklerinden olan tipolojik analiz kullanılmıştır. (Hatch, 2002) Çalışma grubu ile yapılan görüşmeler, ses kayıt cihazı ile kaydedilmiştir. Analiz sırasında her bir alt amaçla ilişkili olarak görüşme soruları birer tema /boyut biçiminde ele alınmıştır. Her bir temanın içindeki anlam birimleri ortaya konmuş ve bu anlam birimleri aracılığıyla da kuramsal açıklamalara dayandırılarak çıkarımlar yapılmıştır.

Nitel verilerin raporlaştırılması aşamasında, bulgularla ilgili olarak, görüşmelerden birebir alıntılar yapılarak, güvenilirlik arttırılmaya çalışılmıştır. Katılımcılar için S1, S2, …, K1, K2, … gibi kodlamalar kullanılmıştır.

BULGU VE YORUMLAR

Bulgular, sınıf öğretmenlerinden elde edilen bulgular ve ilköğretim matematik öğretmenlerinden elde edilen bulgular olarak sınıflandırılmıştır.

Sınıf Öğretmenlerinden Elde Edilen Bulgular:

Sınıf öğretmenleri ile yapılan görüşmelerde, öğretmenlerin tamamı, verilen hizmet içi eğitimin yeterli olmadığını, çok daha verimli bir eğitim verilmesi gerektiğini ifade etmişlerdir.

Sınıf öğretmenleri olarak kendilerini en çok etkileyen durumun, okula başlama yaşının küçülmesi ve birçok öğretmenin norm fazlası durumuna düşmesi olduğunu söylemişlerdir. Ayrıca, öğrencileri dördüncü sınıfta mezun etme durumunu biraz yadırgadıklarını ve biraz da öğrencilerin beşinci sınıfta ortaokula adaptasyonu konusunda endişelendiklerini dile getirmişlerdir.

Genel anlamda beşinci sınıf matematik derslerine sınıf öğretmenlerinin mi yoksa branş öğretmenlerinin mi girmesi gerektiği sorusuna S2, S3, S4, S5 ve S6 rumuzlu öğretmenler, beşinci sınıf matematik derslerinin müfredat olarak sınıf öğretmeninin kaldıramayacağı düzeyde olmadığını, bu yüzden sınıf öğretmenleri tarafından verilmesinin daha yerinde olduğunu düşündüklerini belirtmişlerdir. S1, S7 ve S8 rumuzlu öğretmenler ise zaman içinde sistemin oturmasıyla, ders anlamında branş öğretmenlerinin daha yararlı olabileceğini; fakat çocukların o yaştaki ilgi ve ihtiyaçları düşünüldüğünde derslerin sınıf öğretmenleri ile yürütülmesinin daha doğru sonuçlar vereceğini düşündüklerini söylemişlerdir.

Yine öğretmenlerin tamamı, öğrencinin sınıf öğretmeni ile farklı bir iletişim içinde bulunduğunu, bazı durumlarda sadece öğretmenini sevdiği için ders çalıştığını dile getirmişlerdir. Ayrıca sınıf öğretmenlerinin öğrencileri kişisel olarak çok iyi tanıyıp eksikliklerini bildikleri için sınıf içinde zamanla bu öğrencilerin eksiklerini kapatabildiklerini ifade etmişlerdir. S1, S2 ve S6 rumuzlu öğretmenler bu konuda düşüncelerini şöyle dile getirmişlerdir:

"Sınıf öğretmeni çocuklar için anne baba gibi. Çocuklar beşinci sınıfta ortaokul olduklarında bu ilgiyi göremeyince bocalıyorlar. " (S1)

"Bazı öğrenciler beşinci sınıfta branş öğretmeni ile karşılaşınca zeki bile olsa kendisini ifade edemeyebiliyor. Öğretmen de farkına varmazsa çocuk dersten uzaklaşabiliyor." (S2)

"Öğrenci beşinci sınıfta yaş itibariyle hâlâ çocuk. İlgiye, denetime ihtiyacı var. Ortaokula gidince bu denetim biraz daha azaldığından, davranışlar bozuluyor, dolayısıyla dersler de bozuluyor." (S6)

Genel olarak bakıldığında, sınıf öğretmenleri, beşinci sınıf öğrencisinin branşa geçiş için yeterli olgunlukta olmadığını, matematik ders müfredatının sınıf öğretmenleri tarafından yapılamayacak kadar ağır olmadığını, belki ders anlatma anlamında branş öğretmenlerinin daha yararlı olduğunu; fakat öğrenci psikolojisi de düşünüldüğünde beşinci sınıf matematik derslerinin sınıf öğretmeni tarafından anlatılmasının daha yararlı olacağını düşündüklerini ifade etmişlerdir.

İlköğretim Matematik Öğretmenlerinden Elde Edilen Bulgular:

Öğretmenlerin tamamı, toplantı ve slayt gösterimi şeklinde gerçekleştirilen hizmet içi eğitimin kendilerine çok fazla yarar sağlamadığını, kendilerini sistem geçişi için çok hazır hissetmediklerini, bu yüzden ilk sene çok zorlandıklarını ifade etmişlerdir**.** M5 ve M7 rumuzlu öğretmenlerin bu konudaki düşünceleri şöyledir:

"Slaytları bize verseler biz evde de okuyabilirdik. Daha farklı ve kalıcı bir eğitim olmalı." (M5)

"Bana şu an sınıf öğretmenliği yap deseler yapamam. O bambaşka bir şey. Dolayısıyla bizim beşinci sınıf matematik derslerini verimli yürütebilmemiz için tam anlamıyla hazır olmamız, o çocukların psikolojisini iyi bilmemiz ve kaliteli bir hizmet içi eğitim almamız gerekir." (M7)

İlköğretim matematik öğretmenlerinin beşinci sınıf derslerine branş öğretmenlerinin girmesinin avantajları ve dezavantajlarına dair görüşleri şu şekilde olmuştur:

"Ben önceleri kesinlikle ilköğretim matematik öğretmenleri girmeli diye düşünüyordum. Fakat beşinci sınıf öğrencilerinin bu kadar çocuksu olacaklarını düşünmemiştim. Öğrencilerin hem duygusal hem de davranış olarak hâlâ sınıf öğretmenine ihtiyaç duyduklarını hissettim. Ders anlamında belki bizler daha faydalı olabiliriz ama dezavantajları avantajlarından daha fazla diye düşünüyorum." (M1)

"Öğrencinin yaşı çok küçük. Davranışları çok çocuksu. Hiç alışık olmadığımız sorularla bize geliyorlar. Sarılıp öpmek istiyorlar. Bunlar bize ilginç geliyor. Fakat bunun yanında konuları beşinci sınıftan başlayarak bağlantılı şekilde götürebiliyoruz." (M2)

"Ben kendi adıma beşinci sınıf dersi istemiyorum. Çünkü davranış olarak yeterli olgunlukta değiller." (M4)

"Öğrenciler beşinci sınıfta, her durumda yanlarında olan sınıf öğretmeni açlığını doyuramıyorlar." (M5)

"Eğer test çözümü konusunda mükemmel öğrenci yetiştirmek istiyorsak bizlerin bu dersleri yürütmesi daha iyi. Fakat çocukların bu yaştaki duygusal ihtiyaçlarını daha iyi karşılayabilmek ve daha iyi bireyler yetiştirmek istiyorsak kesinlikle sınıf öğretmenleri bu dersleri yürütmeli. Bu bireyler derste de başarılı olacaklardır zaten. Çünkü biz ne kadar anlayışlı olursak olalım, onları ne kadar seversek sevelim, bir sınıf öğretmeninin yaklaşımını sergileyemeyiz." (M7)

"Beşinci sınıf derslerine girmekten zevk almıyorum. Öğrenciler çok çocuksu ve konular biraz basit geliyor. Dolayısıyla beni tatmin etmiyor." (M3)

M7 ve M8 rumuzlu öğretmenler, öğrencilerin beşinci sınıfta soyut öğrenme yaşının henüz gelişmediğini, branşa geçmek için yeterince hazır olmadıklarını, bu yüzden beşinci sınıfta bocalarsa bu bocalamanın ömür boyu devam edeceğini ve çocuğun matematik dersinden soğuyacağını ifade etmişlerdir.

Diğerlerinden farklı olarak, M6 rumuzlu öğretmen, beşinci sınıfta branş sisteminin çok yerinde bir karar olduğunu, böylece 5. , 6. , 7. ve 8. sınıflarda konuları bağlantı kurarak anlatabildiklerini, öğrencileri üst sınıflara kendi elleriyle hazırlayabildiklerini dile getirmiştir.

Daha önce aynı sıkıntıları altıncı sınıf öğrencileri ile yaşayıp yaşamadıklarına dair öğretmen görüşleri şu şekilde olmuştur:

"Altıncı sınıf öğrencileri ortaokula daha hazır halde geliyordu. Bu kadar sıkıntı yaşamıyorduk." (M1)

"Daha önce altıncı sınıflarda da böyle bir bocalama dönemi oluyordu ama beşinci sınıflar kadar uzun ve zor bir süreç olmuyordu. Daha kolay adapte oluyorlardı." (M3)

"Daha önce altıncı sınıflar çok küçük, seviyelerine inemiyoruz derdik. Şimdi aynı şeyi beşinci sınıfta daha ağır bir şekilde yaşıyoruz." (M6)

"Çocuk gelişiminde bir yıl çok önemlidir. Bir yılda çok şey değişebilir. Dolayısıyla beşinci ve altıncı sınıfta yaşanan sorunları karşılaştırırsak, altıncı sınıflar bu uyum sürecini çok daha kolay atlatıyorlar." (M8)

Öğretmenlere, bu sıkıntıların sistemin yeni oluşu ile ne kadar ilgili olduğu sorulduğunda, M6 rumuzlu öğretmen dışındaki tüm öğretmenler, sıkıntının temel sebebinin öğrencinin o yaştaki psikolojik durumu, yaş olarak olgunluğa erişememiş olması olarak gördüklerini, zamanla tabii ki daha iyi olacağını; ama tam anlamıyla çözüleceğini düşünmediklerini ifade etmişlerdir. Okula başlama yaşının da erkene alınması sebebiyle bundan sonra gelen beşinci sınıf öğrencilerinin daha küçük yaşta olacaklarını, bununla birlikte başka sorunların da ortaya çıkabileceğini söylemişlerdir.

SONUÇ VE ÖNERİLER

Beşinci sınıfta matematik derslerinin sınıf öğretmenleri veya ilköğretim matematik öğretmenleri tarafından verilmesi konusunda yapılan bu araştırmaya göre, sınıf öğretmenlerinin tamamı, müfredat olarak beşinci sınıf matematik derslerinde zorlanmadıklarını fakat çocukların bu yaştaki duygu durumları da düşünüldüğünde beşinci sınıfta matematik derslerini sınıf öğretmenlerinin yürütmesinin daha doğru olacağı yönünde fikir belirtmişlerdir.

İlköğretim matematik öğretmenleri de aynı konuda benzer düşünceleri savunmuşlardır. M6 rumuzlu öğretmen dışında diğer öğretmenler, beşinci sınıf öğrencisinin hâlâ sınıf öğretmeninin ilgi ve denetimine muhtaç olduğunu, ders anlatımı ve soru çözümü konusunda kendilerinin belki daha yararlı olabileceğini; ama sadece bu anlamda düşünmenin yanlış olduğunu, sınıf öğretmeni takibinde beşinci sınıfa devam etmelerinin daha yararlı olacağını ifade etmişlerdir.

Hem sınıf öğretmenlerinin hem de ilköğretim matematik öğretmenlerinin tamamı, zaman içinde sıkıntıların azalacağını; ama öğrencinin yaş itibariyle yeterli olgunluğa erişememesi sebebiyle tam anlamıyla sona ereceğini düşünmediklerini belirtmişlerdir.

Yine öğretmenlerin tamamı, beşinci sınıf matematik ders müfredatı ve ders saatleri ile ilgili herhangi bir sıkıntının olmadığını, konuları rahat bir şekilde yetiştirebildiklerini ve bol soru çözümü yapabildiklerini söylemişlerdir.

Benzer bir araştırma olan Demir, Doğan ve Pınar (2013)'ın, beşinci sınıflardaki eğitim öğretim sürecinin branş öğretmenlerinin görüşleri doğrultusunda incelendiği ve farklı alanlarda 8 branş öğretmeni ile yapılan çalışmada, 2 öğretmen dışındaki tüm öğretmenler, beşinci sınıfta okutulan derslerin branş öğretmeni tarafından verilmesi gerektiğini, temel derslerin içeriğinin alan uzmanlığı gerektirdiğini, 6,7 ve 8. sınıfa hazırlık amacıyla beşinci sınıfta branşlaşmaya gidilmesinin doğru olacağını ifade etmişlerdir.

Çalışmadan çıkan sonuçlar değerlendirildiğinde, öğretmenlere periyodik olarak daha verimli ve kalıcı hizmet içi eğitimler düzenlenmesi ve bu eğitimlerde hem yeni sistem tüm ayrıntılarıyla tanıtılması hem de o yaş grubundaki öğrencilerin temel özellikleri ve psikolojilerinin anlatılması önerilebilir.

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A BRIEF OVERVIEW OF MATHEMATICS EDUCATION HISTORY IN RUSSIA WITH THE QUALITY APPROACH

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ABSTRACT: It is observed that the developed countries determine the quality standards of education and they achieve an increase in the educational efficiency as a result of application of these standards. In the modern world where having a higher education level is the basic indicator of being developed, especially developing countries are attempting to reinforce their education systems with modern standards in all senses in order to keep pace with the competition. Therefore, it is necessary for our country to question the compliance of such standards and to develop them constantly. Accordingly, one way to make this possible is to give importance to the mathematics science in the statistical field.

In the modern world, Russia takes place among the countries which have a different issue and a different position. The fact that it has a voice in the field of politics and military results from a serious education system of high quality—especially the mathematics education. Even though Russia puts its signature under several accomplishments in the field of mathematics, there are only a few researches in the world and especially in Turkey which deal with the studies of Russian mathematicians. It is thought that conducting a study in this field would be very beneficial in terms of both global mathematics history and mathematics history in Turkey. One of the reasons why Russian scientists are good at mathematics and why mathematics has a very long history in Russia might be that mathematics education institutionally takes the first place in higher education.

The objective of this research is to indicate the role and importance of mathematics education within the frame of total quality management approach and to examine the developments of mathematics learning and education in Russian education system and the works and studies of mathematics educators. In the research, the lives and works of some of the mathematicians, mathematics educators and pedagogues who take place in kilometer stones with their studies related to the mathematics learning and education conducted from past to present in Russia are chronologically classified. Moreover, it is tried to highlight to what extent the world and Turkey benefit from global mathematics history and Russian mathematics history while teaching mathematics and to what extent it is necessary to benefit from these histories.

As a result of the research conducted, it is seen that the mathematics education in Russia dates back to 1650s and this field has been researched as a science since 1798, significant steps have been taken in this field up today and they have developed special mathematics teaching methods in this field.

Key words: education, mathematics learning, mathematics history, total quality management, productivity.

KALİTE YAKLAŞIMIYLA

RUSYA'DAKİ MATEMATİK EĞİTİM TARİHİNE KISA BİR BAKIŞ

ÖZET: Gelişmiş ülkelerin eğitimde kalite standartlarını belirledikleri ve bu ilkeleri uygulamaları neticesinde eğitimde verimlilik artışı sağladıkları gözlenmiştir. Eğitim seviyesinin yüksekliğinin, gelişmişliğin temel göstergesi haline geldiği günümüz dünyasında özellikle gelişmekte olan ülkeler, rekabete ayak uydurabilmek için eğitim sistemlerini bütün boyutlarıyla çağdaş standartlarda bir yapıyla donatmak çabasındadırlar. Bu nedenle ülkemizde de standartların uygunluğunun sürekli olarak sorgulanması ve geliştirilmesinin sağlanması gerekmektedir. Bunun temellerinden biri de sayısal alandaki matematik bilimine önem vermekle mümkündür.

Günümüz dünyasında artık Rusya farklı bir konuya ve konuma sahip ülkeler arasında yer almaktadır. Siyasi ve askeri alanda söz sahibi olmasının arkasında ciddi ve kaliteli bir eğitim, özellikle de matematik eğitimi yatmaktadır. Rusya, matematik alanında büyük başarılara imza atmasına rağmen dünyada özellikle de

Türkiye'de Rus matematikçilerinin çalışmalarını anlatan araştırmaların sayısı yok denecek kadar azdır. Bu konuda bir çalışmanın yapılması hem dünya matematik tarihi hem de Türkiye matematik tarihi adına faydalı olması düşünülmektedir. Rus bilim adamlarının matematik alanında başarılı olmalarının sebeplerinden birisi ve en önemlisi matematiğin çok eski yıllara dayanmasına ve matematik eğitiminin yükseköğretimde kurumsal olarak ilk sırayı alması sebep olarak gösterilebilir.

Bu araştırmanın amacı; toplam kalite yönetimi felsefesi kapsamında matematiğin yeri ve önemini ortaya koymak ve Rus eğitim sisteminin matematik eğitim-öğretimi alanındaki gelişmeleri ve matematik eğitimcilerinin eserlerini ve çalışmalarını incelemektir. Araştırmada, Rusya'da geçmişten bugüne kadar matematik eğitim ve öğretimiyle ilgili çalışmalarıyla ilklerde yer almış bazı matematikçi, matematik eğitimcisi, eğitim bilimcilerinin hayatları ve eserleri kronolojik sıraya göre tasnif edilmiştir. Ayrıca, dünyada ve Türkiye'de matematik dersi anlatılırken dünya matematik tarihinden ve Rus matematik tarihinden ne kadar faydalanıldığı/ faydalanılması gerektiği konusu aydınlatılmaya çalışılmıştır.

Yapılan araştırma sonunda Rusya'da matematik öğretiminin 1650'li yıllarda başladığı ve 1798 yılından itibaren ise bilim olarak araştırıldığı, günümüze kadar ciddi mesafeler kazandığı, bu alanda kendilerine özgü matematik öğretim metotları geliştirdikleri görülmüştür.

Anahtar sözcükler: eğitim, matematik öğretimi, matematik tarihi, toplam kalite yönetimi, verimlilik.

GİRİŞ

Küreselleşen dünyada iletişim ve ulaşım teknolojilerindeki hızlı ve yoğun gelişmeler tüm sektörleri etkilemekte olup, hiç şüphesiz eğitim kurumlarına da büyük ölçüde yansımaktadır. Her sektörde eğitime duyulan yüksek talep, eğitim kurumlarının yapısını ve eğitimle birlikte toplumu ve piyasayı da yeniden şekillendirmektedir. Süreklilik gösteren bu değişim; evrensel değerlere açık, bilgi üretimine katkı sağlayan, bilgiyi aktif ve yaratıcı kullanabilen ve bunları yatırıma dönüştüren daha nitelikli insan yetiştirme zorunluluğu çerçevesinde eğitim kurumlarının da farklılaşmasına neden olmaktadır. Eğitim kurumlarında sunulan eğitim kalitesi ve verimliliği, bir ülkenin gelişmişlik düzeyinin göstergesi olup bu yönde harcanan çabalar önem arz etmektedir.

Bir toplumun görgüsünü, bilgisini, kültürünü, refah ve kalkınmışlık düzeyini kısaca genel niteliklerini belirleyen ve etkileyen en önemli etken, o toplumun bilgi ve eğitim düzeyidir. Bunun için bütün toplumlar, mensuplarının kitlesel eğitimini genişletmeyi ve yükseltmeyi başlıca amaç; bunlara erişmeye yönelik de detaylı hedefler belirtmektedirler. Ülkelerin eğitim düzeylerini saptayabilmek için belirli bir yaş dilimlerinde ki genç nüfusun, o yaş dilimi için verilmesi öngörülen eğitimden ne kadar istifade etmiş olduğuna bakılır. Örneğin; ülkelerin ilköğretimdeki, ortaöğretimdeki, yükseköğretimdeki okullaşma oranlarını ifade ederek birbiri ile karşılaştırmak mümkündür (Köksoy,1998:1). Öğretimde kalite ölçümü ve denetiminin pek çok yararlı sonuçlarının bulunduğu tartışılmaz bir gerçektir. Diğer sektörlerde olduğu gibi bunların en önemli iki yararı vardır. Bunlar; (Köksoy, 1998:1).

Birincisi; öğretim hizmetlerinden doğrudan doğruya yararlananlar (öğrenciler ve toplum)

İkincisi ise; eğitimin sonucu olarak ortaya çıkan somut ve soyut çıktılar, topluma daha kaliteli ürün ve hizmet sunabilmek için öğretim kurumlarını bir rekabet ortamında sokmak ve güçlendirmek için çaba sarf etmelerini sağlamaktır.

Bu çalışmada, eğitim alanının sadece sayısal yönünden biri olan matematik ve onun gelişimine katkı sağlayan belli başlı Rus matematikçilerinden bahsedilecektir.

Kalite ve Eğitim

Gelişmiş ülkelerde bilim üretiminin ancak 1/3'ü okullarda yapılırken, Türkiye'de ise bu oran 2/3 civarındadır (Köksoy, 1998:131-134).

Eğitim ve bilim evrenseldir, kalite gibi; "bilimsel kanunların, kuralların, sonuçların zamanı, mekânı, ülkesi, milliyeti, ırkı, cinsiyeti, dili, dini yoktur. Bu kanunlar ve kurallar aynı şartlar sağlandığı takdirde herkes için ve evrenin her yerinde aynı şekilde geçerlidir" anlamına gelmektedir.
Eğitim ve bilim insanlığın ortak ürünüdür, kalite gibi; "bugün bilimin ulaşmış olduğu düzeye gelişinde insanoğlunun varoluşundan günümüze kadar gelmiş geçmiş bütün medeniyetlerin, toplumların ve her toplum içinde sivrilmiş bilim adamlarının ortak katkısı, tuzu, biberi vardır; bilimsel gelişmeler topyekün ele alındığında hiçbir millete, devlete ve kişilere mal edilemez" anlamına gelmektedir.

Eğitim ve bilim insanlığın hizmetindedir, kalite gibi; temel bilimler için uzunca bir zaman diliminden sonra evrensel bir anlam ifade eder. Çünkü üretildikleri zamanda ticari bir değeri yoktur. Uzunca, bir zaman içinde ve birike birike temel bilimlerin sonuçları, uygulamalı ve teknolojik araştırmalara konu olduklarında bilim bütün insanlığın kullanımına, yararına, sağlık ve mutluluğuna önemli katkılar sağlayan sonuçlar verir.

Eğitimde düzeni, gelişimi ve ilerlemeyi sağlamanın yolu kalite standartlarını belirlemek ve uygulamaktan geçmektedir. Sayısal ve sözel yöntemleri kullanmak bir gerekliliktir. Sayısal alanda Matematiğin etkin kullanımı, kalite standartlarının artmasına ve gelişimine katkı sağlamaktadır.

Kalite, insanların kendilerine sunulan mal ve hizmetlerden bekledikleri özelliklerle ilgilidir. Yaşadıkları coğrafi konumlar, kültürel farklılıklar, ekonomik ve sosyal koşullarındaki değişmeler, edindikleri bilgi ve beceriler, teknolojinin ilerlemesi insanların gereksinim ve beklentilerinde sürekli değişime ve gelişmeye yol açar. Bu nedenle sunulan ürün ve hizmetin kalitesi de sürekli olarak değişmek ve gelişmek zorundadır.

İnsanoğlu ilk üretimi ile birlikte, bilinçsiz de olsa kalite kavramında sahip olmuştur. Ürettiği ilk gereçlerde ihtiyacını karşılayacağını düşündüğü özellikleri ürününe kazandırmış, daha sonraki ürünleri önceki deneyimlerine göre geliştirmiştir. Matematik biliminin gelişimiyle etkin kullanım alanı olan kalite çalışmalarında kullanılmış ve kaliteli ürün ve hizmet sunumunda insanoğlunun kullanımına sunulmuştur (Kalder, 1999:28).

Verimlilik, bir mal veya hizmet üretim sisteminde kullanılan üretim faktörleri ile ortaya çıkan üretim miktarı arasındaki oransal ilişki olmakla birlikte kaynakların etkin kullanımıdır. Bir kurumda verimlilikten söz edebilmek için önceki döneme göre, aynı girdilerle daha fazla çıktı ya da aynı çıktı daha az girdilerle gerçekleştirilmiş olmalıdır. Üretim faktörleri emek, sermaye, tabiat, girişimci olarak tanımlanmakla birlikte "zaman" faktörü verimlilikte önemli olduğundan bunun da eklenmesi gerekir (Uğur, 2013: 8,9).

Yaşam standardımızın yükselmesi, büyük ölçüde hizmet sektöründeki kalite ve verimliliğin sürekli artması ve artırılmasına bağlıdır. Hizmet sektörü içinde bulunan eğitim hizmeti, bu sektör içinde yer alması ve hizmet sektörüne eleman yetiştirmesi açısından sektörün hem öznesi hem de nesnesi konumundadır. Eğitim kurumları içinde hiç kuşkusuz okullar, ülkelerin kalkınma ve gelişiminde en önemli yeri teşkil etmekte olup, bu sürecin artan oranda sürekliliğinin sağlanması ise kalite bilinci ve uygulamaları ile mümkündür. Kalite bilincini etkin olarak uygulanabilmesi içinde matematik bilimine ihtiyaç vardır.

Eğitim, bir hizmet türüdür. Eğitim sektörü içinde yer alan okullar, bugün hem kendi alanlarında hem de uluslararası düzeyde rekabet etmektedirler. Hizmet kalitesinin sürekli iyileştiren ve geliştiren her düzeyde okullar günümüzün yoğun rekabet ortamında öne çıkmakta ve lider konumda yer almaktadırlar (Güzel, 2006:32). Okulların, öğrencilerine sağladıkları eğitim seviyesinin yüksekliği dikkate alınarak uluslararası düzeyde sıralamaya tabii tutulmakta ve kaliteli olarak algılanmaktadır.

Gelişmiş ülkeler eğitimde kalite standartlarını belirledikleri ve bu ilkeleri uygulamaları neticesinde eğitimde verimlilik artışı olduğu gözlenmiştir. Eğitim seviyesinin yüksekliğinin, gelişmişliğin temel göstergesi haline geldiği günümüz dünyasında özellikle gelişmekte olan ülkeler, rekabete ayak uydurabilmek için eğitim sistemlerini bütün boyutlarıyla çağdaş standartlarda bir yapıyla donatmak çabasındadırlar. Bu nedenle ülkemizde de standartların uygunluğunun sürekli olarak sorgulanması ve geliştirilmesinin sağlanması gerekmektedir. Bunun temellerinde biri de sayısal alandaki matematik bilimine önem vermekle mümkündür.

Hizmet üreten bir işletme, müşteri beklenti ve talepleri doğrultusunda hizmet standartlarını geliştirmek durumundadır. Hizmet standartları, işgören rollerini açıklamaya ve işletmenin önceliklerini iletmeye yardımcı olur ve hangi performansın değerlendirilebileceğine ilişkin bir ölçü sağlar. Standartlar çok da fazla olmamalıdır. Müşteri beklentilerinin en önemli olanlarını ve sayıca az olarak belirlemek, beklentileri yönetmek konusunda daha iyi sonuçlar meydana getirir (Örs, 2007:190). Her alanda ürün ve hizmet standartlarını yükseltmek, ancak matematiği ve matematiksel modelleri etkin ve verimli kullanmakla sağlanır. Örneğin; kalite standartları yükseltmek için kullanılan 6 Sigma, İPK, Yalın Üretim vb.

Toplam Kalite Yönetimi (TKY), "kalite – maliyet – fayda – etkinlik – verimlilik" çerçevesi üstüne kurulmalıdır. Kalitede devamlı iyileşmeyi amaçlayan sistem, üretimde yer alan bireylerin fonksiyon ve becerilerini değerlendirmek yerine, organizasyonun verimliliğini artırmayı amaçlamaktadır. Bu yönetim şeklinde kalitenin ek bir maliyet oluşturacağı inancı yerine uzun vadede kalite artışını daha ucuza mal edilebileceği olgusuna bırakmaktadır. TKY, müşterilerin veya kullanıcıların ihtiyaçlarını kalite, fiyat ve hizmet bakımından en iyi şekilde karşılayan ve aynı zamanda maliyeti düşüren bir yönetim sistemidir. Bu faaliyetlerin yerine getirilmesinde TKY'de uygulanan felsefe, üst yönetimin liderliğinde müşteri, kullanıcı merkezli, onun kalite algılamaları ve beklentileri doğrultusunda, takımlar halinde katılımlı bir yönetim süreci içinde iyileştirme olgusuna dayalı bir örgüt kültürü oluşturmaktadır. TKY, genel bir kavram olup, matematikle birebir ilişkilidir. Bunlar (Köksoy, 1998:135);

- Eğitimde Kalite Güvencesi
- Eğitimde Kalite Kontrolü
- Eğitimde Kalite Denetimi
- Eğitimde Kalite Değerlendirmesi
- Eğitimde Akreditasyon
- Eğitimde Kalite Sıralaması vb.
  kavramları içine almaktadır.

Yukarıdaki kriterler referans alınarak sürecin etkin ve sürdürülebilir olması sağlanmaktadır.

Kalite Yaklaşımıyla Eğitim

Kalite, günün şartlarına, ihtiyaçlarına ve gelişen teknolojiye paralel olarak sürekli olarak değişen ve gelişen bir kavramdır. Dünyada hızlı değişen ve gelişen şartlara uyum sağlayabilmek için eğitim nereye doğru gitmekte olduğunu anlamak, dünyada ne gibi değişiklikler beklendiğini görebilmek ve anlamak gerekir (Köksoy, 1998:9).

Eğitim sistemleri her toplumsal kurum gibi toplumdaki değişmelerden etkilenmekte ve bu değişmelere uyum göstermektedir. Toplumdaki değişmelerin eğitim ve öğretim yansımalarını kestirilebilmek için dört boyut üzerinde durmak yeterli olabilir (Köksoy, 1998:10). Bunlar;

- Dünyada, ekonomik ve üretim sistemindeki değişmeler. Tüm bu değişiklikler eğitimin yaygınlaşması, süreklileşmesi ve demokratik bir ortamda yapılması eğilimini doğurmaktadır.
- Dünyada, devlete bakış açısındaki değişmelerdir.
- Dünyada, bilime bilgiye yaklaşımdaki değişmelerdir.
- Dünyada, refah düzeyi artan toplumlarda eğitim talebinin artmasıdır.

Kalite; önlemedir, müşterinin tatminidir, verimliliktir, esnekliktir, etkili olmaktır, spesifikasyonlara uygunluktur, süreçtir, yatırımdır. Kalite, iyileştirilebilecek her şeydir. Kalite, kusursuzluk arayışına sistemli bir yaklaşımdır. Matematik ise bunu sağlayan ve destekleyen en temel bilimdir (Efil, 2010;8). Matematik bilimi de bu alanda çalışan ve mesai harcayan ilgililer tarafından devamlı olarak geliştirilmekte ve insanoğlunun hizmetine sunulmaktadır.

Kalite tanımları; amaca uygunluk derecesi, kullanıma uygunluk, standartlara uygunluk, beklentileri karşılama seviyesi, memnuniyetin ölçüsü gibi açıklanabilir. Toplam kalite yönetimini oluşturan sözel ve sayısal olmak üzere iki ana boyut vardır. Bu beklentileri karşılamak için matematik alanındaki tüm gelişmeler insanoğlu ve çevresi için ürün geliştirme ve hizmet sunumunda direk ya da dolaylı yönden kullanılmaktadır. Örneğin; ürün ve hizmet kalitesini belirleyen unsurları genel olarak; görünüş, boyut, işlev, bulunabilirlik, değiştirebilirlik, güvenilirlik, dayanıklılık, teslim zamanı vb. birçok alanda matematik kullanımı şart ve gereklidir (Kalder, 1999:24).

Toplam kalite yönetiminden beklenen yararların başında gelen "iş sonuçlarının mükemmelleşmesi" başlığı altında; ürün ve hizmet kalitesinin artması, maliyetlerin düşmesi, üretimin artması, verimliliğin artması, satışların artması, ıskartaların azalması, stok seviyelerinin azalması, malzeme ve zaman kaybının azalması, çevrim süresinin azalması, şikâyetlerin azalması, atıkların azalması, ekonomik risklerin azalması, yaşam kalitesinin artması vb.dir. Toplam kalite yönetiminden beklenen bu yararlarının gerçekleşebilmesi için matematik kullanılmış ve kullanılmaya da devam edilmekte ve edecektir (Kalder, 1999:32).

Toplam kalite yönetiminin temel ilkeleri; yönetimin liderliği, müşteri odaklılık, insan odaklılık, tam katılım, sürekli geliştirme, önlemeye yönelik yaklaşım, ölçmeye, bilgiye, istatistiğe dayalı yaklaşım, toplumsal sorumluluktur. Bunları etkin bir şekilde yerine getirmek ve tüm ilkelerin gerçekleştirilmesi için matematik bilimine ihtiyaç vardır (Kalder, 1999:33).

Toplam Kalite Yönetiminin uygulanmasında istifade edilen bazı araç ve tekniklere baktığımızda, bunlar; veri toplama ve analizi, aritmetik ortalama, standart sapma, grafikler, dağılma ve korelasyon, gruplandırma, histogram, kontrol noktaları, pareto analizi vb. birçok teknik matematik kökenlidir (Kalder, 1999:66).

Toplam Kalite Yönetimi felsefesinin içinde yer alan maliyet yönetimi, verimlilik yönetimi, kaynak yönetimi, teknoloji yönetimi ve iş yönetiminin tamamı matematiksel yöntem ve tekniklerin kullanımı ile gerçekleştirilmektedir (Efil, 2010:47). Matematiğin gelişimiyle birlikte yönetim anlayışı ve teknikleri de aynı yönde gelişim sağlamış ve sağlamaktadır. Bu da insanoğlunun yaşamını rahatlatmakta ve yaşam alanlarını genişletmektedir.

Toplam kalite yönetimiyle ilgili amaçları belli başlık altında toplamak gerekirse; savurganlığı önlemek, verimliliği artırmak, kaliteyi artırmak, maliyetleri düşürmek, işlem zamanlarını kısaltmak ve sürekli iyileştirmek ve geliştirmektir. Bu amaçları gerçekleştirmek ancak matematiğin kullanılması ile mümkündür (Efil, 2010:77).

Toplam kalite yönetiminin kullanım araç ve tekniklerinden olan istatistiki kalite kontrol ve kalite maliyetlerinin temelini matematiksel yöntemler oluşturur. Bunun için ise personelin eğitimi şarttır. Bu şekilde; matematiksel teori, metot ve yöntemler etkin bir şekilde kullanılarak iş hayatının içinde uygulama alanı bulmaktadır (Kıngır, 2010:108).

Rusya Öğretim Sistemi

Komünist rejim döneminde Rusya'daki öğretim sistemi, akademik yapılanma bakımından Alman sistemine benzemekle beraber, amaçlar doğrultusunda çok büyük farklılıklar vardır. Bu dönemdeki öğretimin esas amacı bir yandan komünist rejimi güçlendirmek ve yaymak, diğer yandan devletçilik yapısı altındaki üretimi artırmaktı. Okullarda okutulan vazgeçilmez zorunlu dersler arasında *"Marksisizm - Leninizmin Esasları", "Bilimsel Komünizm", "Bilimsel Ateizmin Esasları"* konulu dersler yer almaktadır. Geniş bir dünya coğrafyasını ve pek çok devleti etkisi altında bulunan komünist Rusya dönemindeki öğretim modeline *"İdeolojik – Devlet - Üretim"* merkezli model denilebilir (Köksoy, 1998:6).

Sovyetler Birliği'nde olduğu gibi günümüz Rusya'sında öğretim kurumları; üniversiteler, pedagoji enstitüleri, yüksek teknik okullar ve yüksek sosyal bilimler okulları olmak üzere 4 grup halinde eğitim faaliyetlerini sürdürmektedir. Üniversitelerin ve enstitülerin eğitim süreleri 4 ila 6 yıl arasında değişmektedir. Meslek yüksekokulların eğitim süreleri ise 2 yıldır. Yüksek öğretim kurumları kısmi olarak farklı yerlerle ilişkili olmalarına rağmen genel olarak merkezi Moskova'da olan VAK denilen Türkiye'de YÖK'e karşılık gelen Yüksek Akademik Komisyonuna bağlıdır. Rusya'daki Yüksek Öğretim Kurumları arasında farklılıklar olmakla birlikte eski sistemden kalan didaktikler hala günümüzde devam etmektedir. Yüksek Öğretim kurumlarında bilimsel araştırmalar yürütülürken veya mesleki eğitim alınırken Marksist ve Leninizm fikirlerinin verilmesi adına istisnasız bütün bölümlerde felsefe ve ekonomi temel dersler arasında yer almaktadır. Bilimin temeli kabul edilen felsefe dersi okutulurken Lenin'in hayat felsefesine, eserlerine ve faaliyetlerine eğitim programında uzun bir süre ayrılır. Aynı şekilde, ekonomi dersinde Marksizm felsefesi uzun uzun anlatılır. Ayrıca beden eğitimi, yabancı dil ve pedagoji dersleri bütün fakültelerin ortak zorunlu dersleri arasında yer almaktadır (Aşkın, 2012: 39).

Matematik Eğitimi

Genelde matematik, insan hayatını zehir eden derslerden, içine korku salan sınavlardan ve okul biter bitmez kurtulacak bir kabus olarak algılanır. Bazıları içinse, matematik dersi hayatı anlamanın ve sevmenin bir yoludur (Sertöz, 2002). Hayatı anlayan ve seven insanlar arasında Rus matematikçi Perelman'ı göstermek mümkündür. Yüzyılın çözülemeyen problemi *"Poinkare Varsayımını"* açıklığa kovuşturan Perelman, kendisine verilmek istenen büyük para ödülünü kabul etmemiş ve bu işi para için yapmadığını ifade etmiştir. Matematik böyle insanlar için ciddi bir iştir. Matematik, Dönmez (2002) aslında korku duyulan bir disiplin olmayıp aksine yaşam gibi eğlenceli, neşeli ve insanı dinlendiren uğraştır.

Matematiği anlamlı ve zevkli hale getirmek için problemin gelişim süreci anlatılır. Bunun için geçmişte yaşamış önemli matematikçilerin hayatları anlatılır ve onların eserlerine yer verilir. Okullarda matematik tarihiyle zenginleştirilmiş matematik dersleri ile öğrenciler, matematiğin sürekli kendini yenileyen ve geliştiren bir bilim olduğunu, kültürel bir yönünün bulunduğu ve düşünce dünyamıza nasıl yön ve şekil verdiğini görürler (Baki, 2008). Bu yüzden, dünyada ve Türkiye'de matematik derslerinde matematik tarihine yer verilmesi ile ilgili çalışmalar önem arz etmektedir (Fauvel ve Maanen,1997; Liu, 2003; Gönülateş, 2004; Carter, 2006; Goodwin 2007; Albayrak, 2008; Tözlüyurt, 2008; Baki, 2008).

Son yıllarda Türkiye'de matematik tarihinin matematik öğrenme ve öğretmede kullanmıyla ilgili araştırmalarda ciddi artışlar olduğu göze çarpmakla birlikte diğer ülkeler gözönüne alındığında yeterli seviyede olduğunu söylemek pek mümkün değildir. Matematik tarihinin okul matematiği dersinde kullanımı öğretmen adaylarının yönelik bir araştırmada, öğretmen adaylarının tutumlarında herhangi bir değişikliğe sebep olmadığı ve sonucun pozitif olarak çıktığı gözlemlenmiştir (Gönülateş, 2004; İdikut, 2007; Albayrak, 2008; Tözlüyurt, 2008; Alpaslan, 2011).

Wilson ve Chauvot (2000) okul matematiğinin gelişmesinde Avrupalı matematikçilerin önemli bir yere sahip olduğunu vurgulanmasına rağmen diğer ülkelerin bu alanda yaptıkları katkıların göz ardı edildiğini ve azaltıldığını hatta çarpıtıldığını belirtmektedir (Joseph, 1990). *"Bilimin milleti yoktur"* prensibi esas alınarak hangi ülkede olursa olsun öğretmenlerimiz, önemli matematikçilerin hayatlarını inceleyerek onların çalışmalarını, kişiliklerini ve hayat felsefelerini matematik derslerinde anlatarak dersleri zenginleştirmeli, matematiğin insanlık tarihinde yüklendiği rolü, kültürümüzle ilişkisi ve günlük hayatımızdaki yeri hakkında bilgi sahibi olmaları yönünde hem kendilerine hem de öğrencilerine katkı sağlayacaklardır.

Josep, (1990) matematik tarihi hakkında düşüncelerini kaleme aldığı yıllarda, Rusya'da özgürlük devrimi (Glasnost) yaşanmaktaydı. Ülkenin demir kapılarını sonuna kadar açılacak olması Rus matematiğinin ve matematikçilerinin dışarı açılması anlamına gelmekteydi. Ne yazık ki Rusya, sahip olduğu bilim ve bilimadamlarını yeterli ölçüde dünyaya tanıtabilme şansı bulamamıştır. Demir parmaklıklar ardına kadar açılmış olsa bile rejim didaktiğinin etkileri devam etmiş ve uzun bir süre bilim kendi havuzundan öteye akma fırsatı bulamamıştır.

Günümüz dünyasında artık Rusya farklı bir konuya ve konuma sahip ülkeler arasında yer almaktadır. Siyasi ve askeri alanda söz sahibi olmasının arkasında ciddi ve disiplinli bir eğitim, özellikle de matematik eğitimi yatmaktadır. Rusya, matematik alanında büyük başarılara imza atmasına rağmen dünyada özellikle de Türkiye'de Rus matematikçilerinin çalışmalarını anlatan araştırmalar bulunmamaktadır. Bu konuda bir çalışmanın yapılması hem dünya matematik tarihi hem de Türkiye matematik tarihi adına faydalı olması düşünülmektedir. Rus bilim adamlarının matematik alanında başarılı olmalarının sebeplerinden birisi ve en önemlisi matemağin çok eski yıllara dayanmasına ve matematik eğitiminin yüksek öğretimde kurumsal olarak ilk sırayı alması sebep olarak gösterilebilir.

14 Ocak 1701 yılında 1. Petro tarafından ilk Modern Rus Devleti Eğitim Kurumunun kararnamesi çıkartılmış ve bu kurum Moskova Matematik Öncü Okulu olarak ilan edilmiştir. Bu münasebetle Rusya Matematik Topluluğu tarafından 2001 yılında okul matematiği eğitiminin 300.yıl dönümü kutlanmıştır. Özellikle bu andan itibaren Rus matematik eğitimi tarihinden ve modern eğitiminden söz edilebilir. 2005 yılında ise Rusya'da yüksek matematik eğitiminin 200.yılına girilmiştir.

Günümüz dünyasında İngiltere, Avustralya, Hollanda gibi birçok Avrupa ülkelerinin eğitim reformu çalışmalarında problem çözme becerilerinin kazanılması, bu becerilerin gerçek hayat problemlerine uygulanması ve matematiğe karşı olumlu tutum geliştirilmesiyle ilgili bir eğilim vardır. Birçok Avrupa ülkesi ve Amerika, matematik eğitimini güncel hedeflerine ulaştırmak için sürekli program geliştirmeye yönelik çalışmalar yapmaktadırlar (Altun ve Memnu, 2008). Eğitim sisteminde değişimlerin ve gelişmelerin yaşandığı Rusya'da 19.yüzyılın başlarında anayasa ile ilköğretim, ortaöğretim *(lise)*, yükseköğretim *(üniversite)* olmak üzere üç etaptan oluşan eğitim modeli belirlenmiştir.

Rusya'da yüksek matematiğin temelini üniversiteler oluşturmaktadır. Eğitim Bakanlığı üniversite eğitimine çok önem vermektedir. 1803-1806 yıllarında hükümet üniversite eğitimine 130.000 ruble (4000 USD) gibi o zamanın parasıyla çok büyük bir bütçe ayırmıştır. (Kolyagin, 2001). Denizcilik, askerlik, mühendislik ve birçok özel eğitim kurumlarını içine alan profesyonel eğitim sistemleri de matematik eğitimine çok önem vermişlerdir. Bu zaman diliminde matematik programları oldukça genişlemiş hatta üniversite ile boy ölçüşür hale gelmiştir.

1804 yılında ise Rusya'da üniversite yönetmeliği kabul edilmiştir. Bu tarihi, Rusya'da yüksek matematik eğitiminin temellerinin atıldığı yıl olarak saymak mümkündür. Üniversitede ilk defa bağımsız Fizik-Matematik Fakültesi kurulmuştur. Bununla birlikte üniversite bünyesindeki Bilimler Akademisi ve Moskova Üniversitesi'nde seçilmiş yüksek matematik derslerini birinci sınıf uzmanlar (Akademisyenler; Eyler L., Fuss N. İ., Kotelnikov S.K., Rumovskiy S.Y.) vermişlerdir. O zamanlarda bu kişiler matematiğin öncüleri sayılmaktaydı. Çünkü üniversitede matematik kürsüleri bulunmamakta ve özel uzman matematikçi kadrosu hazırlanmamaktaydı.

1804 yılında Moskova Üniversitesi'nde Fizik ve Matematik Bilimleri Fakültesi kurumsal hale gelmiş ve içerisinde 8 anabilim dalını barındırmıştır: Deneysel ve teorik fizik, pür matematik, uygulamalı matematik, astronomi, kimya, botanik, mineral ve tarım bilimleri, teknoloji ve bilimdir. Görüldüğü gibi Rusya yükseköğretim sisteminin yapı taşlarını fizik ve matematik bilimleri oluşturmaktadır. Yönetmeliğe göre üç yıl olan yükseköğretim sistemiyle lise öğretmenleri, matematikçi bilim adamları ve üniversiteler için öğretim elemanları yetiştirilmiştir.

İlerleyen tarihlerde üniversite matematik eğitiminin içeriği matematik kürsüsü *(daha sonra faaliyete geçen pür matematik ve uygulamalı matematik ana bilim dalı)* tarafından hazırlanmıştır. İlk iki yıl okutulan pür matematik adı altında aritmetik, cebir, geometri ve trigonometri ile birlikte yüksek matematiğin bölümü olan analitik geometri ve yüksek cebir ve integral hesapları *(zaman içerisinde kendine ait matematik dersleri)* dersleri verilmiştir. Uygulamalı matematik adı altında mekanik, optik astronomi vb. dersler üçüncü sınıfta okutulmuştur (Milli Matematik Tarihi, 1967:50).

Günümüzde 250 yılı aşkın bir süredir matematikçi, fizikçi, kimyacı, biyolog ve birçok alanda bilim adamı yetiştiren Moskova Devlet Üniversitesi'nin ve bu üniversitede çalışan profesörlerin pür matematik alanında katkıları oldukça büyüktür. Araştırma konusu Rusya'da matematik eğitimi tarihi olduğundan pür matematikle ilgili bu kadar bilgiyle yetinilecektir.

Matematik öğretimi ve eğitimi her zaman metodistlerin ilgi konusu olmuştur. Genelde metot kitaplarında bu konu ayrı bir başlık altında ele alınarak farklı metotların temel özellikleri anlatılmakta ve eğitim öğretim sürecinde uygulama şartları gösterilmektedir.

Rusya'da pedagoji üniversitelerinde, pedagoji enstitülerinde ve pedagoji teknik meslek yüksekokullarında bir ders disiplini olarak okutulan *"Matematik öğretim metotları"* pedagojik ders disiplini kapsamına girmekte ve belirli ölçüde bunun felsefesini, psikolojisini, didaktiğini, mantığını ve matematiğini almış öğrencilere öğretilmektedir.

Rusya'da *"matematik öğretim metotları"* ders programı *"genel metot"* ve *"özel metot"* olmak üzere iki bölüme ayrılmaktadır. Genel metot; psikolojik-didaktik temele dayanarak genel metot düşüncelerini, durumlarını ve tavsiyelerini oluşturmaktadır. Özel metot ise; okul matematiği dersinin genel metodun uygulanılarak öğretilmesinden ibarettir.

Rusya'da matematik öğretimi ve eğitiminin tarihi gelişimini incelemek üzere bu alanda yaptıkları çalışmalarla ilkleri oluşturmuş bazı önemli Rus matematik eğitimcilerinin hayatları ve eserleri kronolojik sıraya göre düzenlenmiştir:

18.Yüzyılda Matematik Öğretimi ve Eğitimi

Magnitskiy Leontiy Filippoviç (1669- 1739)

Rus matematikçi ve eğitimci olan Magnitskiy hakkında kesin olarak biyografik bilgi bulunmamakla birlikte bazı kaynaklara göre onun Tver şehrindeki Ostanşkovskiy Patrik Manastır'ında doğduğu Moskova Slavan-Grek-Latin akademisinden mezun olduğu yazılmaktadır. Moskova Matematik ve Seyrüsefer Bilimleri Okulu'nda önce matematik öğretmeni yardımcısı, daha sonraları ise başöğretmen ve ders bölümü başkanı olarak çalışmıştır. Magnitskiy bir dizi pratik ders kitaplarının yazarıdır. Üstün kabiliyeti, bilgisi ve çalışkanlığı sayesinde o vakitte Rus okulu için mükemmel bir matematik ders kitabı yazmıştır.

Rusya'da İlk Aritmetik Ders Kitaplarından Birisi "Aritmetik"

Rus milli matematik öğretimi ve eğitimi basit olmayan kendine özgün şekliyle bir gelişim süreci geçirmiştir. *Okul idarecileri "ne öğretilmeli" sorusunun ardından* "matematik neden öğrenilmeli" gibi soruları matematik hakkındaki düşünceleri ortaya atanlar arasında 18.yüzyıl matematikçi (Magnitskiy,1914) yazdığı *"Aritmetik"* kitabında gösterilebilir. Bu kitap çok ilginç bir özelliğe sahiptir. 1703 yılında basılan ilk Rus matematik ders kitabı hem tarihi hem de içeriği açısından mükemmeldir. Eser milli değerler statüsüne girdiğinden yazar tarafından imzalı bu kitap Lomonosov Moskova Devlet Üniversitesi'nin bilim kütüphanesinde özenle korunmaktadır.

Fen Bilimleri Kütüphanesi'nin ender kitaplar bölümünde Magnitskiy'in Slavan alfabesiyle yazılmış 662 sayfalık *"Aritmetik"* kitabından iki nüsha bulunmaktadır. O dönemki bütün ders kitaplarında olduğu gibi Magnitskiy, aritmetikte beş işlem üzerinde durmakta; sayılandırma, toplama, çıkarma, çarpma, bölmedir. Magnitskiy kitabında Rusçanın yanında paralel olarak hem Latince hem de Grekçe tanımlar vermektedir. Toplama, çıkarma, çarpma, bölme işlemlerinin anlatım metodu şimdikinden hiç farklı değildir. Önce örnekleri vermekte, onları yavaş yavaş zorlaştırmakta ve en son olarak problemin kuralını yazmaktadır. Kitap cebirsel, geometrik, trigonometrik ve logaritmik bütün temel matematik işlemlerinin öğretimi için uygulamalı faydalı bir ders materyali niteliği taşımaktadır. *"Aritmetik"* sadece teorik bir kitap olmayıp aynı zamanda çok sayıda pratik ve meşhur problemleri de içermektedir (Gnedenko, 1946; Prudnikov, 1956).

Rusya'da bu kitapla fen ve matematik bilimleriyle uğraşan hemen hemen bütün kuşağa eğitim verilmiştir. Hatta bu kitapla Moskova Devlet Üniversitesi'nin kurucusu Lomonosov Mihail Vasilyeviç öğrenim görmüştür. Eserin içeriğine bakıldığında 18.yüzyılın birinci yarısında Rusya'da aritmetiğin özelliği ve öğretimi hakkında kaliteli eğitimin olduğu ortaya çıkmaktadır.

19.Yüzyılın İlk Yarısında Matematik Öğretimi ve Eğitimi

Pötr Simenoviç Guryev (1807-1884)

Akademik Guryev'in oğlu 30 yıl boyunca öğretmenlik yaptığı Gançinskiy yetimler enstitüsünde ve kendi imkânlarıyla eğitim veren yetimler okulunda elde ettiği tecrübelerle kendi temel görüşlerini üç eserinde toplamıştır. Bu eserler *"Aritmetik Sayfalar"* (1832), *"Küçük Yaştaki Çocuklara Aritmetik Öğretim Rehberi"* (1. Bölüm 1839- 2. Bölüm 1842) ve *"Pratik Aritmetik"* (1861) (Pedagoji Ansiklopedisi, 1964).

Rusya'da aritmetik metodunun kurucularından birisi Guryev olmuştur. İyi bir matematik hazırlığı bulunan bu kişi her yönden eğitimli bir kişidir. O Rus ve yabancı matematik ve eğitim literatürlerinin simgesi niteliğindedir (Depman, 1965:376).

Guryev'in bu eserlerinde, teorik materyaller ve pratik yapma materyalleri *(seminer)* birbirleriyle bütünlük arz etmektedir. Ders kitabının büyük bölümünü kapsayan örnekler ve problemler kolaydan zora doğru prensibiyle hazırlandığından öğrencilerin onları çözmesi çok kolay olmaktadır. Onun *"Aritmetik sayfalar"* eserine bugün didaktik materyal denmektedir. Bu kitapla her öğrenci kişisel olarak, kendi bilgi darağacına, hazırlığına ve kabiliyetlerine göre çalışabilmektedir. *"Pratik aritmetik"* adlı çalışmasında Guryev materyallerin bütünleşik olmasını temel almıştır. Bunun için ilk onluk, ilk yüzlük ve çok rakamlı sayılar üzerinde yoğunlaşmıştır. Guryev kendi *"Rehber"* kitabında ise önce teorik gerekçe ve pratik işlem metodu üzerinde durmuştur. Daha sonraları bu çalışma *"işlemleri öğrenme metodu"* adını almıştır. O, ilk olarak aritmetiğin teorik ve pratik temel metotları üzerinde çalışma yapmıştır.

Rusya'da matematik metodunun bilim olarak başlaması Guryev'in eserlerinin ortaya çıkmasıyla gerçekleşmiştir. Bunlar; *"geometriyi mükemmelleştirme deneyi"* (St.Petersburg, 1798), *"matematik hakkında yorumlar ve onun dalları"* (St.Petersburg, 1809) dır.

Yevtuşevskiy Vasiliy Andrianoviç (1836-1888)

Matematik eğitimi alanında metodist olarak kabul edilmekte olup *"Milli Okul"* dergisinin editörlüğünü ve birçok eğitim dergisinin de üyeliğini yapmıştır. Poltav şehrinde doğan Yetuşevskiy Petersburg Üniversitesi'nden 1861 yılında mezun olmuş ve daha sonra eğitim kursları almıştır.

Yevtuşevskiy aritmetiği bütünleşik olarak öğretilmesini tavsiye etmiştir. Onun kendi girişimiyle oluşturduğu aritmetik cebir ve geometri dersleriyle bağlantılı geometri dersi ve örnek problemleri vardır. Yevtuşevskiy'in eserlerinden özellikle *"Aritmetik Metodu"* (1872) ve *"Aritmetik Problem Derlemesi"* (1871) Rus okulunun gelişim tarihi açısından önemli yeri olduğundan birçok yayın evi tarafından desteklenmiştir (Pedagoji Ansiklopedisi, 1964).

Bu çalışmalarında sadece uzun yılların şahsi tecrübeleriyle yetinmemiş, yurtdışındaki öğretim metotlarının öğrenim sonuçlarını da değerlendirmiştir. Aritmetik Metodu kitabında zihinsel ve yazımsal hesaplamalar arasında bağlantı kurarken, görsellik kavramını daha derinden irdelemiştir.

Yevtuşevskiy'in eğitimle ilgili görüşleri, matematikçi Çebışev Pavnutiy Livoviç ve ünlü yazar Tolstoy Lev Nikolayeviç'in de katıldığı ilim kürsülerinde çok boyutlu tartışmalara sebep olmuştur. Meydana çıkan polemik bütün yönleriyle Rusya'da matematik öğretim metotlarının gelişmesine zemin hazırlamıştır (Kolyagin vd, 2007:223).

19. Yüzyılın İkinci Yarısında Matematik Öğretimi ve Eğitimi

Goldenberg Aleksander İvanoviç (1837-1902)

Matematikçi ve eğitimci olan Goldenberg Moskova'da doğmuştur. 1858 yılında Moskova Devlet Üniversitesi'ni bitirmiştir. 1861 yılından itibaren Topçuluk Akademisi'nden mezun olduktan sonra dört yıl topçu subayı olarak görev yapmıştır. 1865 yılında ikinci askeri lisesine matematik öğretmeni olarak atanmıştır. 1867 yılında emekliye ayrılmış ve öğretmenlik görevine özel eğitim kurumlarına geçerek devam etmiştir.

Goldenberg, elementar matematik (cebir) hakkında ilk dergi olan *"Matematik Sayfası"* nı (1879-1882) yayınlamıştır. İşlemleri öğrenme metodunun kurucularından biridir. Onun *"Aritmetiğe Giriş Metodu"* (1885) eseri okulda matematik öğretiminde çok büyük reform etkisi yapmıştır. İlköğretim kurumları için aritmetikle ilgili dört tane problem kitabı hazırlamıştır. Matematik sayfasındaki bütün makaleleri matematikle ilgili olup tarihi bilgiler içerir. Dergi için özel bir makalesini Bobının Viktor Viktoroviç yazmıştır. Dergide okuyucuların çözmesi için ilginç matematik sorularına yer vermiştir (Lankov, 1951:44-45).

Latışev Vasiliy Alekseyeviç (1850-1912)

Matematikçi ve eğitimci olan Latışev, 1850 yılında Sankt Petersburg Üniversitesi'nin Matematik Fakültesi'nden mezun olduktan sonra Gatçinskiy öğretmen seminerlerinin ve Santk Petersburg Öğretmen Enstitüsünün öğretmeni olmuştur. 20 yıl boyunca Petersburg Öğretmen Enstitüsü'nde çalışan Latışev matematik metodu alanındaki faaliyetlerine 1878 yılında başlamıştır. 1892 yılında Sankt Petersburg Milli Okuluna müdür olarak atanmıştır. 1880'den itibaren *"Rus Milli Öğretmen"* dergisinin editörlüğünü yapmıştır. Makalelerini *"Pedagoji Derlemesi"* adlı dergide yayınlamıştır. Ortaöğretim alt sınıflar için iki ciltlik *"Aritmetik Ders Kitabı"* hazırlamıştır. Bunlar *"Açıklamalı Aritmetik Kursu"* ve *"Aritmetik Öğretim Metodu"* dur (Brokgauza ve Yefrona, 1907). Latışev, matematik öğretimi ve eğitimini üst düzeye çıkarmış ve matematik öğretim metodu teorisinin oluşmasını sağlayanlardan birisidir. Latışev, matematik eğitim ve öğretiminde *"Latışev Metodu"* ile aşağıdaki katkıları sağlamıştır:

- Prensipli olarak davranışa dayalı öğrenim metotları taraftarıdır.
- Teoriye özel önem vermiş, problem çözümü hesaplamalarında pratik alıştırmaların sonuçları gibi teorinin, öğrenciler tarafından yavaş yavaş işlenmesi gerektiğini vurgulamıştır.
- Eğitim metodu olarak çocuklarda çok bilgi yerine sağlam bilginin oluşturulması gerektiğini söylemiştir.
- Öğrencilerin bağımsızlığının gelişmesi için onlardan çalışma ve emek istenmesi gerektiğini anlatmıştır.
- Problem çözümü öğretimi metodunu oluşturmuş, örnek problemlerin çözüm detaylarını göstermiştir.

Simön İliç Şohor-Trotskiy (1853-1923)

Rus matematikçi ve eğitimci olan Simon, Kamentse-Padolskiy'de doğmuştur. Novorassiyskiy Üniversitesi'nde uzaktan eğitim alarak okumuş ve aynı zamanda Petersburg Ulaşım Yolları Enstitüsü'nde öğrenim görmüştür. Daha sonraları Berlin'de, Geydelberg ve Königsberg'de matematik, fizik ve felsefe eğitimi almıştır. 1918-1923 yıllarında Kamennoosnpavskiy Tarım Enstitüsü'nde profesör olmuştur (Kolyagin vd., 2007:242).

O birçok metodik çalışmalarında matematik öğretim metotlarının ve içeriğinin reforma ihtiyaç duyulduğunu savunmuştur. Matematik öğretim metotlarını hazırlamıştır. Şohor-Trotski'nin başlıca çalışmaları *"Aritmetik Metodu"* (1886),*"Problemlerle Geometri"* (1908), *"Matematiğe Giriş Kursu Metodu"* dur (1924). Şohor-Trotski'nin çalışmalarında değindiği konular şunlardır:

- Matematik öğretiminin üç amacını tanımlamıştır; eğitici, öğretici ve pratiktir.
- Öğrencinin anlamak ve bilmek zorunda olduğu büyüklük ve kendi anlama sınırları arasındaki fonksiyonel bağımlılığından oluşan *"fonksiyonel düşünmenin"* eğitilmesi gerekliliğini söylemiştir.
- Amaca uygun yeni problem metodu oluşturmuştur.
- Teorik olarak görsel ders kitaplarının kullanımını gerçekleştirmiş, bir kısmının kendine ait olduğu yapının çeşitlerine göre açıklamasını vermiştir.
- Laboratuvar metodunu destekleyenlerdendir.
- Matematiğin fikri içeriği, öğretimin psikolojik temelleri, aritmetik problemlerin sınıflandırılması gibi konuların çözümünde ciddi katkıları olmuştur.

Amaca uygun problemler metodunun temel fikri; öğrencinin çözüp matematiği benimseyeceği problemler her ders için özel olarak amaca uygun bir araya getirilmiştir. Bu metodun uygulanmasının asıl amacı öğrencilere sadece bilgi vermek değil, aynı zamanda bu bilgilerin öğrenciler tarafından keşfedilmesidir. Bilindiği üzere bu problem şimdi de aktüalitesini korumaktadır.

20. Yüzyılda Matematik Öğretimi ve Eğitimi

Okul matematiğinin öğretim sorunları üzerinde çalışmalar ciddi olarak 1918 yılında başlamıştır. İlk programın oluşturulmasının temelinde ilköğretim için birinci sıradaki *"iş"* dersi olması prensibi esas alınmıştır. Diğer tüm dersler bu dersle bağlantılı olarak öğretilmektedir. Rus eğitim sistemine matematik de diğer dersler gibi hizmet eden bir rol oynamıştır. Çünkü öğretim metodu, ders materyalinde çok daha önemli sayılmaktaydı. O dönemde matematik programı çok yüklü ve çocuklara yönelik olmayan bilgilerle doluydu. Örneğin; geleneksel aritmetik materyalinin dışında 3.sınıfta bir ve iki bilinmeyenli denklemler, negatif sayılarla işlem, üslü ve köklü ifadeler, koordinat metodu, $y=x$ ve $y=a/x$ fonksiyonlarının grafikleri öğretilmekteydi. Geliştirilmemiş öğretim metodu, yetersiz ders kitapları ve yetersiz metot kitapçıkları okulun gerekli olan bilgiyi verememesine neden olmaktaydı.

Matematik öğretimi ve eğitiminde matematik tarihinden 1960'lı yıllarından itibaren faydalanılmaktadır (Fried, 2001). Son yıllarda ise matematik tarihi öğrenme ve öğretme önem arz etmiş ve bu alanla ilgili olarak Matematik Tarihi ve Öğretimde Kullanımı Enstitüsü *(The Instutute in the History of Mathematics and Its Use in Teaching)* kurulmuştur. Sonrasında 1996 yılında ICME *(The meeting of the International Congress on Mathematics Education)* konferansları düzenlenmiş olup burada öğrencilerin motivasyonlarını artırmak amacıyla matematik derslerinde matematik tarihinin kullanılması gerektiği üzerinde durulmuştur. (Marshall, 2000).

Aslında Fried (2001) ve Marshall (2001) yaptıkları ve hayata geçirmek istedikleri düşünceleri Sovyet Rusyası'nda 1920'li yıllardan itibaren matematik eğitiminin gündem konuları arasında yer almaktaydı. O zamanda elde bulunan ders kitapları, ders araçları ve problem kitapçıkları çevredeki hayat ve matematik materyalleri arasında ilişki kurmaktadır. Matematik tarihi bilgilerinin uygun formda sunulması; geniş çapta görsel prensiplerin kullanımını, değişik yardım materyallerinin ve bilgilerinin bulunmasını, öğrencinin dünya görüşünün gelişmesine yardımcı olduğunu karakterize etmektedir.

Yıllar Bazında Matematik Alanında Rusya'daki Gelişim

1931-1935 yılları arasında Rusya'da başlangıç sınıfları için matematikle ilgili yeni oluşturulmuş programın farklı özellikleri şöyledir:

- Kurallı sistemde öğretim araçlarının dağılımı,
- Sınırları belirlenmiş bilgi, beceri ve yatkınlık çevreleri,
- Öğretim araçlarının yıllara göre eşit dağılımı.

Aynı zamanda bu problemlerin çözüm yöntemlerini bilinçli bir şekilde benimsemeye daha az önem verilmiştir. Bunların birçoğu fazla yer tutan ve yapmacık yöntemler yardımıyla ezberlenmiş formüller yoluyla çözülmüştür. Öğrencilerin pratik beceri ve yatkınlıklarını belirleyebilmek için büyük önem verilmiştir.

İlköğretim için yeni programa geçişte sabit ders kitaplarından olan N.S. Popova'nın aritmetik ders kitabı kullanılmıştır.

1931-1941 yıllarında ilköğretim için aritmetik öğretim metotları hakkında A.S. Pçelko, İ.N. Kavuna, N.C. Popova, Y.F. Çermareva ve V.T.Snigireva ve başkalarının ders kitapları bastırılmıştır.

1940-1950' li yıllarda okul ders kitapları mükemmelleştirilmiştir. 1942 yılında N.C. Popova'nın ders kitapları Yerine İ.N. Nikitina, L.N. Valodina ve G.B. Polyaka'nın 1-4.sınıfları için konan ders kitapları 1956 yılında A.C. Pçelko Ve G.B Polyaka'nın kitaplarıyla değiştirilmiştir.

Matematiğe giriş kursu tanıştırıcı özelliğini korumuştur. Bu hazırlığın amaçları ve içeriği yavaş yavaş değişmektedir. Matematiğe giriş kursu öğrencilerin kabiliyetlerinin gelişimine ve onlarda öğrenme becerilerinin biçimlemesi için şartları meydana getirmektedir.

1966-1972 yılları okul eğitiminin reform dönemi sayılmaktadır. Bu dönemde ilkokullar için matematik hakkında yeni bir program oluşturulmaktadır. Bu programa göre ilkokulda matematik kursunun temel içeriği aritmetik oluşturmaktadır. Programa, sayılar hakkında aritmetik işlem özelliklerinin derinleşmesi, benimsenmesi suretiyle, organik olarak aritmetik bilgi sistemine girmekte olan geometri elementleri ve cebir tanıştırıcı dersleri takviye edilmektedir. N.A. Mençinskoy, L.V. Zankova, V.V. Davıdova gibi bilim adamlarının alt sınıf okul öğrencilerinin aritmetik öğretim psikolojisi alanındaki araştırmalarıyla daha sonra ilköğretim eğitiminin geliştirilmesi için zengin materyal birikmektedir.

SONUÇ

Kalite anlayışı, son yıllardaki üretilen ürün veya sunulan hizmeti kullananların, bu ürün ve hizmetlerden ne kadar memnun kaldıklarının belirlenmesine dayanmaktadır. Buna göre kalite kısaca *"müşteri memnuniyeti"* olarak da ifade edilmektedir. Aynı tanım, eğitim kurumları için de geçerlidir. Günümüz eğitim kurumlarının hizmet ve ürün sunduğu müşterilerini;

- Öğrenci ve öğrenci velileri,
- Üst eğitim ve araştırma kurumları,
- Çeşitli kamu ve özel sektörler,
- Ulusal toplum ve ulusal devlet,
- Evrensel toplum ve evrensel bilim,

olarak ifade etmek mümkündür. Dolayısıyla, bir eğitim kurumunun ve vermiş olduğu hizmetin kalitesini belirleyebilmek için öncelikli olarak müşterilerinin görüşlerine önem vermesi kaçınılmaz bir zorunluluktur (Köksoy, 1998:215). Eğitim kalitesinin artırılması da matematik biliminin geliştirilmesi ve etkin kullanılmasıyla mümkündür. Matematik bilimine ağırlıklı olarak Rus matematikçiler büyük katkı yapmışlardır.

Rusya'da matematik öğretimi ve eğitim psikolojisi alanında birçok özel soru ve sorunlar hakkında araştırmalar yapan bilim adamları ve değişik ders kitaplarının yazarları A.S. Pçelko, V.A. İgnatyev, N.S. Popova, M.İ. Moro, L.N. Stankin, M.A. Bantova, A.M. Pışkalo, Y.M. Kolyagin, A.M. Polevşikova ve P.M. Erdniyev başta olmak üzere birçok matematik eğitimcisi, matematik öğretimi ve eğitimi üzerinde yıllarca çalışma yaparak, Rus eğitim sistemine fayda sağlama yollarını sürdürmeye devam etmektedirler (Kolyagin vd., 2007).

Matematik öğretimi ve eğitimi, 1650 yılından itibaren başlayan 1798 yılında ise ilim ortamlarına giren ve yakın zamanda değişik eğitim kurumlarında önemliliğini her zaman korumaktadır. Elde edilen bilgiler, çalışmalar ve yayınlanan kitaplar sayesinde Matematik öğretimi ve eğitiminin Rusya'da başarılı bir şekilde yürütüldüğü Matematik derslerinde matematik tarihinin 1920'lerden itibaren kullanılması gerektiği üzerinde durulduğu sonucuna varılmıştır. Matematik dersleri anlatılırken Rus matematik tarihinin bir bölüm olarak işlenmesi derslere yenilik getireceği, öğrencileri ise motive edeceği düşünülmektedir.

Araştırmada matematik öğretimi ve eğitiminin Rus matematik eğitim tarihi ve bazı Rus matematik eğitimcilerinin hayatları ve eserleri kronolojik sıraya göre düzenlenmiş ve matematik eğitiminin Rusya'da 200 yıl öncesine dayandığı görülmüştür.

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THE EFFECT OF TEACHER'S COMPETENCY ON STUDENTS' ATTITUDE TOWARD MATHEMATICS

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ABSTRACT: This study aimed to investigate the effect of teacher's competency on students' attitude toward mathematics. The study was a quantitative research. A total of 55 10th (28 students) and 11th (27 students) grade students, who were selected randomly from a high school in Burdur Province, participated in the study. 11 students studied in the division of science-mathematics, 19 students studied in the division of Turkish-mathematics, and 25 students studied in the division of social sciences. On the other hand, 18 of the students were female and 37 of the students were male. A scale of attitude toward mathematics, of which validity and reliability were done by Ural ve Argün (2010), was used to measure students' attitude toward mathematics. In order to determine the teacher's competency, students were asked to fill a 5-point Likert scale consisting of 15 items out. SPSS was used to determine the reliability of the scale and Cronbach's Alpha was found .873. Anova analysis in SPSS was conducted to investigate if there was a significant relation between the scores of attitude toward mathematics and the scores relating to the teacher's competency. As a result, it was determined that teacher's competency didn't have a significant impact on students' attitude toward mathematics.

Key words: attitude toward mathematics, teacher's competency.

ÖĞRETMEN YETERLİLİĞİNİN ÖĞRENCİLERİN MATEMATİĞE KARŞI TUTUMUNA ETKİSİ

ÖZET: Bu çalışmada, öğretmenin yeterliliğinin öğrencilerin matematiğe karşı tutumuna etkisi araştırılmıştır. Çalışma nicel bir araştırmadır. Araştırmanın katılımcılarını, Burdur merkezden rasgele seçilen bir lisenin 28'i 10. sınıf ve 27'si 11. sınıf olmak üzere toplam 55 öğrencisi oluşturmaktadır. Öğrencilerin 11'si sayısal, 19'si eşit ağırlık ve 25'i sosyal bölümde öğrenim görmektedir. Diğer taraftan, öğrencilerin 18'i kız ve 37'si erkektir. Öğrencilerin matematiğe karşı tutumunu ölçmek için, Ural ve Argün (2010) tarafından geçerlik ve güvenilirlik çalışması yapılmış olan tutum ölçeği kullanılmıştır. Öğretmenin yeterliği için 15 maddeden oluşan beşli likert tipinde bir form kullanılarak öğrencilerin algıları tespit edilmiştir. Ölçeğin güvenirliği SPSS programında yapılmış ve Cronbach's Alpha katsayısı .873 bulunmuştur. Öğrencilerin matematiğe karşı tutum puanları ile öğretmen yeterliğine ilişkin algı puanları arasında anlamlı bir ilişki olup olmadığını belirlemek için ise SPSS programında anova incelemesi yapılmıştır. İncelemenin sonucunda, öğretmenin pedagojik yeterliliğinin öğrencilerin matematiğe karşı tutumu üzerinde anlamlı düzeyde bir etkisinin olmadığı tespit edilmiştir.

Anahtar sözcükler: matematiğe karşı tutum, öğretmen yeterliliği.

GİRİŞ

Tutum, insanın bir tutum nesnesini kabul ya da reddetmesine yönelik, yerleşik, örgütlü, tutarlı ve dirik bir eğilimidir (Başaran, 2005). Tutumlar bir kimsede bir şeye karşı ilgi uyanmasını sağlayan merak ve değerlendirme gibi özelikleri de kapsadığı için sadece öğrenmenin olup olmamasını değil aynı zamanda kişinin öğrenme tarzını da etkiler (Atasoy, 2004). Hart (1989) tutumun üç bileşeni kapsadığını belirtmiştir: "objeye karşı duygusal tepki, objeye karşı davranış ve objeye karsı inançlar". Öğrencilerde herhangi bir derse karşı olumlu ya da olumsuz tutum gelişmişse, öğrenmeyi etkileyerek öğrencinin konuyu daha kolay ya da daha zor öğrenmesine neden olmaktadır (Özyürek, 1983). Bloom (1995), yapılan araştırmaların bireylerin öğrenmeleri arasındaki farklılıkların yaklaşık dörtte birinin kaynağının duyuşsal özelliklerden geldiğini gösterdiğini belirtmiştir. Çoğu eğitimci, tutum ve motivasyonun okullarda başarısızlıkta oldukça önemli etkenler olduğunu düşünür (Hillen, 1996). Matematige karşı tutumu Neale (1969), "matematiği sevme ya da sevmeme, matematiksel aktivitelerle uğraşma yada onlardan kaçma eğilimi, kişinin matematikte iyi ya da kötü olacağı inancı ve matematiğin faydalı yada faydasız olduğu inancı" nın toplam bir ölçüsü olarak tanımlamaktadır. Tobias'a (1991) göre, matematiğe karşı tutumu oluşturan faktörler arasında, matematiği algılama biçimi, matematiğin faydalılığına inanış, matematiksel etkinliklerde başarılı olabileceğine inanmak ve kendine güvenmek, matematikten hoşlanma duygusu, matematik problemleri çözmekten zevk alma ve matematik öğrenimi sırasında edinilen deneyimler yer almaktadır.

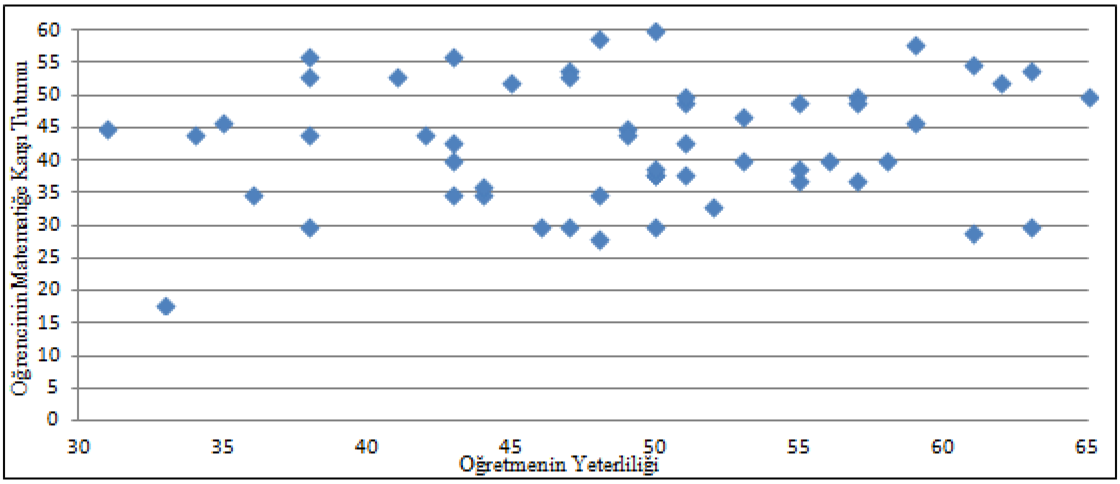
Genel olarak eğitim ve öğretimde öğrencilerin duyuşsal giriş özellikleri ile öğrenci başarısı arasında anlamlı ilişkinin olduğu bilinen bir gerçektir (Tan, 2006; Tobias, 1991). Literatürde de matematik dersine karşı tutumun matematik başarısını açıklayan önemli değişkenlerden biri olduğunu gösteren çalışmalar mevcuttur (Al-Agili, Mamat, Abdullah ve Maad, 2013; Aslan, 2000; Azina ve Halimah, 2012; Cokadar & Kulge, 2008; Demir ve Kılıç, 2010; Johnson, 2000; Mohammadpour, 2012; Mohd, Mahmood, Ismail, 2011; Pala, 2008; Papanastasiou, 2000; Peker ve Mirasyedioğlu, 2003; Savaş, Taş ve Duru, 2010; Skouras, 2014; Stevens et al., 2004; Tapia ve Marsh, 2000; Yenilmez ve Özabacı, 2003). Diğer taraftan, *"öğretmen"* (mesleki deneyimi, bilgisi, yaklaşımı, araç–gereç kullanımı, iletişim becerileri, matematik sevgileri gibi) (Al-Agili ve diğ., 2012; Al-Agili ve diğ. 2013; Adeogun and Osifila, 2008; Chhinh and Tabata, 2003; Darling-Hammond, 2000; Dursun ve Dede, 2004; Fetler, 2001; Mcber, 2000; Marchant et al., 2001; Terzi, 2002; Tella, 2008; Urdan & Midgley, 2003;), *"öğretim yöntemleri"* (Adeogun ve Osifila, 2008; Dursun ve Dede, 2004; Hamidah Yamat ve diğ., 2011; Maat ve diğ., 2011), "özgüven" (Ercikan, McCreith ve Lapointe, 2005; Mohammadpour, 2012; Pala, 2008; Schunk ve Pajares, 2002; Valentine, Dubois ve Cooper, 2004), *"motivasyon"* (Konu ve Rimpela, 2002; Veenstra ve Kuyper, 2004), "matematik ve sınav endişesi" (Al-Agili ve diğ., 2013; Akın, 2008; Ashcraft, 2002; Ashcraft ve Kirk, 2001; Cates ve Rhymer, 2003; Woodard, 2004), "öğrenme yöntemi ve matematik çalışma zamanı" (Dursun ve Dede, 2004; Konu and Rimpela, 2002; Özer ve Anıl, 2011; Savaş, Taş ve Duru, 2010; Skouras, 2014; Veenstra ve Kuyper, 2004) matematik başarısını etkileyen önemli faktörlerdir. Alkan, Güzel ve Elçi (2004) tarafından yapılan araştırmada, matematiğe yönelik olumsuz tutuma sahip olanların, gerçekte matematiği tanımadıkları anlaşılmıştır. Olumsuz tutum geliştirmenin nedenleri arasında; öğretmenin takip ettiği öğretim yöntemi, ders kitaplarının sınıf seviyesine uygun olmaması (Taşdemir, 2009), aile ve çevrenin matematiği zor öğrenilen ders olarak göstermesi, kaynak ve araç-gereç seçimi, öğrencilere verilen ödevlerin fazlalığı (Ünlü, 2007), matematiğin günlük yaşamdaki öneminin bilinmemesi, anne ve babaların çocuklarıyla matematik dersi konusunda ilgilenememesi, "Ben matematiği yapamam" düşüncesi (Yılmaz, 2006) olarak gösterilebilir. Dolayısıyla bu faktörler de matematiğe karşı tutumu etkilemektedir. Bu faktörlere bakıldığında matematik öğretmenin matematiğe karşı tutum oluşturmada etkili olduğu açıktır. Ersoy (1998), bir matematik öğretmeninin sahip olması gereken üç temel özellikten bahseder; bunlar: matematik konularını iyi bilmek, öğrenciyi her yönüyle tanımak ve öğretmeyi bilmek. Dolayısıyla öğretmenin, öğrencilerin matematik başarısını artırma, matematiğin yararlılıklarını öğretme, öğrencilerin matematiğe karşı özgüvenlerini artırma ve öğrencilerle iletişim noktasında sorumlulukları vardır.

YÖNTEM

Bu çalışmada, öğretmenin yeterliliğinin (bağımsız değişken) öğrencilerin matematiğe karşı tutumuna (bağımlı değişken) etkisi araştırılmıştır. Çalışma nicel bir araştırmadır. Araştırmanın katılımcılarını, Burdur merkezden rastgele seçilen bir lisenin 28'i 10. sınıf ve 27'si 11. sınıf olmak üzere toplam 55 öğrencisi oluşturmaktadır. Öğrencilerin 11'si sayısal, 19'si eşit ağırlık ve 25'i sosyal bölümde öğrenim görmektedir. Diğer taraftan, öğrencilerin 18'i kız ve 37'si erkektir. Öğrencilerin matematiğe karşı tutumunu ölçmek için, Ural ve Argün (2010) tarafından geçerlik ve güvenilirlik çalışması yapılmış olan tutum ölçeği kullanılmıştır. Öğretmenin pedagojik yeterliği için 15 maddeden oluşan beşli likert tipinde bir form (Ek 1) kullanılarak öğrencilerin algıları tespit edilmiştir. Ölçeğin geçerliliği için uzman görüşlerine başvurulmuştur, güvenirliği ise SPSS programında yapılmış ve Cronbach's Alpha katsayısı .873 bulunmuştur. Öğrencilerin matematiğe karşı tutum puanları ile öğretmen yeterliğine ilişkin algı puanları arasında anlamlı bir ilişki olup olmadığını belirlemek için ise SPSS programında tek yönlü anova testi yapılmıştır.

BULGULAR

Öğrencilerin öğretmenin yeterliliğine ilişkin verdikleri puanlar ve öğrencilerin matematiğe karşı tutum puanları arasındaki bağıntının grafiği Şekil 1'de gösterilmiştir.



Şekil 1. Öğretmen Yeterliği ve Öğrencilerin Matematiğe Karşı Tutumu Arasındaki Bağıntının Grafiği

Şekil 1'e bakıldığında iki değişken arasında korelasyon olmadığı görülmektedir (Pearson= .16). Diğer taraftan, öğretmen yeterliliğinin öğrencilerin matematiğe karşı tutumunu üzerinde etkisini belirlemek için SPSS programında yapılan tek yönlü ANOVA testine ilişkin sonuçlar Tablo 1'de verilmiştir.

Tablo 1. Öğretmen Yeterliliğinin Öğrencilerin Matematiğe Karşı Tutumuna Etkisi

Varyansın Kaynağı	Kareler Toplamı	sd	Kareler Ortalaması	F	p
Gruplararası	1712,011	27	63,408	,560	,931
Gruplariçi	3055,917	27	113,182		
Toplam	4767,927	54			

Analiz sonuçlarına göre, öğretmenin pedagojik yeterliliğinin öğrencilerin matematiğe karşı tutumu üzerinde anlamlı düzeyde bir etkisinin olmadığı tespit edilmiştir [F(27-27)=.56, p>.05].

TARTIŞMA VE SONUÇ

Araştırma sonucunda, öğrencilerin matematik öğretmenlerinin yeterliliğine ilişkin algılarının, onların matematiğe karşı tutumlarını anlamlı düzeyde farklılaştırmadığı tespit edilmiştir. Benzer çalışma daha büyük örneklemler için yapıldığında veya öğrencilerin matematik başarıları temelinde kategorize edilerek yapılırsa farklı sonuçlar elde edilebilir. Avcı, Tuncel ve İnandı (2011) tarafından yapılan araştırmada, öğrencilerin matematiğe yönelik tutumları ile okudukları okul türü ve alan türü arasında anlamlı bir farklılık görülmüştür. Anadolu Lisesi öğrencilerinin matematiğe yönelik tutumlarının, genel lise ve meslek lisesi öğrencilerine göre daha olumlu olduğu görülmüştür. Ayrıca, tutumların sırasıyla sözel, eşit ağırlık ve sayısal bölümde okuyanlar şeklinde arttığı belirlenmiştir. Benzer bulgu Kaplan ve Kaplan (2006) tarafından da elde edilmiştir. Diğer taraftan, bu çalışma lise öğrencileri üzerinde yapılmıştır. Örneklemin ortaokul veya ilkokul öğrencilerinden oluşturulması da sonucu etkileyebilecek bir başka faktör olabilir. Taşdemir (2009) tarafından yapılan araştırmada, sınıf seviyesinin artması ile öğrencilerin tutumlarında bir azalma görülmüştür. Altun (1995) ve Baykul (1990) da benzer bulgular elde etmiştir.

Duygu, bilgi ve davranış tutumun üç bileşenidir (Başaran, 2005). Matematik öğretmenin alan ve pedagojik alan yeterliliği öğrencilerin matematiksel bilgileri edinmesi ve edinimde bulunması açısından önemlidir. Bu durum, tutumun iki bileşenini pozitif etkileyecektir. Ancak tutumun en önemli bileşeni duygudur. Şekil 1'e bakıldığında öğretmen yeterliliğine ilişkin değerlendirmelerin orta düzeyde olduğu (ne yüksek ne düşük) görülmektedir. Bu durumda tutumun duygu boyutunun oluşmasının, matematiksel bilgilere sahip olmadan daha öte bir şey olduğu söylenebilir.

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Ekler

Ek 1. Öğretmenin Pedagojik Yeterliliğini Değerlendirme Formu

	Kesinlikle Yetersiz	Yetersiz	Kısmen Yeterli	Yeterli	Kesinlikle Yeterli
Sınıf içi disiplini sağlama					
Öğrencilerle bireysel olarak ilgilenme					
Öğrencilerin fikirlerini özgürce dile getirmesine önem verme					
Veli, öğrenci ve öğretmen ilişkisine önem verme					
Öğrencilerine karşı sabırlı ve hoşgörülü davranma					
Öğrencilerin derslerdeki etkinliklere aktif katılımını sağlama					
Öğrencinin ilgi ve isteklerine önem verme					
Öğrencilerin, kişisel problemlerinin çözüme yardımcı olma					
Öğrencilerle karşılıklı sevgi ve saygıya dayalı iletişim kurma					
Öğrenci sorularına uygun ve yeterli yanıtlar verebilme					
Öğretimi bireysel farklılıklara göre sürdürebilme					
Demokratik bir öğrenme ortamı sağlayabilme					
Öğrencileri ilgiyle dinleme					
Sınavları öğrenci düzeyine uygun hazırlama					
Derslerde öğrencilerin düzeyine uygun örnekler çözme					

EXAMINING OF PROBLEMS PARTAKING IN SECONDARY SCHOOL TEXTBOOKS IN ACCORDANCE WITH THE OPINIONS OF TEACHERS

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ABSTRACT: The aim of this study is to examine the problems partaking in mathematics textbook of ninth grades that is taught in public secondary schools of Adana province in 2014-2015 academic year in terms of language, visual elements, content and problem types in accordance with the opinions of teachers. The study group consists of 15 mathematics teachers who work in secondary education. Semi structured teacher interview form was used as data collection tool that was formed by researchers. The interviews were done as face to face in the schools of teachers with the contribution of two researchers. The opinions of teachers were recorded via tape recorder. The recorded data were transferred to computer on the same day. According to the results of the study teachers thinks that the problems are clear and understandable but they are inadequate in numbers.

Key words: textbook, mathematics teachers, problem solving

ORTAÖĞRETİM DERS KİTAPLARINDA YER ALAN PROBLEMLERİN ÖĞRETMEN GÖRÜŞLERİ DOĞRULTUSUNDA İNCELENMESİ

ÖZET: Bu araştırmanın amacı, 2014-2015 öğretim yılında Adana ilinde resmi ortaöğretim okullarında okutulan dokuzuncu sınıf matematik ders kitabında yer alan problemlerin, dil anlatım, görsel unsurlar, içerik ve problemlerin türlerinin öğretmen görüşleri açısından incelenmesidir. Araştırma çalışma grubunu ortaöğretim görev yapan 9 matematik öğretmeni oluşturmaktadır. Veri toplama aracı olarak araştırmacılar tarafından oluşturulan yarı yapılandırılmış öğretmen görüşme formu kullanılmıştır. Görüşmeler öğretmenlerin çalıştığı okulların uygun bir bölümünde iki araştırmacı katılımıyla yüz yüze gerçekleştirilmiştir. Öğretmenlerin görüşleri ses kayıt cihazı aracılığıyla kaydedilmiştir. Kaydedilen veriler günü gününe bilgisayar ortamına aktarılmıştır. Araştırmanın sonucunda öğretmenlerin problemlerin açık ve anlaşır olduğunu ancak sayısının yeterli olmadığını düşündükleri ortaya çıkmıştır.

Anahtar sözcükler: ders kitabı, matematik öğretmeni, problem çözme.

GİRİŞ

Problemler, insanların yaşamları boyunca karşılarına çıkan bir olgudur ve bu olgu matematiğin dilini kullanabilenler için çözülmesi zevkli bir bulmaca iken matematiği yapamayan insanlara içinden çıkılması zor bir durum gibi gelebilmektedir. NCTM (2000, s.51) tarafından matematik öğretim programlarının odak noktasını problem çözme ile ilgili amaçların oluşturmasının gerektiği vurgulanmaktadır. Ülkemizde Orta Öğretim matematik öğretim programında teknolojik gelişmelerle birlikte günümüzde önceki kuşakların karşılaşmadığı yeni problemlerin ortaya çıktığı belirtilmektedir. Günümüz dünyasında matematiğe değer veren, matematiksel düşünme gücü gelişmiş, matematiği modelleme ve problem çözmede kullanabilen bireylere daha çok ihtiyaç duyulduğu da vurgulanmaktadır. bu bağlamda lise matematik öğretim programı öğrencileri matematiksel düşünme gücü gelişmiş iyi birer problem çözücü olarak yetiştirmeyi amaçlamaktadır (MEB,2013, s. I)

Öğretim programlarının hayata geçirilmesinin araçlarından biri de ders kitaplarıdır (Artut ve ldırı, 2013). Millî Eğitim Bakanlığı Ders Kitapları Yönetmeliği'nde ders kitabı, "her tür ve derecedeki örgün ve yaygın eğitim kurumlarında kullanılacak olan, konuları öğretim programları doğrultusunda hazırlanmış, öğrenim amacı ile kullanılan basılı eser" olarak tanımlanmıştır. Öğretmen ders kitaplarını kullanarak öğretim etkinliklerini daha etkili kılabilir. Ders kitapları öğrenciye, öğretmenin ele aldığı konuları istediği zaman ve yerde kendi belirleyeceği bir hızda tekrarlamasına fırsat sağlayan önemli bir temel materyaldir (Aycan, Kaynar, Türkoğuz ve Arı, 2001).

Gelişmiş veya gelişmekte olan ülkelere bakıldığında, ders kitaplarının her zaman önemli bir eğitim aracı olduğu görülmektedir. Örneğin, Japonlardan bazıları, ders kitaplarını bir toprak parçası kadar değerli bulmuşlardır. Önceleri Japon öğretmenler, okulda derste iken deprem olduğunda, kurtarılması gereken öncelikler arasında kitapları da belirtmişlerdir (Tutak ve Güder, 2012).

Günümüzde ise Japonlar, ders kitaplarını öğretim için temel kaynak olarak göstermektedirler (Semerci ve Semerci, 2004). Amerika Birleşik Devletleri'nde de ders kitaplarının önemli bir yeri vardır. Shannon'un yaptığı bir araştırmaya göre, öğrenciler sınıfta zamanlarının yaklaşık yüzde 80'ini ders kitapları ve ders kitaplarıyla ilgili etkinliklere harcamaktadır. Diğer taraftan Türkiye'de de ders kitapları, temel bir bilgi kaynağıdır (Kaya, 2002: 92–93; Tertemiz, Ercan ve Kayabaşı 2001: 1; Akt. Tutak ve Güder, 2012).

Ülkemizde her öğrencinin ulaşabileceği ilk ve en önemli bilgi kaynaklarından biri ders kitaplarıdır. Bu kadar önemli bir konumda yer alan matematik kitaplarında yer alan problemlerin nitelikleri şüphesiz çok önemlidir. Aynı zamanda ders öğretmenlerin öğretim etkinliklerinde kullandıkları temel materyal olduğu için ders kitaplarında yer verilen problemlere ilişkin görüşleri ve değerlendirmeleri, bu problemleri sınıfta kullanıp kullanmayacağını belirlemede önemlidir.

Matematik ders kitapları ile yapılan çalışmalar incelendiğinde daha çok çalışmaların (Arslan ve Özpınar, 2009; Çakır**,** 2009; Dane, Doğar ve Balkı, 2004; Delice, Aydın ve Kardeş, 2009; Delil, 2006; İzmirligil, 2008; Kurtulmuş, 2010; Semerci ve Semerci, 2004;Taşdemir, 2011; Yüksel, 2010) ilköğretim düzeyindeki ders kitapları ile ilgili olduğu görülmektedir. İlköğretim matematik ders kitapları ile ilgili yapılan bu çalışmalarda öğretmen ve öğrenci görüşlerine göre ders kitapları bazı değişkenler (öğretim programının amaçlarına uygunluk, görsel ögelerin kullanımı gibi) açısından değerlendirilmiştir. Ulaşılabilen kaynaklar çerçevesinde orta öğretim düzeyinde matematik ders kitapları ile ilgili olarak yapılan literatür incelendiğinde ise Gün (2009) tarafından ortaöğretim dokuzuncu sınıf Matematik ders kitabına ilişkin öğretmen ve öğrenci görüşlerini belirlemek amacıyla bir çalışma yapıldığı görülmektedir. Benzer şekilde Ünver' de (2009) çalışmasında dokuzuncu sınıf seviyesinde fonksiyon konusunda yer alan benzetimlerin, matematik ders kitabında ve sınıflarında nasıl kullanıldığını incelemiştir.

Öğretim programı ve literatür incelendiğinde matematik ders kitaplarının matematik öğretiminde önemli bir yere sahip olduğu ve problem çözme becerisinin matematik dersinde kazanılması gereken önemli bir kazanım olduğu görülmektedir. Bu bağlamda ders kitaplarında yer alan problemler hakkında öğretmen görüşlerinin alınmasının önemli olduğu düşünülmektedir. Bu doğrultuda bu araştırmada, 2014-2015 öğretim yılında Adana ilinde resmi ortaöğretim okullarında okutulan dokuzuncu sınıf matematik ders kitabında yer alan problemlerin, dil anlatım, görsel unsurlar, içerik ve problemlerin türlerinin öğretmen görüşleri açısından incelenmesi amaçlanmıştır.

YÖNTEM

Bu çalışma ortaöğretim dokuzuncu sınıf matematik ders kitaplarında yer alan problemleri öğretmen görüşleri açısından incelemek amacıyla nitel araştırma yöntemlerinden görüşme tekniği ile gerçekleştirilmiştir. Görüşme yöntemi kişilerden belli bir konuda duygu ve düşüncelerini alma etkinliği olarak tanımlanabilir (Sönmez & Alacapınar, 2013). Bu çalışmada da ortaöğretim matematik ders kitaplarında problemler öretmen görüşleri açısından belli ölçütlere göre araştırılmıştır.

Çalışma Grubu

Araştırmanın çalışma grubunu 2014-2015 öğretim yılında Adana'da merkez ilçede görev yapan resmi matematik öğretmenleri arasından kolay ulaşılabilir durum örnekleme yöntemi ve gönüllülük esası ile seçilmiş toplam dokuz öğretmen oluşturmuştur. Kolay ulaşılabilir durum örneklemesinin araştırmacıya pratiklik ve hız kazandırdığını, araştırmacının bu yöntemde yakın olan ve erişilmesi kolay olan bir durumu seçtiğini ancak çoğu zaman diğer örnekleme yöntemlerini kullanma olanağının bulunmadığı durumlarda kullanıldığını belirtmişlerdir Görüşme yapılan öğretmenler in dördü kadın, beşi erkektir. Görüşmeye katılan öğretmenlerin birinin 10-15 yıl, ikisinin16-20 yıl, beşinin 21-25 yıl ve birinin de 25-30 yıl mesleki kıdeme sahiptir. Ayrıca, öğretmenlerden üçünün eğitim fakültesi mezunuyken altısı ise fen edebiyat matematik bölümü mezunudur.

Veri Toplama Aracı

Bu çalışmada veri toplama aracı olarak yarı yapılandırılmış görüşme formu hazırlanmıştır. Görüşme formda kişisel bilgilere ait iki soru (mesleki kıdem, mezun olunan okul) ile ortaöğretim dokuzuncu ders kitabında yer alan problemlere ilişkin on bir sorudan oluşmaktadır.

Verilerin Analizi

Araştırmada görüşme formundan elde edilen veriler içerik analizi ile çözümlenmiştir. İçerik analizi, birbirine benzeyen verileri belirli kavramlar ve temalar çerçevesinde bir araya getirmek ve bunları okuyucunun anlayabileceği bir biçimde organize ederek yorumlamaktır (Yıldırım ve Şimşek, 2006). Öncelikle yapılan görüşme formunda elde edilen verilerinden birbirine benzeyen belirli kavramlar ve kodlar bir araya getirilerek uygun temalar oluşturulmuştur. Verilerin güvenirliği için kodlar iki araştırmacı tarafından ayrı ayrı kodlanarak iki kodlayıcı arasındaki uyuşma oranı hesaplanmış ve .97 olarak bulunmuştur.

BULGULAR

Bu bölümde yapılan görüşmeler sonucunda elde edilen veriler aşağıda Tablo 1'de yer almaktadır.

Tablo 1. Öğretmen Görüşlerine Göre Dokuzuncu Sınıf Ders Kitabında Yer Alan Problemlere Yönelik Öğretmen Görüşlerine İlişkin Dağılım

1. Problemin sunumunda kullanılan dil açık ve anlaşılır ifadeler içermekte midir?	f
Evet.	6
Kararsızım.	3
2. Günlük dil ile problemin sunumunda kullanılan matematiksel dil arasında tutarlılık vardır.	
Uyumludur.	6
Uyumlu değildir.	3
3. Sizce dokuzuncu sınıf ders kitabında verilen problemlerin sayısı yeterli mi?	
Yetersiz	9
Konu anlatımı ile konu sonunda verilen sorular yetersiz	2
4. Dokuzuncu sınıf ders kitabında verilen problemler, öğrencileri araştırmaya ve verilmeyen bilgileri bulmaya teşvik ediyor mu	
Belli konular için evet genelde yok	5
Kısmen	2
Yok	2
5. Size göre dokuzuncu sınıf ders kitabındaki kitabında ve öğrenci çalışma kitabında yer alan problemlerin sunumunda şekil, resim, tablo ve grafik gibi görsel öğeler yeterince kullanılıyor mu? Sizce görsel materyal kullanımının öğrencilerin problem çözme başarısı üzerindeki etkileri neler olabilir?	
Çözümlü örnek az olduğundan yetersiz. Kesinlikle özellikle anlaşılması zor konularda görsellik bence çok önemli, kavrama ve anlaşılması için görselliğe önem verilmesi gerekli	5
Kullanılıyor	1
6. Size göre iyi bir problem nasıl olmalıdır?	
Anlaşılır ve günlük hayatla ilişkili olmalı	3
Problemlerde verilen bilgiler açık ve öz olmalı	3
Benzer soruları çözebilecek anlatımda ve içerikte olmalı	2
Basitten zora doğru	1
Seviyeye uygun	1
6.1 Sizin ders kitaplarınızda verilen problemleri iyi problemler olarak değerlendirebilir misiniz? Evet/Hayır nedenlerini açıklayabilir misiniz?	
Evet, bölüm sonundaki alıştırma soruları iyi. Ama anlatımla sorular uymuyor.	3
Hayır	2
İyi	1
7. Öğrencileriniz aşağıdaki problem türlerinden hangisini çözerken daha başarılı oluyorlar? Sizce bunun nedeni nedir?	
Klasik sorular alışık oldukları sorularda daha başarılı	6
Araştırma ve düşünmeye dayalı problemlerin sevmiyorlar	3
Yeni bilgi gerektiren sorularda zorlanıyorlar	2
Rutin olmayan	1
Günlük yaşamla ilgili problemler	1
8. Matematik derslerinde MEB ders kitaplarını hangi düzeyde kullanıyorsunuz? Matematik ders kitabında yer alan problemleri kullanırken değişiklikler yapar mısınız? Bu değişiklikleri hangi doğrultuda yaparsınız?	
Ara sıra çocukları teşvik için kullanıyorum.	3
Kullanmıyor	2
Kullanıyorum,	2
Konu sonu değerlendirmelerinde kullanıyorum	2
9. Öğrencileriniz problem çözme alışkanlığını günlük yaşama uyarlayabilecek şekilde(transfer etme) kazanabiliyorlar mı?	
Çok zorlanıyor.	4
Kısmen	3
Ders çalışma alışkanlıkları yok.	1
Hayır	2

10. Problemlerin sonuçları, öğrencilere çözümü tartışma fırsatı veriyor mu?	
Bazen	8
Çok az	2
11.Problemler, öğrencilerin bulundukları sınıflara ve gelişim seviyelerine uygun mu?	
Evet.	6
Kısmen	3

Tablo 1 incelendiğinde görüşme yapılan öğretmenlere, problem cümlelerinde kullanılan dilin açık ve anlaşılır olmasına ilişkin görüşleri sorulmuştur. Görüşme yapılan on öğretmenin yarısından fazlası (6 öğretmen) problemleri açık ve anlaşılır bulduklarını, geriye kalan üç öğretmen kararsız kaldıklarını, bir öğretmen ise açık ve anlaşılır bulmadığını belirtmişlerdir. Görüşmeye katılan öğretmenlerin iki tanesi problemleri açık ve anlaşılır bulmadıklarını ifade ederken bu öğretmenlerin bir tanesi problemlerin genel olarak açık ve anlaşılır olmadığını şu sözle dile getirmişlerdir: " Çok kısa ve çok az örnek olduğu için açık değildir."(Ö9)

Görüşme yapılan öğretmenlere, günlük dil ile problemin sunumunda kullanılan matematiksel dil arasında tutarlı olup olmamasına ilişkin görüşleri sorulmuştur. Görüşme yapılan on öğretmenin yarısından fazlası (6 öğretmen) problemleri tutarlı birbiriyle uyumlu bulduğunu, geriye kalan dört öğretmen uyumlu bulmadığını belirtmişlerdir. Görüşmeye katılan öğretmenlerin yarısından fazlası günlük dil ile uyumlu ifade ederken bu öğretmenlerin bir tanesi günlük dil ile uyumlu bulduğunu ama yine de öğrencilerin zorlandığını şu sözlerle dile getirmiştir: "Evet. Fakat okulumuzdaki öğrencilerin seviyesi çok düşük olduğundan zorlanıyorlar." (Ö2). Görüşmeye katılan dört öğretmenden ikisi günlük dil ile uyumlu bulmadığını şu sözlerle dile getirmişlerdir: "Uyumlu değil, daha açık ve anlaşılır olmalı"(Ö8), "Hayır. Günlük yaşama dair problemlerden uzak, uygulamalardan uzak."(Ö9)

Görüşmeye katılan öğretmenlere, dokuzuncu sınıf ders kitabında verilen problemlerin sayısı yeterli olup olmamasına ilişkin görüşleri sorulmuştur. Öğretmenlerin tamamı yetersiz olduğunu belirtmişlerdir. Bu yönde görüş belirten Ö2 kodlu öğretmen görüşünü şu sözlerle dile getirmiştir: "Yetersiz. Konu anlatımı ile problemler arasında bağlantı yok." ,

Araştırmada görüşme yapılan on öğretmene, dokuzuncu sınıf ders kitabındaki kitabında yer alan problemlerin sunumunda şekil, resim, tablo ve grafik gibi görsel öğeler yeterince kullanılıp kullanılmadığı ve görsel materyal kullanımının öğrencilerin problem çözme başarısı üzerindeki etkileri üzerine ilişkin görüşleri sorulmuştur. Görüşme yapılan öğretmenlerin çoğu görsel öğelerin yetersiz olduğunu ama öğrencinin anlaması için görselliğin önemli olduğunu, geriye kalan iki öğretmen kullanıldığını ve görselliğin önemli olduğunu, bir öğretmen görsel öğelerin yetersiz ve görselliğin herhangi bir etkisi olmadığını belirtmişlerdir. Görüşmeye katılan öğretmenlerin yarısından fazlası görsel öğelerin yetersiz olduğunu ama öğrencinin anlaması için görselliğin önemli olduğunu belirten içlerinden iki tanesi şu sözleri dile getirmişlerdir: " Çözülmüş örnek sayısı çok az olduğu için görselliği yeterli bulmuyorum. Soyut konuları görsellerle daha anlamlı düşüncelere dönüştürerek fikir üretiyor" (Ö2), "Görseller yeterli değil. Öğrenci gözünde canlandıramadığı soyut kavramları görsellerle daha iyi kavrayabiliyor"(Ö3).

Araştırmada görüşme yapılan on öğretmene, iyi bir problem nasıl olması gerektiğine ilişkin görüşleri sorulmuştur. Görüşme yapılan öğretmenlerin yaklaşık yarısı (4 öğretmen) anlaşılır ve günlük hayatla ilişkili olması gerektiğini, geriye kalan üç öğretmen problemde verilen bilgiler açık ve öz olması gerektiğini, iki öğretmen öğrencilerin benzer soruları çözebilecek anlatımda ve içerikte olması gerektiğini, diğer iki öğretmen seviyeye uygun olması gerektiğini ve son olarak bir öğretmen kolaydan zora doğru olması gerektiğini belirtmişlerdir. Bu yönde görüş belirten öğretmenlerden ikisinin görüşü şöyledir: "İyi bir problem anlaşılır olmalı, mümkünse günlük hayatla ilişkilendirilmeli" (Ö6) ve "İyi problem konu hakkında bilgi vermeli. Çözümü fikir kazandırmalı."(Ö7).

Öğretmenlere, kullandıkları ders kitaplarındaki verilen problemlerin iyi problemler olup olmadıklarına dair görüşleri sorulmuştur. Görüşme katılan öğretmenlerin üçü kullandıkları kitaplardaki bölüm sonu problemlerin iyi ancak konu anlatımı ile soruların uyumlu olmadığını, geriye kalan üç öğretmenin kullandıkları kitaplardaki problemin iyi olmadığını, bir öğretmen ise kullandıkları kitaplardaki problemin iyi olduğunu belirtmişlerdir. Örneğin öğretmenlerin birkaçının görüşü şöyledir: "Kitaptaki problemleri açıklamalı anlatımlara göre daha detaylı buluyorum. Alıştırmalar tüm konuyu kapsıyor ama öğretmen yardımı gerekiyor. Bunu standart okullar için düşünüyorum" (Ö7), "Hayır. Kitapta çözülen problemlerle alıştırmalar ilgisiz. YGS, LYS sınav sorularını destekleyici değil. Belki de ÖSYM yanlış yapıyordur!"(Ö5), "İyi problem değil. Konu anlatılmadan direk birkaç problem üzerinden konu es geçilmiş." (Ö9).

Araştırmada görüşme yapılan on öğretmene, öğrencilerinin hangi tür soruları çözerken daha başarılı olduklarına dair görüşleri sorulmuştur. Görüşme yapılan on öğretmenin yarısından fazlası (7 öğretmen) öğrencilerin alışık oldukları klasik sorularda daha başarılı olduğunu, üç öğretmen öğrencilerin araştırmaya ve düşünmeye dayalı problemleri sevmediklerini, öğretmenlerden ikisi öğrencilerin yeni bilgi gerektiren problemlerde zorlandıklarını, öğretmenlerden bir tanesi rutin olmayan problemlerde başarılı olduklarını, başka bir tanesi ise günlük yaşamla ilgili problemlerde daha başarılı olduğunu belirtmişlerdir.

Görüşmeye katılan öğretmenlerin yarısından fazlası öğrencilerin alışık oldukları klasik sorularda daha başarılı olduğunu belirten içlerinden bir tanesi şu sözleri dile getirmiştir: "Denklem problemlerini biraz anlıyorlar, ilköğretimde karşılaştıkları için sayı kesir problemlerini rahat çözüyorlar"(Ö9). Görüşmeye katılan üç öğretmenden iki tanesi öğrencilerin düşünmeye ve araştırmaya yönelik problemleri sevmediklerini şu şekilde dile getirmişlerdir:" Rutin problemlerde daha başarılılar. Yoruma ve araştırmaya yönelik soruları sevmiyorlar. Kitabımızdaki problemlerin aynı tip olmasını istiyorlar. Çok kolay ve düşünceye dayalı, ezbere dayalı çözümü çok kolay olanları tercih ediyorlar. Merak ve öğrenme heyecanı hiç yok. İleriye dönük hiçbir hedefleri yok!" (Ö2), "Rutin problemlerde daha başarılılar. Araştırma yapmayı hiç sevmiyorlar. Hep çözdükleri problemin hemen hemen aynısını istiyorlar. Kolay ve yorulmadan çözüm istiyorlar. Çocuklarda öğrenme heyecanı yok. Amaçsızca okula gelerek eğitim alıyorlar." (Ö7). Görüşmeye katılan bir öğretmen öğrencilerin günlük yaşamla ilgili problemlerde daha başarılı olduklarını şu sözlerle dile getirmiştir:" Sayı ve kesir problemlerini çözmekten hoşlanıyorlar, daha anlaşılabilir günlük hayatla ilişkili."(Ö8).

Araştırmada görüşme yapılan on öğretmene, MEB ders kitabını hangi düzeyde kullandıkları ve problemlerde değişiklik yapıp yapmadıklarına dair görüşleri sorulmuştur. Görüşme yapılan on öğretmenin yarısına yakını (3 öğretmen) çocuklara teşvik için arada kullandıkları, üç öğretmen kitabı kullanmadığını kendileri hazırladığını, yarısına yakın (4 öğretmen) öğretmen kitabı kullandıklarını belirtmişlerdir.

Görüşmeye katılan öğretmenlerin yarısına yakını MEB ders kitabını kullanmadıklarını belirtenlerden bir tanesi şu sözleri dile getirmiştir: " Yetersiz düşük seviyede buluyorum. Benim okulun başarı düzeyindeki öğrenciler için bol örnekli test tekniğine uygun sorularla takviye yapıyorum. Soru sayılarını arttırıyorum. "(Ö9). Görüşmeye katılan dört öğretmenden üç tanesi MEB kitabını kullanmasıyla ilgili şu sözleri dile getirmişlerdir: " MEB kitabını kullanıyorum. Çözülmüş örnekleri hiç kullanmadım. Bölüm sonundaki alıştırmaların ve testlerin içinden bazılarını seçiyorum. Kitap dışı soruları da çok kullanıyorum" (Ö2), " Ders kitabındaki tüm örnek ve alıştırmalarını çözerek, ek kaynaklardan örnekler çözerek ve problemlerde sayısal değerleri değiştirerek işlerim."(Ö4), " MEB kitaplarının alıştırmalarını ve testlerini mutlaka kullanıyorum. Değişiklik yapmıyorum. Hatta MEB alıştırmalarını değerlendirme soruları olarak kullanıyorum." (Ö7).

Araştırmada görüşme yapılan on öğretmene, öğrencilerinin problem çözme alışkanlığını günlük yaşama uyarlayabilecek şekilde kazanıp kazanmadığına ilişkin görüşleri sorulmuştur. Görüşme yapılan on öğretmenin yarısına yakın (4 öğretmen) öğrencilerinin çok zorlandıklarını, üç öğretmen öğrencilerinin kısmen zorlandıklarını, iki öğretmen öğrencilerinin zorlanmadıklarını, bir öğretmen ise ders çalışma alışkanlıklarının olmadığını belirtmişlerdir. Görüşmeye katılan öğretmenlerin yarısına yakını öğrencilerinin problem çözme alışkanlığını günlük yaşama uyarlayabilmesinde çok zorlandığını belirtenlerden bir tanesi şu sözlerle dile getirmiştir: "Konuya ve üniteye göre değişiyor. Şekilli anlatımlarda ve geometri sorularında çok zorlanıyorlar. Hiç sevmeyenler var. Sınıf ortamına kişilerin durumuna göre değişiyor. Temel matematik bilgileri iyi olanlar çok çabuk günlük yaşama uygulayabiliyorlar*"* (Ö2). Görüşmeye katılan üç öğretmenden bir tanesi öğrencilerinin problem çözme alışkanlığının günlük yaşama kısmen uyarladıklarını şu sözlerle dile getirmiştir: "Konuya göre değişiyor. Geometriden çok uzaklar. Sınıf ortamı ve seviyesine göre de değişiyor. Birinci dönem bu konuda çok zorlanıyoruz. Eski alışkanlıkları ancak ikinci döneme değişebiliyor. Temel matematik problemi yaşamayan öğrenciler daha çabuk kazanabiliyorlar."(Ö7).

Araştırmada görüşme yapılan on öğretmene, problemlerin sonuçlarının öğrencilerine çözümü tartışma fırsatı verip vermediğine ilişkin görüşleri sorulmuştur. Görüşme yapılan on öğretmenin nerdeyse tamamı (9 öğretmen) problemlerin sonuçlarının öğrencilerine bazen çözümü tartışma fırsatı verdiğini, bir öğretmen ise problemlerinin çözümünün çok az tartışma fırsatı verdiğini belirtmişlerdir. Görüşmeye katılan öğretmenlerin nerdeyse tamamı problemlerin sonuçlarının öğrencilerine bazen çözümü tartışma fırsatı verdiğini belirtenlerden bir tanesi şu sözlerle dile getirmiştir: " Bazen çözümün neden böyle yapıldığı hakkında tartışılıyor."(Ö4)

Araştırmada görüşme yapılan on öğretmene, problemlerin öğrencilerinin bulundukları sınıflara ve gelişim seviyelerine uygun olup olmadığına ilişkin görüşleri sorulmuştur. Görüşme yapılan on öğretmenin yarısından fazlası (6 öğretmen) problemlerin öğrencilerinin bulundukları sınıflara ve gelişim seviyelerine uygun olduğunu, geri kalan 5 öğretmen ise problemlerin öğrencilerinin bulundukları sınıflara ve gelişim seviyelerine uygun olmadığını belirtmişlerdir. Görüşmeye katılan öğretmenlerin yarısından fazlası problemlerin öğrencilerinin bulundukları sınıflara ve gelişim seviyelerine uygun olduğunu belirtenlerden üç tanesi şu sözlerle dile getirmişlerdir: " Uyumlu evet. Yalnız ortaokuldan liseye geçtiklerinde çok zorlanıyorlar. Kendini derse veren öğrenciler kendilerini kurtarıyor. Çocukluktan çıkmayan kendini gençlik hevesine kaptıran maalesef lisede bocalıyor. Notları da zayıf gelince iyice ümitsizliğe kapılıyor."(Ö1), " Evet %80 uyumlu. Fakat 6. , 7. Ve 8. Sınıflarda liseye geçişte bir problem yaşadıkları için ezbere dayalı, kısa cevaplı, yorumu hiç yapamayan, araştırmaya kapalı, hiç kitap okumayan bir seviyede oldukları için gelişim seviyesine uygun bulmuyorum"(Ö2), "Evet uygun. Ama 6,7 ve 8. Sınıf eğitimleri çocuğun liseye başladığındaki hazır bulunuşluk seviyesi için yeterli değil. Çok ciddi sorunlarla, tamamen ezbere alışmış, araştırmaya kapalı bir biçimde geliyorlar. Soru sormadan, yazmadan, ödev yapmadan başarılı olmak istiyorlar. Bu nedenle amaca ulaşılamıyor." (Ö7). Görüşmeye katılan geriye kalan dört öğretmenden iki tanesi problemlerin öğrencilerinin bulundukları sınıflara ve gelişim seviyelerine kısmen uygun olduğunu şu sözlerle dile getirmişlerdir: " Çokta uygun değil. Öğrenci öğretmensiz kitaptaki problemlerin çoğunu yapamıyor. Problemler seviyenin üstünde seçilmiş. Problemlerin, basitten zora doğru öğrencileri problem çözmeye teşvik edici şekilde verilmesi uygun olur." (Ö4), " Öğrencilerin 9. Sınıfta hazır bulunuşluk seviyeleri yetersiz. Sorular 9. Sınıf seviyesine uygun ancak öğrenci potansiyel olarak o seviyede değil. İlköğretim özellikle de 6,7,8. Sınıflar ciddi bir problem yaratıyor"(Ö6).

SONUÇ

1) Görüşme yapılan öğretmenlere göre, problem cümlelerinde kullanılan dilin açık, anlaşılır ve günlük yaşamla tutarlı olduğu sonucuna ulaşılmıştır.
2) Öğretmen görüşlerine göre dokuzuncu sınıf ders kitabında verilen problemlerin sayısının yeterli olmadığını sonucuna ulaşılmıştır.
3) Görüşme yapılan öğretmenlere göre dokuzuncu sınıf ders kitabındaki kitabında problemlerin sunumunda şekil, resim, tablo ve grafik gibi görsel öğelerin yeterli olmadığı sonucuna ulaşılmıştır.
4) Araştırmanın sonucunda iyi problem açık, anlaşılır ve günlük hayatla ilişkili olması gerektiği sonucuna ulaşılmıştır.
5) Görüşme yapılan öğretmenlere göre öğrencilerin alışık oldukları klasik sorularda daha başarılı oldukları ortaya çıkmıştır.
6) Görüşme yapılan öğretmenlerin çoğunun ders kitaplarını kullandıkları sonucuna ulaşılmıştır.
7) Öğretmenlerin öğrencilerinin problem çözme alışkanlığını günlük yaşama uyarlamakta zorlandıkları sonucuna ulaşılmıştır.
8) Araştırmada görüşme yapılan öğretmenlere göre problemlerin sonuçlarının öğrencilerine çözümü tartışma fırsatı verdiği ortaya çıkmıştır.
9) Görüşmeye katılan öğretmenlerin yarıdan fazlası problemlerin öğrencilerinin bulundukları sınıflara ve gelişim seviyelerine uygun olduğunu sonucuna ulaşılmıştır.

ÖNERİLER

1) Araştırmaya katılan öğretmenler genel olarak matematik dersi için verilen problemlerin sayısının yeterli olmadığını belirtmişlerdir. Bu bağlamda ders kitaplarının sayısının artırılması önerilebilir.
2) Araştırmanın sonucunda öğrencilerinin problem çözme alışkanlığını günlük yaşantılarına uyarlayabilecek nitelikte sınıf içerisinde etkinlikler yapılması önerilebilir.
3) Araştırmada öğretmenlere göre öğrencilerin rutin olmayan problemleri çözme başarılarının yeterli olmadığı ortaya çıkmıştır. Bu bağlamda bu durumun nedenleri araştırılabilir

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TEACHER VIEWS FOR SOROBAN ABACUS TRAINING

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ABSTRACT: Soroban abacus is called mental arithmetic education in our country. Mental arithmetic is known to increase students' skills in four operations. How is success and status of students have received training of Soroban abacus about problem solving, creativity, concept development, courses of interest, success in other lessons and social relations in their classes? This study aims to investigate in order to answer this question, the impact on students of mental arithmetic training through interviews with 14 student teachers trained in mental arithmetic between 7 and 12 years of age. These students were reached using snowball sampling. In this research, the effect of Soroban abacus training on students' problem-solving skills, creativity, the concepts of learning, the state interest in the mathematics class, success in other lessons, and the impact on their relationship with other friends in the classroom. For this purpose 6 items has been determined by tree experts. In this study it was interviewed with class and mathematics teacher of these 14. Descriptive analysis was performed on the data obtained. Finally Soroban abacus training of children say they are better than other children in the areas identified above.

Keywords: soroban abacus training, mental arithmetic, problem solving.

SOROBAN ABACÜSÜ EĞİTİMİ İÇİN ÖĞRETMEN GÖRÜŞLERİ

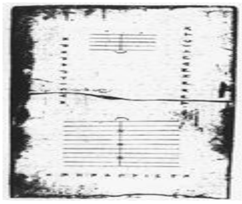
ÖZET: Soroban abacüsü eğitimi ülkemizde mental aritmetik olarak adlandırılmaktadır. Mental aritmetiğin öğrencilerin işlem dört işlem becerilerini artırdığı bilinmektedir. Bunun yanısıra problem çözme, yaratıcılık, kavram gelişimi, derslere ilgi, diğer derslerdeki başarı ve sosyal ilişki konularında soroban eğitimi almış öğrencilerin durumları nasıldır? Bu soruya cevap aramak amacıyla bu çalışmada mental aritmetik eğitimi alan 7 ve 12 yaşları arasındaki 14 öğrencinin öğretmenleri ile görüşmeler yapılarak mental aritmetik eğitiminin öğrenciler üzerindeki etkisi araştırılmaya çalışılmıştır. Bu öğrencilere olasılıksız örnekleme yöntemlerinden kartopu örnekleme yöntemi kullanılarak ulaşılmıştır. Araştırmada Soroban abacüsü eğitiminin öğrencilerin problem çözme becerilerine, yaratıcılıklarına, kavram öğrenmelerine, matematik derslerine karşı ilgi durumlarına, matematik dersi dışındaki diğer derslerdeki başarı durumlarına, sınıf içerisindeki diğer arkadaşlarıyla olan ilişkilerine etkileri incelenmiştir. Bu amaçla yukarıda söylenen 6 madde 3 alan uzmanının görüşleri doğrultusunda belirlenmiştir. Çalışmada Soroban abacüsü eğitimi alan 14 öğrencinin sınıf ve matematik öğretmenlerinden 6 soruya yazılı cevap vermeleri istenmiştir. Görüşme sonucunda elde edilen veriler üzerinde betimsel analiz yapılmıştır. Genel durum olarak Soroban abaküs eğitimi alan çocukların diğer çocuklara göre yukarda belirlenen alanlarda daha iyi oldukları söylenebilir.

Anahtar kelimeler: soraban abacüs eğitimi, mental aritmetik, problem çözme.

GİRİŞ

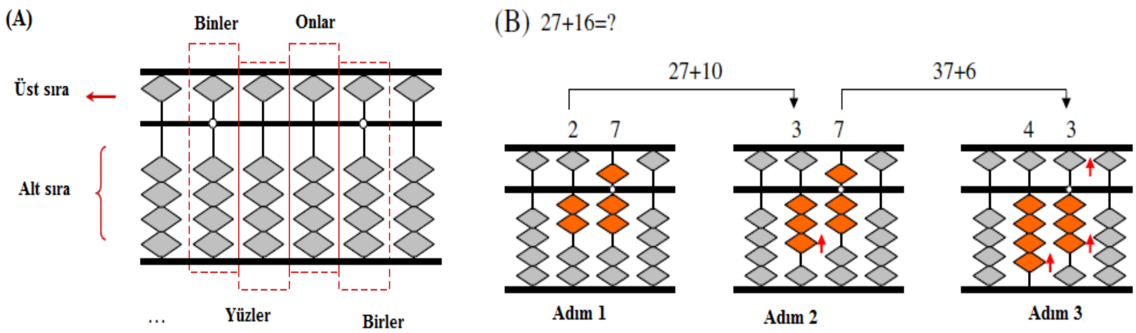
Günümüzde matematik öğretimi ilgili teorilere bakıldığında anlamlı bir öğretim için somuttan soyuta doğru bir öğretimden bahsedilebilir. Kavramların somut hali öğrenme döngüsünde ilk adımdır. Somut için ön bilgilerle ilişkilendirebilen durumlar denebilir. Bu nedenden dolayı tüm matematiksel kavramlar için öğretimde somut adıma ihtiyaç vardır. Çünkü öğrenmenin bir tanımı önbilgiler yardımıyla yeni bilgilere ulaşımdır. Öğretimde somut adım daha sonra yarı-soyut aşamaya yerini bırakmalıdır. Yarı soyut aşama için çentikler ve sayı doğrusundan bahsedilebilir. Somut adımdaki gerçek nesneler ve bunların resimleri bu basamakta yerini çentik, birim ve sayı doğrusuna bırakmıştır. Matematik öğretiminde işlem becerileri önemli bir yer almaktadır. Toplama, çıkarma, çarpma, bölme işlemlerinin öğrenci tarafından zihinden yapılabilmesi onların pratik işlem becerisini geliştirir. İşlemlerin öğretimi için somut basamak gerçek nesnelerdir. Gerçek üzerinde anlam kazanan işlem kavramı daha sonra birimlere transfer edilebilir. Birimlerin sistematik olarak kullanılması yarı soyut aşama içerisinde görülebilir.

Sayıların zihinde canlanması ve aralarındaki işlemlerin zihinden yapılabilmesi kolay olmayabilir. Bunun için yardımcı materyallere ihtiyaç vardır. İnsanlar eski çağlarda çentikleri kullanmışlardır. Daha sonra bu durum yerini gitgide geliştirilen olan abaküslere bırakmıştır. M.Ö 300'lü sayma tahtası olarak adlandırılan şekil 1'deki gibi mermerden yapılmış Salamis Tableti kullanılmıştır (http://www.ee.ryerson.ca/~elf/abacus/history.html). Salamis Sayma tahtası ilk abaküs olarak bilinmektedir. Daha sonra, farklı biçimlerde Mısır, İran ve Yunanistan'da bir ahşap çerçevenin içine yerleştirilmiş çubuklara dizilmiş boncuklar biçimindeki abaküsler kullanılmıştır.



Şekil 1. Salamis Tableti

Günümüzde 1958 de Lee Kai-chen tarafından keşfedilen Soroban abaküsü işlem yapmak amacıyla sık olarak kullanılmaktadır. Bu abaküs çubuklar boyunca kaydırılan beşerli boncuklardan oluşur. Bu boncuklar yardımıyla işlemler yapılır (http://www.ee.ryerson.ca/~elf/abacus/history.html). Aşağıda Soroban abacüsüyle 27+16 işleminin nasıl yapıldığı anlatılmaktadır.



Şekil 2. Soroban Abaküsü (Chen et al. 2006).

Şekil 2 (A) daki Soroban abaküsünde üst sırada bulunan her boncuk 5 değerine, alt sırada bulunan her boncuk 1 değerine sahiptir. Şekil 1(A) da görüldüğü gibi sağdan sola doğru sırasıyla birler, onlar, yüzler, binler,… kolonları bulunmaktadır. Birler kolonunda alt sırada bulunan boncukların sayı değeri 1, üst sırada bulunan tek boncuğun sayı değeri 5 dir. Onlar kolonda alt sırada bulunan boncukların sayı değeri 10, üst sırada bulunan tek boncuğun sayı değeri 50 dir. Yüzler kolonunda alt sırada bulunan her boncuğun sayı değeri 100, üst sırada bulunan tek boncuğun sayı değeri 500 dür. Şekil 1 (B) de 27+16 işlemi abaküs üzerinde şöyle yapılmıştır. İlk önce 27 sayısının nümerik gösterilimi için; abaküs üzerinde onlar kolonunun alt sırasındaki iki boncuk yukarı kaydırılmış (+10+10) daha sonra birler kolonunda +7 (+5+2) için üst sırada bir boncuk aşağı kaydırılmış (+5) alt sıradan iki (+2) boncuk yukarı çekilmiştir. 16 (+10+6) nın 27 ye eklenmesi şöyle yapılmıştır. +10 için onlar kolonunun alt sırasından bir boncuk yukarı çekilmiş 6 (10-5+1) için birinci olarak 10-5 için birler basamağında üst sırada bulunan bir boncuk geriye alınarak (-5), onlar basamağından bir boncuk (+10) yukarı çekilmiştir. Daha sonra +1 için birler basamağının alt sırasından bir boncuk yukarı çekilmiştir. Şekil 1 (B) deki adım 3 deki şekle bakıldığında sonuç 43 ortaya çıkmıştır (Chen et al. 2006).

Baddeley ve Hitch (1974) çalışan bir hafıza sistemi tanımladılar. Çalışan hafıza modeli günlük hayatımızda mantıklı düşünme sırasında bilgileri geçici olarak nasıl işlediğimizi ve depoladığımızı açıklamak için geliştirilmiştir. Çalışma çalışan hafıza sistemi birçok bilişsel beceri perfomansları, bireylerin genel IQ ve okul başarıları gibi durumlarının belirlenmesinde önemli bir rol oynamaktadır (Gathercole, 1999). Bir fiziksel hesaplama aleti olan abacüsü kulanan deneyimli kişiler, görselleştirmeyi mental abacüsle yaparak aritmetik hesaplamaları iyi bir şekilde icra ederler (Miller & Stigler, 1991). Abacüs kullanımı bireylerin çalışan hafızalarına olumlu yönde etkileri olduğu birçok araştırma da gösterilmiştir (Chen et al. (2006), Lean ve Lan (2005), Lu (2002), Hanakawa et all, (2003)). Şahiner ve Şad (2014) yaptıkları çalışmada zihinsel aritmetik eğitimine ilişkin olarak öğrenci, öğretmen ve veli görüşlerini incelemişlerdir. Bunun için 10 öğrencinin kendisi, öğretmen ve velileri ile yarı yapılandırılmış görüşme sonuçlarını dikkate alarak yaptığı araştırmada zihinsel aritmetik eğitiminin öğrencilerin matematik dersi akademik başarılarına, işlem becerilerini artırmalarına, öğrenmeye olumlu tutum geliştirmeye, güdülenmelerine ve derslere aktif katılmalarına olumlu yönde etkisi olduğu sonucunu elde etmişlerdir. Hayashi (2000), Kawano (2000) ve Amaiwa (2000) göre erken yaşlardaki abacüs eğitimi çocukların problem çözme becerilerini geliştirdiği yöndedir. Rubenstein (2001) yaptığı çalışmasında abacüs öğrenen öğrencilerin problem çözme becerilerinin geliştiği ve problem çözmek için birden fazla yöntem ve teknik belirlediklerini elde etmişlerdir. Ayrıca matematik dersine karşı olumlu tutum geliştirdiklerini belirtmiştir.

Tsang ve arkadaşları (2009) 10-15 yaşları arasındaki 28 çocukta (14 kız,14 erkek) yaptıkları mental aritmetik ile ilgili fonksiyonel MR çalışmasında difüzyon tensor görüntüleme metoduyla mental aritmetik yeteneği ile ilişkili bölgeleri birbirine bağlayan ara yolları hesaplayarak test etmişler. Her çocukta bu ara bağlantı yolu anatomik olarak belirlenmiş. Bu hesaplama ile beynin sol taraftaki ara yolların aritmetik işlemler, problem çözme ve mental yeteneklerde daha etkin olduğu görülmüştür (aktaran Kara, 2013). Kara (2013) 33 abacüs eğitimi alan öğrenci üzerinde yaptığı çalışmada abaküs mental aritmetik eğitiminin yaratıcı düşünme programının matematiksel problem çözme becerilerinin geliştirilmesine pozitif yönde etkisinin olduğu ve bu etkinin geniş etki büyüklüğüne sahip olduğu sonucunu elde etmiştir. Literatürde Soraban abaküsü ile yapılan çalışmaların bir çok kısmı abacüs eğitiminin Baddeley ve Hitch (1974) tanımladığı "çalışan hafıza" ya katkıları ile ilgilidir. Literatürde ulaşabildiğimiz kadarıyla abaküs eğitiminin öğrencilerin problem çözme, yaratıcılık, kavram öğrenme, matematik dersine ilgi ve arkadaşlarıyla olan sosyal becerileri üzerine az sayıda araştırma vardır. Bu durum göz önüne alınarak bu çalışmanın amacı soroban abacüs eğitimi almış öğrencilerin problem çözme becerilerini, yaratıcılıklarını, kavram öğrenme durumlarını, matematik dersine karşı ilgilerini, diğer derslerdeki başarı durumlarını ve arkadaşlarıyla olan sosyal iletişim becerilerini onların öğretmenlerinin görüşleri doğrultusunda belirlemektir.

YÖNTEM

Katılımcılar

Kartopu örnekleme yöntemiyle İzmir ilinde abacüs eğitimi alan öğrencilere ulaşılmıştır. Bu yöntem araştırmaya katılan bir katılımcı yoluyla diğer katılımcılara ulaşarak örneklemin oluşturulmasıdır (Karasar, 2007). Abaküs eğitimi alan öğrencilerin sınıf ya da matematik öğretmenleri bu araştırmanın katılımcılarını oluşturmaktadır. Bu çalışmada 14 öğretmene ulaşılmıştır. Aşağıda tablo 2 de öğretmenlerin hangi sınıfı okuttukları gösterilmiştir.

Tablo2. Öğretmenlerin Okuttukları Sınıflar

Öğretmen	Sınıf	Öğretmen	Sınıf
Öğretmen1	2.sınıf	Öğretmen8	3.sınıf
Öğretmen2	4.sınıf	Öğretmen9	2.sınıf
Öğretmen3	3.sınıf	Öğretmen10	5.sınıf
Öğretmen4	4.sınıf	Öğretmen11	2.sınıf
Öğretmen5	4.sınıf	Öğretmen12	4.sınıf
Öğretmen6	1.sınıf	Öğretmen13	3.sınıf
Öğretmen7	3.sınıf	Öğretmen14	4.sınıf

Veri toplama aracı

Araştırmada Soroban abacüsü eğitimi alan öğrencilerin sınıflarında bu eğitimi almayan öğrencilere göre problem çözme becerileri, yaratıcılıkları, kavram öğrenmeleri, matematik derslerine karşı ilgi durumları, matematik dersi dışındaki diğer derslerdeki başarı durumları, sınıf içerisindeki diğer arkadaşlarıyla olan ilişkileri incelenmek istenmiştir. Bu amaçla yukarıda söylenen alanlar doğrultusunda öğretmenlere sorulmak istenen 6 soru 2 alan uzmanının görüşleri doğrultusunda belirlenmiştir. Bu maddeler en son haliyle şu şekildedir.

1. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre problem çözme becerileri için neler söylemek istersiniz?
2. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre yaratıcılık yetenekleri için neler söylemek istersiniz?
3. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre kavramları öğrenme başarısı için neler söylemek istersiniz?
4. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre matematik dersine karşı ilgileri bakımından ne söylersiniz.
5. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre diğer derslerdeki başarı durumları nasıldır?
6. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre arkadaşlarıyla olan sosyal ilişkileri için neler söylemek istersiniz?

Çalışmaya katılan öğretmenlerden bu sorulara yazılı cevap vermeleri istenmiştir.

Veri analizi

Yukarıdaki 6 soru doğrultusunda elde edilen yazılı cevaplar üzerinden betimsel analiz yapılarak sonuçlar elde edilmiştir. Betimsel analiz, çeşitli veri toplama teknikleri ile elde edilmiş verilerin daha önceden belirlenmiş temalara göre özetlenmesi ve yorumlanmasını içeren bir nitel veri analiz türüdür. Bu analiz türünde araştırmacı görüştüğü ya da gözlemiş olduğu bireylerin görüşlerini çarpıcı bir biçimde yansıtabilmek amacıyla doğrudan alıntılara sık sık yer verebilmektedir. Bu analiz türünde temel amaç elde edilmiş olan bulguların okuyucuya özetlenmiş ve yorumlanmış bir biçimde sunulmasıdır (Yıldırım ve Şimşek, 2003).

BULGULAR

Çalışmada Soroban abaküsü eğitimi alan çocuklarının öğretmenlerinin kendilerine sorulan altı soruya verdikleri cevaplar sırasıyla şu şekildedir.

1. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre problem çözme becerileri için neler söylemek istersiniz?

Bu soruya 14 öğretmenden öğretmen1 ve öğretmen2 abacüs eğitimi alan çocukların sınıflarındaki diğer almayan çocuklara göre problem çözme becerilerinin daha zayıf olduklarını belirtmişlerdir. Öğretmen3 ve öğretmen4 abacüs eğitimi alan çocukların sınıflarındaki diğer çocuklarla bu konuda farkları olmadıklarını belirtmişlerdir. Bunların dışında kalan 10 öğretmen sırasıyla öğretmen 5,6,7,8,9,10,11,12,13ve 14 abacüs eğitimi alan çocukların almayan çocuklara göre problem çözme becerilerinin daha iyi olduklarını ifade etmişlerdir. Bu öğretmenlerden 1. Sınıf mental aritmetik eğitimi alan öğrencinin sınıf öğretmeni olan öğretmen 6 şu şekilde cevap vermiştir.

"Zaman içerisinde karşılaştığı problemlere alternatif cevap verebilen çocukların, bakıldığında mental aritmetiğininde iyi olduğu göz önüne çıktı."

5. sınıflardan soroban abaküs eğitimi alan bir öğrencinin matematik öğretmeni (öğretmen 10) bu soru için şöyle demiştir.

"Daha hızlı çözüm üretebilmektedir."

2. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre yaratıcılık yetenekleri için neler söylemek istersiniz.

Bu soruya 14 öğretmenden ikisi öğretmen1 (2. Sınıf) ve öğretmen9 (3. Sınıf) Soroban abaküs eğitimi alan öğrencilerin diğer bu eğitimi almayan öğrencilere göre yaratıcılık yeteneklerinin daha iyi olmadıklarını belirtmişlerdir. Öğretmen3 (3. Sınıf) ve öğretmen13 bu çocukların diğer çocuklarla farkının olmadığını söylemiştir. Öğretmen 2,4,5,6,7,8,10,11,12ve 14 bu öğrencilerin bu yönlerinin diğer çocuklara daha iyi olduklarını söylemişlerdir. Bu öğretmenlerden bazılarının bu konuda görüşleri aşağıdaki gibidir.

"Bu öğrenciler diğer öğrencilere göre ZEP (Zenginleştirilmiş Eğitim Programı) dersinde daha üretkenler." (4. Sınıf, öğretmen12)

"Hızlı çözüm üretmekte ve farklı bakış açısıyla yaklaştıkları için değişik fikirler üretebiliyorlar."(5. Sınıf, Matematik öğretmeni10)

3. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre kavramları öğrenme başarısı için neler söylemek istersiniz?

Bu soruya 14 öğretmenden bir öğretmen (öğretmen11, 2.sınıf) diğer çocuklara göre daha başarısız bulmuştur. Öğretmen3,4,5,9 ve 12 kavramları öğrenme yönüyle abaküs eğitimi alan çocukların diğer almayan çocuklara göre aynı düzeyde olduklarını belirtmişlerdir. Öğretmenlerden öğretmen 1,2,6,7,8 ve 10 diğer çocuklardan bu yönüyle daha iyi olduğunu söylemiştir.

Bu konuda öğretmen9'un ifadesi şöyledir.

"Kavramları diğer çocuklarla benzer seviyede öğreniyorlar ama dikkat sorunlarında aşırı hızlı olmaktan hep yanlış anlıyorlar."

4. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre matematik dersine karşı ilgileri bakımından ne söylersiniz.

Bu konuda öğretmen4 abaküs eğitimi alan çocuğun matematik dersine karşı ilgisinin diğer öğrencilere göre daha az olduğunu fakat bu öğrencinin sözel derslerde diğer öğrencilere göre ilgisinin fazla olduğunu belirtmiştir.

Diğer bütün öğretmenler abaküs eğitimi alan öğrencilerin matematik dersine karşı ilgilerinin yüksek olduğunu söylemişlerdir.

5. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre diğer derslerdeki başarı durumları nasıldır?
Bu soruya öğretmen 11 abaküs eğitimi alan çocuğun almayan çocuğa göre diğer derslerdeki başarı durumunun daha düşük olduğunu belirtmiştir. Öğretmen1,10 ve 9 farklılık olmadığını belirtmiştir. Öğretmen2,3,4,5,6,7,8 ve 12 abaküs eğitimi alan öğrencilerin diğer derslerdeki başarıları bu eğitimi almayan öğrencilere göre daha yüksek olduğunu belirtmiştir. Bunun yanı sıra 4. Sınıf öğretmenlerinden öğretmen12 ve öğretmen5 bu öğrencilerin akademik başarı açısından sınıfta ilk sırada olduklarını belirtmişlerdir.

6. Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre arkadaşlarıyla olan sosyal ilişkileri için neler söylemek istersiniz?
Bu soruya öğretmenlerden farklı cevaplar gelmiştir. Bazı öğretmenler öğretmen8,11 ve 12 sosyal iletişimin abaküs eğitimi ile ilişkisi yoktur demişlerdir. Bu cevapları değerlendirmeye almadık. Çünkü biz bu öğrencilerin diğer arkadaşlarıyla sosyal ilişkilerinin durumunu sormuştuk.

Bunun yanı sıra öğretmen2,3,4,5 ve 7 bu öğrencilerin arkadaşlarıyla olan sosyal ilişkilerin diğer öğrencilere göre daha iyi olduğunu belirtmişlerdir. Öğretmen8 öğrencinin çok hızlı ve kendini kontrol etmekte zorlandığını belirtmiştir. Öğretmen10 bu soruyu cevaplamamıştır. Öğretmen6 bu öğrencinin arkadaşlarıyla sosyal ilişkilerine olumsuz olarak bakmış bunun nedenini çocuğun aşırı rekabet içinde olmasına bağlamıştır. Öğretmen1,9,13 ve 14 ilişkilerinin diğer çocuklardan farklı olmadığını söylemişlerdir.

Yukarıda elde edilen bilgiler kısmen tablo 1 de belirtilmeye çalışılmıştır.

Tablo1. Öğretmen Görüşlerine Göre Abaküs Eğitimi Alan Çocukların Sınıflarındaki Diğer Abaküs Eğitimi Almayan Çocuklara Göre Durumları

Sorular	Daha başarısız	Aynı	Daha başarılı
1.Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre problem çözme becerileri için neler söylemek istersiniz?	Öğrt1, Öğrt2	Öğrt3, Öğrt4	Öğrt5, Öğrt6, Öğrt7, Öğrt8, Öğrt9, Öğrt10, Öğrt11, Öğrt12, Öğrt13, Öğrt14
2.Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre yaratıcılık yetenekleri için neler söylemek istersiniz.	Öğrt1, Öğrt9	Öğrt3, Öğrt13	Öğrt2, Öğrt4, Öğrt5, Öğrt6, Öğrt7, Öğrt8, Öğrt10, Öğrt11, Öğrt12, , Öğrt14
3.Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre kavramları öğrenme başarısı için neler söylemek istersiniz?	Öğrt11	Öğrt3, Öğrt4, Öğrt5, Öğrt9, Öğrt12	Öğrt1, Öğrt2, Öğrt6, Öğrt7, Öğrt8, Öğrt10, Öğrt13, Öğrt14
4.Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre matematik dersine karşı ilgileri bakımından ne söylersiniz.	Öğrt4		Öğrt1, Öğrt2, Öğrt3, Öğrt5, Öğrt6, Öğrt7, Öğrt8, Öğrt9, Öğrt10, Öğrt11, Öğrt12, Öğrt13, Öğrt14
5.Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer	Öğrt11	Öğrt1, Öğrt9, Öğrt10	Öğrt2, Öğrt3, Öğrt4, Öğrt5, Öğrt6, Öğrt7, Öğrt8, Öğrt12, Öğrt13,

çocuklara göre diğer derslerdeki başarı durumları nasıldır?			Öğrt14
6.Soroban abaküs eğitimi alan çocukların bu eğitimi almayan diğer çocuklara göre arkadaşlarıyla olan sosyal ilişkileri için neler söylemek istersiniz?	Öğrt6	Öğrt1, Öğrt9, Öğrt13, Öğrt14	Öğrt2, Öğrt3, Öğrt4, Öğrt5, Öğrt7

SONUÇ

Soroban abacüs eğitimi sayı kavramı ve onun üzerindeki işlemlerin başlangıçta abaküs üzerinde ve daha sonra zihinden işlemleri yapmaya yardımcı olmaktadır. Bu durum matematik öğretiminde somut ile başlayıp soyuta ulaşmayı göstermektedir. Matematik bir soyutlama bilimidir (Katrancı ve Altun, 2013). Yurdakul ve Gülay (2011) mental aritmetik eğitimi ile abaküsün, soyut çok basamaklı nümerik ilişkileri, somut boncuk tabanlı bir sistemde sunmasıyla öğrencinin, sayı değerlerini kolayca ilişkilendirerek matematik kavramlarını anladığından bahsetmişlerdir. Matematiksel hesaplama bilişsel bir yetenektir. Zihinsel hesap yapabilme becerisi yöntemlerin, problem çözme becerilerinin ve çalışan hafızanın kullanımına bağlıdır (Sokol et al., 1991). Lu (2002) nin yaptığı çalışmada mental abacüs eğitimi almış bireylerin visual-spatial yeteneklerinin çok geliştiğini ve iki grubun visual-spatial sketchpad in kısa süreli deposunun kapasiteleri arasında ciddi farklılıklar olduğu sonucunu elde etmişlerdir.

Lean ve Lan (2007) abaküs mental aritmetik öğrenen çocuklar arasındaki matematik problemi çözme becerisinin, abaküs mental aritmetik öğrenmeyen çocuklara oranla daha yüksek olduğunu elde etmiştir. Bu çalışmada da soroban abaküs öğrenen öğrencilerde problem çözme becerilerinin diğer öğrencilere göre daha iyi olduğu öğretmenleri tarafından gözlenmiştir. Kara (2013) çalışmasında abaküs mental aritmetik eğitimi yaratıcı düşünme programının matematiksel problem çözme becerilerinin geliştirilmesine pozitif yönde etkisinin olduğu ve bu etkinin geniş etki büyüklüğüne sahip olduğunu belirtmiştir. Bu çalışmada 14 öğrencinin öğretmenlerinden 11 öğretmen bu öğrencilerin yaratıcılık becerilerinin diğer öğrencilere göre daha iyi olduğunu söylemişlerdir. Amaiwa (2000) Mental abküs eğitimi alan bireylerin problem çözme becerilerinin geliştiğini ve bu yüzden negatif sayılar ve kesirler konusunda pozitif etkilerinin gözlemlendiğini belirtmiştir. Hayashi & Kawano (2000)'nun "çocuklar için erken aşamalarda abaküs kullanımı matematik problemlerini çözmek ve sayılar kavramının anlaşılmasını güçlendirmek için etkilidir" (aktaran Kara (2013)). Bu çalışmada da 14 öğretmenden 8 öğretmen abacüs eğitimi alan öğrencilerin kavramları diğerlerine göre daha iyi öğrendiklerini gözlemlemişlerdir. Bunun nedenlerinden birisi abaküs eğitiminin çalışan hafızanın gelişimine olumlu etkilerinden olabilir. Mental Abacüs hesaplamalarının muhtemelen iki boyutlu uzayda görsel uzamsal (visuospatial) bilgi işlemleri için nörallerin (sinir hücreleri) katılımını artırdığı ilişkilendirilmiştir (Hanakawa et all, 2003). Lee et al. (2007) Abaküs eğitiminden sonra, katılımcıların depolama ve visuo-spatial bilgilerine geri ulaşım becerilerinin çok etkili olarak geliştiğini gözlemlemiştir. Bu çalışmada 11 öğretmen Soroban abaküs eğitimi alan öğrencilerin matematik dersine karşı ilgilerinin daha fazla olduğunu söylemişlerdir. Fidan (2008) çalışmasında da böyle bir sonuç elde etmiştir. İlköğretim 1 ile 5 sınıf müfredatında sayılar ve onlarla ilgili işlemler önemli bir yer kapsamaktadır. İşlemleri ileri düzeyde yapan bu öğrencilerin matematik dersine ilgileri artmış olabilir. Ayrıca bu öğrencilerin çalışan hafızalarının daha gelişmiş olması bilişsel beceri isteyen bu dersi başarmaları onların olumlu tutum geliştirmesini sağlamış olabilir. Abaküs eğitimi alan öğrencilerin öğretmenlerinden 10'u öğrencilerinin diğer derslerde de abaküs eğitimi almayan öğrencilere göre daha başarılı olduklarını ifade etmişlerdir. Çalışmada abacüs eğitimi alan öğrencilerin arkadaşlarıyla sosyal ilişkileri konusunda 7 öğretmen daha iyidir demişlerdir. bu sonuç bu araştırmada diğer sorulara göre en az öğretmenlerin en az katıldığı durumdur. Bu çalışma sonuçları ulaşılan sadece 14 abaküs eğitimi alan öğrencinin öğretmenleriyle yapılan yazılı ifadeleri sonucunda ortaya çıkmıştır. Genellemeler yapmak için bu alanda daha çok çalışmalara ihtiyaç olduğu kanaatindeyiz. Öğrencilere sunulan somuttan soyuta doğru öğretimlerin öğrencilerin başarılarını artıracağı düşünülebilir. Çünkü somut durumlar basitten zora doğru bir döngü içerisinde onların ön bilgilerini öğrenmeye katmaktadır. Öğrenmenin bir tanımı önbilgiler yardımıyla yeni bilgilere ulaşımdır. Öğrenme ortamlarının her yönden zengin olması öğrenmeyi daha anlamlı hale getirebilir. Bu nedenden dolayı öğrencilere zengin öğrenme ortamları sunulmalıdır.

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EVALUATION OF SCHOOL ADAPTATION PROCESS OF THE 1ST GRADE STUDENTS BY TEACHERS' REVIEW (Sample of Bingöl City)

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ABSTRACT: The aim of this study is to evaluate the 1st grade students' process of adaptation to school by the teachers' review. This research has been conducted on the basis of qualitative research methods. A questionnaire consisted of 6 questions for the teachers was used in order to collect the data. This questionnaire was applied to 19 teachers and the collected data was analyzed by QSRNvivo10 package program. According to results of the analysis, most of the teachers stated that the school adaptation process was difficult. It was found out that accepting younger age groups to primary schools a result of decreasing the age limit to 60 months, making these pupils start primary education without getting pre-school education, educating a combination of different age groups in the same class made the adaptation process difficult. It is concluded that most of the students had some difficulties in the younger age groups from physical aspects such as holding pens, writing, cutting, gluing, toilet control; from social aspects such as playing, obeying class and school rules, leaving the parents, making friends, from cognitive aspects such as lack of self-confidence; inability to follow instructions, inability to focus, unable to read and bad reading comprehension. It was determined that 60-66 month–old students had problems on adopting to school because of being under age, having uncaring parents and not receiving preschool education. Teachers work hard to support the physical and emotional development of the students, make them socialized, to make them adopt the school rules and to provide the parent support in the student's process of adaptation to school. It was concluded that the separation of age groups categories would reduce the difficulties arise out of the age imbalance in short-term, but in the long run, subjecting these students to the same test and implementing the same program showed that it wouldn't be the ultimate solution. The teachers stated that the program should be eased, the school starting age should be arranged as 72 months again, schools should be enriched in terms of tools and materials, preschool education should be compulsory and the awareness of the parents should be raised.

Key words: school integration process, the 4 + 4 + 4 education system, school starting age

1. SINIF ÖĞRENCİLERİNİN OKULA UYUM SÜRECİNİN ÖĞRETMEN GÖRÜŞLERİNE GÖRE DEĞERLENDİRİLMESİ (Bingöl İli Örneği)

ÖZET: Bu çalışmanın amacı, ilkokul 1. sınıf öğrencilerinin okula uyum sürecinin öğretmen görüşlerine göre değerlendirilmesidir. Bu araştırma nitel araştırma yöntemlerine dayalı olarak yapılmıştır. Çalışmada nitel veri toplama yöntemlerinden görüşme yöntemi kullanılmıştır. Çalışmada veri toplama amacıyla öğretmenlere yönelik 6 sorudan oluşan bir görüşme formu kullanılmıştır. Bu form 19 öğretmene uygulanmıştır. Toplanan veriler QSRNvivo10 paket programına girilmiş ve görüşmelere ilişkin analizlere ulaşılmıştır. Ulaşılan analiz sonuçlarına göre öğretmenlerin çoğu okula uyum sürecinin zor olduğunu belirtmiştir. Okula uyum sürecinin zor olmasına 4+4+4 eğitim sistemi ile birlikte yaş sınırının 60 aya çekilmesi sonucu küçük yaş grubunun okula alınması, bu yaş grubu öğrencilerinin çoğunun okulöncesi eğitim almadan birinci sınıfa başlaması, sınıfta farklı yaş gruplarının bir arada aynı eğitime tabi tutulmasının neden olduğu ortaya çıkmıştır. Küçük yaş grubundaki öğrencilerin çoğunun kalem tutma, yazı yazma, kesme yapıştırma, tuvalet kontrolü gibi fiziksel; oyun oynama, sınıf ve okul kurallarına uyma, ebeveynden ayrılma, arkadaşlık kurma, özgüven eksikliği yaşama gibi sosyal; yönergeleri takip edememe, dikkatini toplayamama, okuyamama, okuduğunu anlayamama gibi bilişsel yönden sıkıntılar yaşadıkları sonuçlarına ulaşılmıştır. 60-66 aylık öğrencilerin yaşlarının küçük olması, velilerinin ilgisiz olması ve okulöncesi eğitimi almamaları nedenleri ile okula uyum sağlamadıkları tespit edilmiştir. Öğretmenlerin okula uyum sürecinde öğrencilerin fiziksel ve duygusal gelişimlerini desteklemeye, sosyalleştirmeye, okulun kurallarını benimsetmeye ve veli desteğini sağlamaya yönelik çalışmalar yaptıkları tespit edilmiştir. Yaşanan sıkıntıların azaltılması için yaş gruplarının sınıflarının ayrılmasının kısa vadede öğretmenin ders anlatmasını ve öğrenciler arasındaki yaş dengesizliğinden doğan sıkıntıları ortadan kaldıracağı ancak uzun vadede bu öğrencilerin aynı sınavlara tabi tutulacağı ve aynı programın uygulanacağı, dolayısıyla da

kesin çözüm olmadığı sonucuna ulaşılmıştır. Öğretmenlerin çoğu programın hafifletilmesi, okula başlama yaşının tekrar 72 aya çekilmesi, okulların araç-gereç açısından zenginleştirilmesi, okulöncesi eğitimin zorunlu olması, velilerin bilinçlendirilmesinin gerektiğini belirtmiştir.

Anahtar sözcükler: okula uyum süreci, 4+4+4 eğitim sistemi, okula başlama yaşı

GİRİŞ

Okul geçmişi olan bütün bireylerin yaşamları boyunca, unutamadıkları en önemli anılarından bazıları, okulun ilk yılında geçirdikleri yaşantılardır (Yapıcı, 2013, s. 2). İlkokula başlayan çocukları, yepyeni bir gelecek ve yeni bir ortam beklemektedir. Bu yeni yaşantıları, her çocuk çeşitli faktörlerin rol oynaması nedeniyle (gelişimsel, sosyokültürel, çevresel, ailesel olarak) eşit biçimde yaşayamamaktadır. Bu durumda, çocukların bu yeni yaşama uyum göstermelerinde ailelere ve öğretmenlere önemli görevler düşmektedir (Ülkü, 2007, s. 3). Bu bağlamda ilkokul 1. sınıf, insan hayatını en fazla etkileyen, kişinin daha sonraki yıllardaki başarısını belirleyen, eğitimin temelini oluşturan önemli bir süreçtir.

Ertürk, hazırbulunuşluk kavramını; bireyin 'eğitim pazarına' getirdiği özelliklerin tümü olarak ifade etmektedir (Senemoğlu, 2010, s. 5). Buradan da anlaşılacağı üzere hazırbulunuşluk, olgunlaşma ve öğrenme yaşantılarını da içine alan geniş bir kavramdır. Olgunlaşma, vücut organlarının kendilerinden beklenen fonksiyonu yerine getirebilecek düzeye gelebilmesi için, öğrenme yaşantılarından bağımsız olarak, kalıtımın etkisiyle geçirdiği biyolojik bir değişimdir (Senemoğlu, 2010, s. 3).

Birinci sınıfa başlamadan önce öğrencilerin belli kritik davranışları öğrenmeleri gerekmektedir ki bu davranışların birçoğu okul öncesi eğitim dönemine tekabül etmektedir.0-8 yaş çocuğun gelişimi açsından en hızlı ve en kritik dönemdir (Ay, F. 2012, s. 213). Bu nedenle çocukların yeterli olgunluk düzeyine gelip gelmediği, okula başlamadan test edilmelidir. Aile, okul ve çevre; çocukların sosyal beceri gelişimlerinde oldukça önemli üç faktördür (Günindi, 2011, s. 136).

Çocuğun içinde yaşadığı topluma uyum sağlayabilmesi için, işbirliği, sorumluluk, atılganlık, uyum, kendini kontrol etme, ilişkiyi başlatma ve sürdürme, grupla bir işi yürütme, duygularını ifade etme, plan yapma ve problem çözme gibi sosyal becerilere sahip olmaları önemlidir (Ceylan ve Ömeroğlu 2012, s. 64). Yeni duruma alışıncaya kadar her bireyde olduğu gibi çocukta da uyum sorunları olabilmektedir. Bunlar genel olarak gelip geçici uyum bozuklukları olarak tanımlanmaktadır. Gelip geçici uyum bozuklukları giderilemeden ileriki yaşlarda da devam ederse o zaman gerçek uyum bozuklukları haline gelmektedir (Alisinanoğlu ve Kesici, 2010, s. 94).

Sosyal gelişme ve sosyalleşme, bireyin topluma mensup hale gelme ve toplumun davranış kalıplarını içselleştirme sürecidir. Çocuklar sosyalleşmiş durumda doğmazlar. Sosyalleşme süreci boyunca ait oldukları çevrenin kural ve normlarına uygun değerleri benimsemeyi öğrenirler (Ramazan ve Unsal, 2012, s. 5829). Çocukların uyum sürecini sağlıklı bir şekilde atlatmaları için çeşitli önlemlerin alınması gereklidir. Bunun için öncelikle öğretmenin olumlu bir sınıf iklimi oluşturması gerekir. Son yıllarda yapılan araştırmalar yaşamın ilk altı yılı boyunca sosyal yetkinlik becerileri geliştirilemeyen çocukların duygusal ve davranışsal açıdan problem sergileme ve yetişkinlikte de sosyal açıdan uyumsuz bir birey olma ihtimalinin yüksek olduğunu göstermiştir (Durmuşoğlu Saltalı ve Arslan, 2012, s. 730).

Okulun sosyalleşeme sürecinin en önemli parçalarından biri olduğu düşünüldüğünde öğretmenlerin öğrencilerin sosyalleşmesine katkıda bulunarak, onların sosyal yetkinlik becerilerini geliştirmelerini sağlamaları gerekmektedir. Okulöncesi eğitim, belli bir plan çerçevesinde öğrenciyi ilkokula hazırlayan bir dizi etkinliği kapsar. İyi bir anaokulunun programı, çocuğun çevresini daha iyi ve etkin bir şekilde tanımasına yardımcı olmaktadır. Çocuk, öğretmeni ve arkadaşları ile uyumlu bir ilişkinin sağlanabilmesi için kendisinin yapması gereken görevlerinin olduğunu öğrenir (Şahin Arı, 2007, s. 11).

Her millet, toplumun şekillendirilmesinde, yani istendik davranışları bireye kazandırmada, eğitim sistemlerinden yararlanır (Sarpkaya, 201, s. 2).Bu amaç çerçevesinde eğitim sistemlerini çağın gereklerine uydurmak için zaman zaman eğitim sistemlerinde değişikliğe gidilmektedir. Bu amaçla Türkiye'de de 2012 yılında 4+4+4 Eğitim Reformu ile ilkokul 4 yıl ortaokul 4 yıl, ve liseler de 4 yıl süreli eğitim veren kurumlar olmuşlardır. Pek çok ülkede çocuklara okula başlama aşamasında hazır bulunuşluk testleri uygulanmakta ve çocuğun çok yönlü olgunlaşması önemsenmektedir. Çocuklara okula hazır olmaları için gerekli donanımlar sağlanmakta ve bunun doğal sonucu olarak da bir takım eşitsizlikler giderilerek okul başarıları arttırılmaktadır. Türkiye'de ise ilköğretime başlamada temel kriter olarak ''kronolojik yaş'' kabul edilmekte çocuğun eksiklikleri ve desteklenmesi gereken yönleri belirlenemememektedir. Çocuk belli bir hazır bulunuşluk düzeyine gelmeden yapılan başlangıçlar ise başarısızlıkla sonuçlanmakta ve bu durum hem çocuğu duygusal anlamda örselemekte, hem de daha eğitim hayatının başında başarısızlık duygusunu yaşatıldıktan sonra yapılacak çalışmaların etkinliği, başta alınacak önlemler kadar güçlü olamamaktadır. Tıp ve eğitim alanında yapılan araştırmalar ilk altı yaşın tüm gelişim alanları için ne kadar önemli olduğunu ortaya koymuştur. Bu bilinçle, gelişmiş ülkelerde okul öncesi eğitimden yararlanma oranı oldukça yüksektir ve bu alanda kalite ve verimin arttırılması için sürekli çalışmalar yapılmaktadır (Erkan ve Kırca, 2010, s. 95).

Zorunlu eğitime başlama yaşı Belçika, Çek Cumhuriyeti, Danimarka, Almanya, İrlanda, Estonya, Fransa, İtalya, Avusturya, Romanya, Portekiz, Polonya, ABD, Avustralya, Kore, Japonya'da 6 olarak uygulanmaktadır. Bulgaristan, Finlandiya ve İsveç'te 7, Macaristan, Hollanda ve Malta'da 5, İngiltere'de ise 4-5 yaşındaki çocuklar zorunlu eğitime başlamaktadır. Dünyadaki uygulamalarda eğitimin yapılanmasında ilk kademe ilkokulların süreleri de değişmektedir. İlköğretim süresi Almanya, Avusturya, Brezilya, Bulgaristan, Macaristan ve Rusya Federasyonu'nda 4 yıl, Fransa, İtalya, Hindistan ve Pakistan'da 5 yıl, Japonya, Hollanda ve Güney Kore'de 6 yıl, Avustralya, Norveç ve Güney Afrika'da 7 yıl, İrlanda'da ise 8 yıl olarak uygulanmaktadır (Güven, 2012, s. 559).

"Zorunlu ilköğretim çağı 6-13 yaş grubundaki çocukları kapsar. Bu çağ çocuğun 5 yaşını bitirdiği yılın eylül ayı sonunda başlar, 13 yaşını bitirip 14 yaşına girdiği yılın öğretim yılı sonunda biter. 60-66 ay arasındaki çocukların ise velisinin yazılı isteği ile gelişim yönünden hazır olduğu anlaşılanların ilkokula devamları sağlanacaktır. Diğer öğrenciler okul öncesi eğitime yönlendirilecektir."(Resmi Gazete [RG], 2012, s.6). Söz konusu madde ile birlikte 2012-2013 eğitim-öğretim yılında 66 aylık çocuklar zorunlu olarak okula başlamış, 60-66 ay arasındaki çocuklar ailelerinin isteğiyle okula başlatılmıştır. Ayrıca 66-72 ay arasındaki çocuklardan gelişimlerinin tamamlanmadığına dair doktor raporu alınan öğrenciler de anasınıflarına gönderilmiştir. 2013'te "Okul müdürlükleri, yaşça kayıt hakkını elde eden çocuklardan 66, 67 ve 68 aylık olanları, velisinin vereceği dilekçe ile; 69, 70 ve 71 aylık olanları ise, ilkokula başlamaya hazır olmadıklarını belgeleyen sağlık raporu ile okul öncesi eğitime yönlendirebilir veya kayıtlarını bir yıl erteleyebilir." maddesiyle de çocuğunun okula hazır olmadığını düşünen 66,67 ve 68 aylık öğrencilerin velileri rapor alma zorunluluğundan kurtulmuşlardır (RG, 2013, s. 6).

İlkokula başlama yaşının aşağı çekilmesi sonucu birçok öğrenci okulöncesi eğitim almadan birinci sınıfa başladığı için küçük yaş grubundaki öğrencilerin okula uyumlarını kolaylaştırmak amacıyla 12 haftalık bir okula uyum süreci öngörülmüştür. Millî Eğitim Bakanlığı, ilköğretim birinci sınıf öğrencilerini ve anaokulu öğrencilerini "okula uyum programı" uygulamak için bir hafta erken okula çağırmaktadır. Bu süre içinde çocuklara okulu, arkadaşlarını ve öğretmenini tanıtmak ve onları okula alıştırmak amaçlanmaktadır. Çünkü öğrencilerin yaklaşık yüzde 12'si okula başlama sürecinde fobiye kapılmaktadır. Okula gitmemek için direnmekte ve hatta bazıları hastalanmaktadır (S.Yaşar ve V. Yaşar, 2010, s. 22). Bu durum bazı öğrencilerde birkaç gün sürerken bazı öğrencilerde de birkaç hafta ve hatta bir aydan daha uzun sürebiliyor.).

İlkokul 1. sınıf düzeyindeki kazanımlar için yeterli hazır bulunuşluğa sahip olan 72 aylık öğrencilerin yeni eğitim sisteminde, program kapsamındaki etkinliklere hazır oldukları için yapabilecekken uyum programına bağlı kalınarak bu etkinlikleri yapmalarının engellenmesi ile birlikte kızgınlık yaşamalarına; 60-69 aylık olup hazır bulunuşluğa sahip olmayan öğrencilere de program kapsamında beklentiler içinde kalınarak etkinlikler yaptırmak suretiyle onları zorlamak, onların kızgınlık yaşamalarına neden olabilecektir. Bu nedenle farklı beklenti ve gelişim dönemindeki çocukları bir arada tutmak güçleşebilmektedir. Bu durum sınıf disiplinini bozacağı için öğrenme ortamını olumsuz yönde etkileyebilecektir (Özenç ve Çekirdekçi, 2013, s. 189).

Eğitim programı, öğrenene, okulda veya okul dışında planlı etkinlikler yoluyla sağlanan öğrenme yaşantıları düzeneği olarak tanımlanabilmektedir (Demirel, 2011, s. 4). Program Geliştirme ise eğitim programının hedef, içerik, öğrenme-öğretme süreci ve değerlendirme öğeleri arasındaki dinamik ilişkiler bütünü olarak tanımlanmıştır (Demirel, 2011, s. 5). 4+4+4 Eğitim Sistemi ile birlikte programda çocukların okula uyumlarının daha kolay olması için 12 haftalık uyum programı uygulamaya konulmuştur. Bu uygulamadan dolayı okuma ve yazmaya başlama süreci geciktirilmiştir. Ayrıca çocukların oyun ihtiyaçlarından yola çıkılarak "Oyun ve Fiziki Etkinlikler" dersi programa dahil edilmiş ve bu derse haftada 5 saat yer verilmiştir.

İlkokuma ve yazma öğretimi çocuğun okula gelmeden önce, yani okulöncesi dönemde, hem biyolojik (olgunlaşma), hem bilişsel (ilkokuma ve yazma öğretiminin gerektirdiği düzeyde ön bilgi ve beceri), hem de duyuşsal(öğrenme istekliliği ve güdüsü) ön yeterliklere sahip bulunması gerekir(Çelenk, 2008, s. 84). İlk okuma-yazma süreci tamamlandıktan sonra öğrencilerin karşılarına hemen Türkçe kitabı ve buna bağlı olarak da Türkçe programı gelmektedir. Türkçe kitabı, Türkçe öğretiminin anlama ve anlatım boyutlarının geliştirilmesinde öğrencinin de öğretmenin de ilk başvurduğu araçtır. Bu durum Türkçe kitaplarının hem içerik hem de fiziksel özellikler bakımından büyük bir özenle hazırlanmasını gerektirmektedir (Özdemir ve Çorakçı, 2011, s. 220). 1. Sınıfta okuma yazma öğretiminden sonra kullanılan Türkçe kitaplarına bakıldığında metinlerin çok uzun olduğu görülmektedir. Bu da bu metinlerin okunabilirliğini düşürmektedir.

1. sınıfta kazanımlarının önem taşıdığı bir diğer ders de matematiktir. Matematik dersinin amacı öğrencilerin açık seçik ve mantıklı olarak düşünüp, iletişim kurabilmelerine yardımcı olma, örüntüleri, ilişkileri tanıma ve genelleme yapabilme yeteneğini geliştirme, yaratıcılığı ve sezgisel düşünmeyi, zihinsel bağımsızlığı, estetik değerleri geliştirme ve bunun sonucu kazandığı yeteneklerden; düşüncelerini açık ve kesin olarak belirtme, verileri sistematik olarak düzenleyebilme ve yorumlayabilmedir(İnan, 2009, s. 42). Matematik soyut bir ders olduğu için ve çocuklar somut işlemler döneminde oldukları için bu dersi somut hale getirerek aktarmak önemlidir. Bunun için de uygun ortam ve araç gereçlere ihtiyaç olduğu aşikardır. Sınıf ortamında çocuklar arasında etkileşimi sağlamak için de çeşitli yöntemler kullanılmaktadır. Özellikle işbirliğini arttırmak için öğretmenler tarafından heterojen gruplar oluşturulmaktadır. Bu heterojen gruplar birlikte çalışan farklı yetenek düzeyindeki çocuklardan oluşmaktadır(Denton,West ve Walston, 2003: 1).

Uyum ve hazırlık çalışmaları on iki haftalık bir süre için düzenlenen etkinlikleri içermektedir. Hazırlanan etkinliklerin üç temel amacı bulunmaktadır:

1. İlkokula yeni başlayan öğrencilerin okula, arkadaşlarına, öğretmenine, öğretim faaliyetlerine uyumunu kolaylaştırmak,
2. Birinci sınıf derslerine hazırlık çalışmaları yaparak okuma yazma çalışmalarına temel oluşturmak,
3. Hayat Bilgisi, Matematik, Görsel Sanatlar, Müzik, Oyun ve Fiziki Etkinlikler derslerindeki kazanımları belli oranlarda ele almaktır (MEB, 2012, s. 7).

Çocukların gelişiminde oyunun çok önemli bir yeri vardır. Özellikle 60-72 ay aralığındaki çocukların eğitiminde, etkinliklerin oyunlaştırılarak verilmesi önem taşımaktadır. Bu nedenle 4+4+4 eğitim sisteminin yürürlüğe konulmasından sonra 1. Sınıf müfredatı da çocukların oyun gereksinimleri dikkate alınarak değiştirilmiş ve "Oyun ve Fiziki Etkinlikler" dersi müfredata konulmuştur (Bağlı, 2004, s. 138).

Okul çağına giren çocuğun büyük bir hareket ve oyun ihtiyacı vardır. Bu bakımdan başlangıçta okul içi faaliyetlere olabildiğince oyun havası verilmeli, yavaş yavaş, okul etkinliklerine geçmelidir. Ayrıca birinci sınıf öğretmeni, birinci sınıfa gelen çocukların okulla ilgili her şeyi yeni öğreneceklerini sürekli göz önünde tutmalı ve defter, kitap açmak, kalem kullanmak gibi basit aktiviteleri dahi yapmak için kendilerine yol gösterilmesinin gerekli olduğunu unutmamalıdır (Bilir, 2005, s. 91).

"1. Sınıf Öğrencilerinin Okula Uyum Sürecinin Öğretmen Görüşlerine Göre Değerlendirilmesi" araştırmanın problem cümlesi olarak belirlenmiştir. Bu araştırmada okula başlama yaşının küçülmesi sonucu özellikle küçük yaş grubundaki öğrencilerde çeşitli uyum sorunlarının olup olmadığı tespit edilmeye çalışılmıştır. Bu bağlamda 1. sınıf öğrencilerinin okula uyum sürecinin de karşılaşılan sorunların neler olduğu hakkında öğretmen görüşlerini almak amaçlanmıştır. Bu amaç doğrultusunda aşağıdaki sorulara yanıt aranmıştır:

1. Öğretmen görüşlerine göre birinci sınıf öğrencilerinin okula uyum süreci nasıldır?
2.1. sınıf öğrencilerinin okula uyum süreci ile ilgili öğretmenler neler yapmaktadır?
3. 1. sınıf öğrencilerinin okula uyum sürecinde öğretmenlerin yaşadığı sorunlar nelerdir?
4. 60 ayda okula başlayan çocukların 1. sınıfa uyumları nasıl olmuştur?
 a. Medyada son zamanlarda yer alan, 60-66 aylık çocukların sınıflarının ayrılması konusunda 1. sınıf öğretmenlerin görüşleri ne yöndedir?
5. 1. sınıf öğretmenlerin yaşanılan sorunlara ilişkin çözüm önerileri nelerdir?

YÖNTEM

Bu araştırma nitel araştırma yöntemlerine göre yapılmıştır. Araştırmada nitel araştırma yöntemlerine dayalı olarak "durum çalışması" deseni kullanılmıştır. Araştırmada nitel araştırmada kullanılan veri toplama yöntemlerinden olan görüşme yöntemi kullanılmıştır.

Evren ve Örneklem

Araştırma Nisan 2013; Mayıs 2013 tarihleri arasında, Bingöl İli Merkez İlçesindeki 6 ilkokulda çalışmakta olan 19 ilkokul birinci sınıf öğretmeni ile gerçekleştirilmiştir. Araştırmanın evreni Bingöl İli Merkez İlçesindeki devlet ilkokulları olarak belirlenmiştir. Araştırmada amaçlı örnekleme yöntemi kullanılmıştır. Amaçlı örnekleme yöntemleri içerisinden ölçüt örnekleme kullanılmıştır.

Tablo 1: Öğretmenlerin Kıdem Yılı ve Cinsiyete Göre Dağılımı

Mesleki Kıdem	Kadın	Erkek	Toplam
1-9 yıl	1	7	8
10-19 yıl	1	6	7
20-29 yıl	1	2	3
30 yıl ve üzeri	0	1	1
Genel Toplam			19

Tablo 1'de görüldüğü gibi, görüşme yapılan 1. Sınıf öğretmenlerinden 3'ü kadın, 16'sı erkektir. "1-9" yıllık mesleki kıdemde 8 öğretmen "10-19" yıllık mesleki kıdemde 7 öğretmen "20-30" yıllık mesleki kıdemde 3 öğretmen "30 yıl ve üzeri" mesleki kıdemde 1 öğretmen bulunmaktadır.

Veri Toplama Aracı

Araştırmada görüşme yöntemiyle veriler toplanmıştır. Çalışmanın ilk aşamasında, konu ile ilgili literatür taranmış ve literatür bilgilerinden yararlanılarak öğretmenlere yönelik bir görüşme formu hazırlanmıştır. Görüşmede sorulan soruların açık ve anlaşılır olmasına dikkat edilmiştir. Görüşme formu İnönü Üniversitesi Eğitim Fakültesi'nde görev yapan uzmanların görüş ve değerlendirmesine sunulmuş, uzmanların görüşlerine göre gerekli düzeltmeler yapıldıktan sonra form uygulamaya hazır hale getirilmiştir. Görüşme formu 6 sorudan oluşmaktadır (Ek-1). Görüşme formu uygulamaya hazır hale getirildikten sonra görüşmeler ayarlanmış, hazırlıklar yapılmış ve görüşmeler gerçekleştirilmiştir.

Verilerin Analizi

Araştırmada veriler içerik analizi yöntemi ile analiz edilmiştir. Görüşmelerden elde edilen veriler yazılı metinlere dökülmüştür. Burada öğretmenler "Ö1,Ö2,...,Ö19" şeklinde kodlanmıştır. Bu kayıtlar NVivo10 nitel veri analiz programı ile çözümlenmiştir. Çözümlenen veriler sonucunda elde edilen kaynak, frekans ve nodelar bulgular bölümünde uygun başlıklar altında verilmiştir.

Geçerlik ve Güvenirlik

Araştırmada geçerliği sağlamak amacıyla araştırmaya katılan kişilerle birebir görüşme yoluyla bilgi toplanmış ve bireylerden doğrudan alıntılara yer verilerek sonuçlara ulaşılmaya çalışılmıştır. Bu araştırma sırasında tutulan notlar, görüşme sonunda katılımcılara okutulmuştur. Katılımcılara ekleyip çıkarmak istedikleri herhangi bir şey olup olmadığı sorulmuş ve gerekli düzeltmeler yapıldıktan sonra son onayları alınmıştır.

BULGULAR

Bu bölümde araştırmanın alt problemleri ile ilgili bulgular ve bu bulgulara yönelik yorumlara yer verilmiştir. Öğretmenlerin yöneltilen sorulara verdikleri yanıtlardan elde edilen bulgular, tema ve alt temalar altında öğretmenlerin yanıtlarından doğrudan alıntılar yapılarak verilmiştir. Doğrudan alıntılarda genellikle frekansı yüksek olan görüşlere yer verilmiştir.

"Birinci sınıf öğrencilerinin okula uyum süreci nasıl olmuştur?" Alt Problemi İle İlgili Bulgular

"Birinci sınıf öğrencilerinin okula uyum süreci nasıl olmuştur?" sorusuna verilen cevapların analizi sonucu elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 2. Öğretmenlerin 1. Sınıf Öğrencilerinin Okula Uyum Sürecinin Nasıl Olduğu İle İlgili Görüşleri

ANA TEMA	Alt Tema	Frekans	Kategorik Kodlama	Frekans
TEMA 1. Sınıf öğrencilerinin okula uyum süreci	Öğrencilerin okula uyumları zor olmaktadır.	112	1. 60-66 aylık öğrencilerin yer alması	16
			-Okulöncesi eğitimi alamama	22
			-Kalem tutamama	6
			-Kuralları uygulayamama	4
			-Ebeveynden ayrılamama	11
			-Dikkati toplayamama	2
			-Oyun oynayamama	2
			2. Farklı yaş grubundaki öğrencilerin aynı sınıfta olması	26
			3.Velilerin bilinçsiz olması	13
	Öğrencilerin okula uyumları kolay olmaktadır.	8	1.Sınıfta küçük yaş grubu(60-66 aylık) olmaması	4
			2.Velilerin ilgili olması	4

Tablo 2'de öğretmenlerin 1. sınıf öğrencilerinin okula uyum sürecinin nasıl olduğu ile ilgili görüşleri incelendiğinde, öğretmenlerin öğrencilerin okula uyumlarının zor olduğunu ve öğrencilerin okula uyumlarının kolay olduğunu belirttikleri görülür.

Öğrencilerin okula uyumlarının zor olduğunu düşünen bir öğretmen: *"Bu sene okula uyum sıkıntılı bir dönem, sıkıntılı bir süreçti. Özellikle 60 aylık öğrencilerle daha büyüklerinin(72-84 aylıkların) aynı sınıfta olması bir sıkıntı oldu. Benim sınıfımda 66 ay ve altında 7 öğrencim var. Hem fiziksel olarak hem çocuğun gelişimleri göz önüne alındığında aynı sınıfta olmaları uyum sürecini etkiledi. Ondan dolayı daha önceki senelerde de ben birinci sınıf okutmuştum. Bu sene daha sıkıntılı bir dönem."* (Ö.1) şeklinde görüş bildirmiştir.

60-66 aylık öğrencilerin olması nedeniyle zorlandıklarını düşünen bir öğretmen: *"Uyum sürecini atlatmaları çok zor oldu. Yaş küçüklüğü nedeniyle. Çoğu öğrenciler özellikle küçük yaştaki öğrenciler çok büyük uyum sorunları yaşadılar. Hala uyum gösteremediler diyebilirim."*(Ö.12) şeklinde görüş bildirmiştir.

Küçük yaş grubundaki öğrencilerin uyumunda sıkıntı yaşandığını düşünen bir diğer öğretmen: *"Sene başında ağlayanlar, annesini isteyenler lavabo ihtiyaçlarını gideremeyenler hep bu küçük yaş grubuydu."(*Ö.19) şeklinde görüş belirtmiştir.

Okulöncesi eğitim alınmadığı için sıkıntı yaşandığını düşünen bir öğretmen: *"Küçük yaş grubundaki öğrenciler anasınıfına gitmedikleri içim ilk bir ay çok zorlandık."*(Ö.8) şeklinde görüş bildirmiştir.

Farklı yaş grubundaki öğrencileri bir arada tutmaya çalışmaktan dolayı sıkıntı yaşandığını düşünen bir öğretmen: *"60-66 aylıklar ve 70 ayın üzerindekilere aynı sınıfta aynı eğitimi vermek mantıklı değil. Biri okula hazır halde gelirken diğeri daha kalem tutmayı beceremiyor."(*Ö.11) şeklinde görüş bildirmiştir.

Öğrencilerin okula uyumlarının zor olmadığını düşünen bir öğretmen: " *Uyum sürecinde bir takım zorluklar oldu ama çok fazla da öyle bir sıkıntı yaşamadık. Bunda biraz çevre faktörü de etkili. İlgili ailelerin olması. Eğer o sınıftaki velilerimiz ilgili ise arkadaşlarımız pek sıkıntı yaşamadılar."*(Ö.3) şeklinde görüş bildirmiştir.

Öğrencilerin okula uyumlarının kolay olduğunu düşünen başka bir öğretmen : *"Ben herhangi bir sorunlu öğrenciyle karşılaşmadım. Bir tanesiyle karşılaştım. Onun da zaten ailesi ile görüştük. Velinin de onayını alarak onu da anasınıfına yönelttik."* (Ö.6) şeklinde görüş bildirmiştir.

"**Birinci sınıf öğrencilerinin okula uyum sürecinde siz neler yaptınız?" Alt Problemi İle İlgili Bulgular**

"Birinci sınıf öğrencilerinin okula uyum sürecinde siz neler yaptınız?" sorusuna verilen cevapların analizi sonucu elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 3. Öğretmenlerin Birinci Sınıf Öğrencilerinin Okula Uyum Sürecinde Neler Yaptıkları İle İlgili Görüşleri

ANA TEMA	Alt Tema	Frekans	Kategorik Kodlama	Frekans
Öğretmenlerin uyum sürecinde yaptıkları	**1.Fiziksel gelişimlerini desteklemeye yönelik çalışmalar**	**39**	Kesme- yapıştırma çalışmaları	12
			Boyama çalışmaları	12
			Çizgi çalışmaları	12
			Öğrenciye tuvalet eğitimi verme	3
	2. Sosyalleştirme Çalışmaları	**27**	Birlikte Oyunlar oynama	22
			Birlikte Şarkılar söyleme	5
	3.Okulun Kurallarını Benimsetme Çalışmaları	**7**	Kuralları birlikte oluşturma	2
			Öğrenciye okulu sevdirme	2
			Öğrencilere pekiştireç verme	3
	4.Veliyle işbirliği	**6**	Velilerle görüşme	5
			Öğrenciyi tanıma formu gönderme	1
	5.Duygusal gelişimlerini destekleme çalışmaları	**10**	Öğrenciyi sevme	10

Tablo 3'te öğretmenlerin uyum sürecinde neler yaptıkları ile ilgili görüşleri incelendiğinde, öğretmenler; öğrencilerin fiziksel gelişimlerini desteklemeye, onları sosyalleştirmeye, okulun kurallarını benimsetmeye, velilerle işbirliğine ve duygusal gelişimlerini desteklemeye yönelik çalışmalar yaptıklarını belirtmişlerdir.

Öğrencilerin fiziksel gelişimlerini desteklemeye yönelik çalışmalar yaptığını belirten bir öğretmen: *"Okula uyum sürecinde uyum ve hazırlık kitabındaki etkinliklerden faydalandım. Kesme yapıştırma, boyama etkinlikleri ve çizgi çalışmaları yaptırdım."*(Ö.13) şeklinde görüş belirtmiştir.

Öğrencilere tuvalet konusunda yardımcı olduğunu belirten bir öğretmen: *"Tuvalet ihtiyacını gideremeyen öğrencilerim vardı. Onlarla ilgilendik. Birebir ben götürüp getirdim."*(Ö15). şeklinde görüş bildirmiştir.

Öğrencilerin sosyalleşmesi için çalışmalar yaptığını söyleyen bir öğretmen: *" En başta okula alışmaları için, derslerimiz zaten genelde oyun ağırlıklıydı, etkinlikler yaptık. Çocukları çok fazla sıkmamaya okuldan soğutmamaya çalıştık. Bahçede oyunlar oynattık. Sınıfta basit oyunlar oynattık."*(Ö.16) şeklinde görüş belirtmiştir. Öğrencilerin okula uyumlarını sağlamak için veli desteğini sağlamaya çalıştığını belirten bir öğretmen: *"Ailelerle görüştük. Bu şekilde sıkıntıları gidermeye çalıştık."(Ö.9)* şeklinde görüş bildirmiştir.

Öğrencilere duygusal gelişimlerini desteklemek için okulu sevdirmeye çalıştığını belirten bir öğretmen: *"Öğretmen biraz daha yumuşak, güler yüzle,sevecen bir tavırla iyi bir yaklaşımla yaklaştığı zaman ister istemez çocuk daha rahat uyum sağlar. Eğitimin temeli sevgidir."*(Ö.6)şeklinde görüş belirtmiştir. Öğrencilere okulu sevdirmek için pekiştireç verdiğini belirten bir öğretmen: *"Hediyeler verdim. Ufak başarılarını desteklemek için mesela kalem verdim."*(Ö.3).

"Birinci sınıf öğrencilerinin okula uyum sürecinde yaşadığınız sorunlar nelerdir ?" Alt Problemi İle İlgili Bulgular

"Birinci sınıf öğrencilerinin okula uyum sürecinde yaşadığınız sorunlar nelerdir ?" sorusuna verilen cevapların analizi sonucu elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 4. Öğretmenlerin Birinci Sınıf Öğrencilerinin Okula Uyum Sürecinde Yaşadıkları Sorunlar İle İlgili Görüşleri

ANA TEMA	Alt Tema	Frekans	Kategorik Kodlama	Frekans
Uyum sürecinde yaşanan sorunlar	**1.Fiziksel yönden sorunlar yaşanmaktadır.**	44	Kalem tutmada	12
			Yazı yazmada	15
			Tuvalet ihtiyaçlarını gidermede	17
	2. Sosyal yönden sorunlar yaşanmaktadır.	63	Ebeveynden ayrılamama	14
			Arkadaş edinememe	4
			Birlikte oyun oynayamama	7
			Kendini ifade edememe.	3
			Büyük yaş grubunda sıkılma	13
			Özgüven eksikliği yaşama	11
			Kurallara uymama	10
	3.Bilişsel yönden sorun yaşanmaktadır.	23	Dikkatini toplayamama	4
			Yönergeleri takip edememe	4
			Okuyamama	5
			Okuduğunu anlayamama	6
	4.Veli desteğini sağlamada	9	Ekonomik durumun yetersizliği	4
			Velinin okur-yazar olmaması	5

Tablo 4'te öğretmenlerin, öğrencilerin okula uyumlarında yaşadıkları sorunlarla ilgili görüşleri incelendiğinde, öğretmenlerin fiziksel, sosyal, bilişsel yönlerden, veli desteğini sağlamada sıkıntılar yaşadıklarını ve bu sorunların daha sonraki yıllarda da devam edeceğini belirttikleri görülmektedir.

Ebeveynden ayrılma konusunda sıkıntı yaşadığını belirten bir öğretmen: *"60-66 ay arası çocuklarda ağlama problemi çok oluyordu. Susturmakta güçlük çekiyordum. Ailelerinden kopamıyorlardı. Bir süre velisiyle beraber derse girdiler(Ö.13)* şeklinde görüş bildirmiştir.

Fiziksel yönden sıkıntı yaşadığını belirten bir öğretmen: *"Tuvalet eğitimi ile ilgili sıkıntılar yaşadım. Kasları gelişmediği için kalem tutmada sıkıntı oldu."*(Ö.13) şeklinde görüş bildirmiştir.

Öğrencilerin dikkatlerini toplayamadığını düşünen bir öğretmen: *"Dikkatlerini yoğunlaştıramıyorlar*."(Ö.17) şeklinde görüş bildirmiştir.
Öğrencilerin arkadaş edinmede sıkıntı yaşadığını belirten bir öğretmen: *"Yeni arkadaşlardan uzak durduğunu, arkadaşlık uyum sürecinin geciktiğini gördüm."*(Ö.18) şeklinde görüş bildirmiştir.

Öğrencilerin oyun oynamada sıkıntı yaşadığını belirten bir öğretmen: *"Oyun oynarken bile sıkıntı yaşadım. Hepsine aynı oyunu oynatmak güç."*(Ö.13) şeklinde görüş bildiriştir.

Farklı yaş grubundaki öğrencileri bir arada tutmada sıkıntı yaşadığını belirten bir öğretmen: *"Bunlar fiziksel olarak aynı sınıfı paylaşıyorlar. E şimdi buların oyun oynamalarında bir sıkıntı oluyor. Küçük olan öğrenci oyuna katılamıyor."*(Ö1) şeklinde görüş belirtmiştir.

Öğrencilerin okuduklarını anlamada sıkıntı yaşadığını düşünen bir öğretmen: *"60 aydan küçük olanlar okuduklarını maalesef anlamıyor. Matematiği anlamıyorlar. Yani anlamada çok sıkıntı yaşıyoruz."*(Ö.19) şeklinde görüş bildirmiştir.

Küçük yaş grubu öğrencilerinin yönergeleri takip edemediğini düşünen bir öğretmen: *"Mesela 'herkes kitabını açsın.' Dedikten sonra bu öğrencime ayriyeten birkaç defa kitabını açar mısın dedikten sonra ancak açabiliyor"*.(Ö.7) şeklinde görüş bildirmiştir.

Öğrencilerin okuyamadıklarını belirten bir öğretmen: *"Okumaya geçiremedim yani küçükleri tam birinci sınıf seviyesine getirmek çok zor oluyor."*(Ö.10) şeklinde görüş bildirmiştir.

Öğrencilerin özbakım becerilerini kazanamadıklarını düşünen bir öğretmen: *"Küçük çocukların okula geliş gidişlerinde, öz bakım becerilerini yapamamasında sıkıntı yaşadık*."(Ö.11) şeklinde görüş bildirmiştir.

Yaşça daha büyük olan öğrencilerin sıkıldığını belirten bir öğretmen: *"Büyük çocuklar kendi işlerini daha çabuk daha rahat yaparken küçük olanlar daha geç yaptıkları için bu sefer büyük çocuklar sıkılıyor."(Ö.12)*şeklinde görüş bildirmiştir.

Kuralları oturtmada sıkıntı yaşadığını belirten bir öğretmen: *"Kurallara alışamıyorlar. Yani çocuk hala anasınıfı* *öğrencisi gibi davranıyor. Kuralları oturtamıyoruz."*(Ö.12) şeklinde görüş bildirmiştir.

Küçük yaş grubundaki öğrencilerin özgüven eksikliği yaşadığını düşünen bir öğretmen: *"Bir bu var, ikincisi yaş olarak daha ileri olan öğrencilerin algıları kendini ifade etmeleri diğerlerine oranla daha iyi durumdalar. Bundan dolayı Küçük olan öğrencilerin (yaş olarak gelişim olarak küçük olan öğrencilerin)diğer öğrencilere göre kendilerini yetersiz olarak görmelerine sebep oluyor."*(Ö.1) şeklinde görüş bildirmiştir.

Veli desteğini sağlamada sıkıntı yaşadığını belirten bir öğretmen: *"Ben yeterli veli desteği de görmedim. Zaten velilerimin çoğunun okuma- yazması yok. velilerim çok bilinçsizler."*(Ö.17) şeklinde görüş bildirmiştir.

"60 ayda okula başlayan çocukların birinci sınıfa uyumları konusunda ne düşünüyorsunuz?" Alt Problemi İle İlgili Bulgular

"60 ayda okula başlayan çocukların birinci sınıfa uyumları konusunda ne düşünüyorsunuz?" sorusuna verilen cevapların analizi sonucu elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 5. Öğretmenlerin 60 Ayda Okula Başlayan Çocukların Birinci Sınıfa Uyumları Konusundaki Görüşleri

ANA TEMA	Alt Tema	Frekans	Kategorik Kodlama	Frekans
60 ayda okula başlayan öğrenciler in sınıfa uyumu	1.Okula uyum sağlamaktadırlar.	2	Sınıfta küçük yaş grubunun olmaması	2
	2.Okula uyumları sağlanamamaktadır.	32	Yaşları küçük olduğu için	22
			Veliler ilgisiz olduğu için	2
			Okulöncesi eğitim alınmadığı için	8

Tablo 5'de öğretmenlerin 60 ayda okula başlayan çocukların birinci sınıfa uyumları konusundaki görüşleri incelendiğinde 60 ayda okula başlayan çocukların okula uyumlarının sağlandığı, okula uyumlarının kısmen sağlandığı ve okula uyumlarının sağlanamadığı yönünde görüş bildirdikleri görülmektedir.

Okula uyum sürecinde sınıfında 60-66 aylık öğrencilerin olmamasından dolayı sıkıntı yaşamadığını belirten bir öğretmen: *"Benim sınıfımda yok ama bu da gene öğrenciden öğrenciye değişiyor. 5.5 yaşındaki çocuğun da gayet rahat okuyabiliyor*."(Ö.6) şeklinde görüş bildirmiştir.

60-66 aylık öğrencilerin yaşları küçük olduğu için okula uyumlarının sağlanamadığını söyleyen bir öğretmen: *"60 aylıklar okula uyum sağlayamıyorlar. 66 aylıkların da buraya gelmesi yanlış. Küçük çocuklar hala oyuna doyamamışlar. Derste sürekli oyun oynamak istiyorlar."*(Ö.11) şeklinde görüş bildirmiştir.

60-66 aylık öğrencilerin aileleri ilgisiz olduğu için okula uyumlarının ağlanamadığını belirten bir öğretmen: *"Aile desteği de olmadığı için özellikle seslerin verilmesi ve okuma çalışmalarında bu sıkıntı daha da arttı*."(Ö.17) şeklinde görüş bildirmiştir.

60-66 aylık öğrencilerin birçoğunun okul öncesi eğitimi almamasından dolayı uyum sorunu yaşandığını belirten bir öğretmen: *"Anasınıfına da gitmeden bu yıl geldikleri için sıkıntı oldu. Anasınıfına gitmiş olsalardı daha iyi olabilirdi."*(Ö.8) şeklinde görüş bildirmiştir.

"Medyada son zamanlarda yer alan, 60-66 aylık çocukların sınıflarının ayrılması konusundaki haberlere ne dersiniz?" Alt problemi İle İlgili Bulgular

"Medyada son zamanlarda yer alan, 60-66 aylık çocukların sınıflarının ayrılması konusundaki haberlere ne dersiniz?" sorusuna verilen cevapların analizi sonucu elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 6. Öğretmenlerin Medyada Son Zamanlarda Yer Alan, 60-66 Aylık Çocukların Sınıflarının Ayrılması Konusundaki Görüşleri

ANA TEMA	Alt Tema	Frekans	Kategorik Kodlama	Frekans
Sınıfların yaş gruplarına göre ayrılması	**1.Sınıflar yaş gruplarına göre ayrılmalıdır.**	**31**	Öğretmenlerin ders anlatması daha rahat olur	12
			Öğrenciler arasında yaş farklılığı nedeniyle uyumsuzluk olmaz	19
	2. Sınıfların yaş gruplarına göre ayrılması çözüm değildir.	**26**	Öğretmenlerin küçük yaş grubunu istememesi	6
			Öğretmenlerin ders anlatmada zorlanması	4
			Öğrenci açısından gereksiz olması	26
			-Aynı programın uygulanması	8
			-Sonraki yıllarda da problemin devam edeceği	18

Tablo 6'de öğretmenlerin medyada son zamanlarda yer alan 60-66 aylık çocukların sınıflarının ayrılması konusundaki görüşleri incelendiğinde 1. sınıfların yaş gruplarına göre ayrılması ve sınıfların yaş gruplarına göre ayrılmasının çözüm olmadığı görüşlerinin hakim olduğu görülmektedir.

Sınıfların yaş gruplarına göre ayrılması gerektiğini ve bu uygulamanın öğretmenin işini kolaylaştıracağını düşünen bir öğretmen: *"Bence seviye sınıfları olsa daha az sıkıntı yaşardık. En azından ona göre yöntemimizi tekniğimizi uygulardık."*(Ö.16) şeklinde görüş bildirmiştir.

Sınıfların yaş gruplarına göre ayrılmasının öğrenciler arasında yaş farklılığından kaynaklanan olumsuzlukları azaltacağını savunan bir öğretmen: *"Yani fiziksel olarak da aynı değiller zihinsel olarak da. O yüzden bayağı sıkıntı yaşıyorlar. Diğer öğrenciler çabuk kavrarken küçük yaş grubu ile ayrı ilgilenmek gerekiyor. Küçük yaş grubuna uygulanan yöntem farklı olmalı."*(Ö.16) şeklinde görüş bildirmiştir.

Sınıfların yaş gruplarına göre ayrılmaması gerektiğini ve bu uygulama yapıldığı taktirde öğretmenlerin küçük yaş grubunu almak istemeyeceğini düşünen bir öğretmen: *"Sınıflar ayrılırsa kimse o sınıfı almak istemez. Alan öğretmene de hakaret olur bence. Öğretmen açısından doğru değildir. 60-66 aylığı alan öğretmene haksızlık olur. Hiç kimse 66 aylığı almak istemez ki*."(Ö.12) şeklinde görüş bildirmiştir.

Sınıfların ayrılmaması gerektiğini ve öğretmenlerin sadece küçük yaş grubunun oluşturduğu sınıfta ders anlatmada daha çok sıkıntı yaşayacağını düşünen bir öğretmen: *"Öğretmen açısından da zor olur tabi. Öğretmen açısından bütün yük orda öğretmene yüklenecek"*(Ö.10) şeklinde görüş bildirmiştir.

Sınıfların yaş gruplarına göre ayrılmasının çözüm olmadığını, sonuçta tüm öğrencilerin aynı programa tabi tutulduğunu düşünen bir öğretmen: *"Sınıfların ayrılması da ayrılmaması da sıkıntı yaratır. Program açısından sıkıntı oluşur. Daha sonra aynı başarı bekleneceği için yanlış olur. Çünkü bu çocuklardan ileriki hayatlarında aynı sınavda aynı başarı beklenecek."*(Ö.11) şeklinde görüş bildirmiştir.

Daha sonraki yıllarda da sıkıntı yaşanacağını düşünen bir öğretmen: *"Ekstra çabalarla biz bu çocukları okumaya geçirdik. İstedikleri kadar okumaya geçsinler. Bu çocuklar bu sınıfta oldukları müddetçe üst sınıflarda ezilecektir."*(Ö.19) şeklinde görüş bildirmiştir.

"Bu sorunların çözümüne ilişkin ne gibi çözüm önerileriniz vardır?" Alt Problemi İle İlgili Bulgular

"Bu sorunların çözümüne ilişkin ne gibi çözüm önerileriniz vardır?" sorusuna verilen cevapların analizi sonucu elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 7. Öğretmenlerin Yaşanan Sorunların Çözümüne İlişkin Çözüm Önerileri İle İlgili Görüşleri

ANA TEMA	Alt Tema	Frekans	Kategorik Kodlama	Frekans
Çözüm Önerileri	**1.Okula başlama yaşı**	**13**	Okula başlama yaşı 72 aya geri çekilmelidir	13
	2.Programın hafifletilmesi	**33**	Türkçede metinler kısaltılmalı	18
			Matematik konuları hafifletilmeli	15
	3.Programda eşgüdümün sağlanması	**15**	Uyum sürecinin her okulda uygulanması	15
	4.Sınıf Mevcutları	**6**	Sınıf mevcutları azaltılmalı	6
	5.Veliler	**24**	Veliler bilinçlendirilme	24
	6.Araç-gereç	**4**	Okullar araç-gereçlerle donatılmalı	4
	7.Okulöncesi eğitim	**17**	Okulöncesi eğitim zorunlu olmalı	17

Öğretmenlerin yaşanan sorunlara ilişkin çözüm önerileri incelendiğinde, öğretmenler çözüm önerisi olarak;

Okula başlama yaşının tekrar 72 aya çekilmesi gerektiğini savunan bir öğretmen: *"Zorunlu okula başlama yaşı tekrar 72 aya çekilmeli."*(Ö.17) şeklinde görüş belirtmiştir.

Programın hafifletilmesi gerektiğini düşünen ve özellikle Türkçe metinlerinin öğrenci seviyesinin üstünde olduğunu düşünen bir öğretmen: *"Türkçedeki okuma metinleri çok uzun. Daha öncekiler dahi daha basitti ve ilgi çekiciydi. Bir okuma parçası ne kadar kısa olursa öğrenci o kadar çok okur ve hızlı okur. Kitaptaki parçalar ise tam tersi çok uzun. Her biri en az beş altı sayfalık. Takip etmede sıkıntı yaşıyoruz."*(Ö.14) şeklinde görüş belirtmiştir.

Programın hafifletilmesi gerektiğini ve matematik dersinin öğrenci seviyesinin üstünde olduğunu düşünen bir öğretmen:*"Matematik de bence birinci sınıf seviyesinin üstünde. Daha çocuk toplama çıkarma yapamazken biz ondan verilmeyenleri bulmalarını istiyoruz."*(Ö.16) şeklinde görüş belirtmiştir.

Programda eşgüdümün sağlanması gerektiğini savunan bir öğretmen: *"Hiçbir okul eşgüdümlü olarak gitmedi bu yıl. Bazı okullar uyum sürecini kısa tuttular. Bizim gibi programa uyan okullar da okuma yazma çalışmalarına geç başladılar."*(Ö.14) şeklinde görüş bildirmiştir.

Sınıf mevcutlarının azaltılması gerektiğini düşünen bir öğretmen: *"Sınıf mevcutları 25 in üstüne çıkmamalı."*(Ö.2) şeklinde görüş belirtmiştir.

Velilerin bilinçlendirilmesi gerektiğini düşünen bir öğretmen: *"Veliler yeterince bilgilendirilmedi, velilere yeterince bilgilendirme yapılabilmeliydi."*(Ö.3) şeklinde görüş bildirmiştir.

Okulların araç-gereç açısından donatılması gerektiğini savunan bir öğretmen:*"Okullar bir kere donanımlı hale getirilmelidir. Özellikle ilkokulda artık günümüz koşullarında teknolojik ürünlerden öğretmen ve öğrenciler tamamen faydalanmalı. Yani bizim hala sınıflarımızda bilgisayar var ama yeterli değildir. Akıllı tahta dedikleri şey ilkokulda da olmalıdır."*(Ö.10) şeklinde görüş belirtmiştir.

Okulöncesi eğitimin zorunlu olması gerektiğini savunan bir öğretmen: *"Öğrencilerin anasınıfına gitmeden birinci sınıfa gitmelerini uygun bulmuyorum. Onun için anasınıfları zorunlu olmalı."*(Ö.8) şeklinde görüş bildirmiştir.

"Eklemek istediğiniz başka bir şey var mı?" Alt Problemi İle İlgili Bulgular

"Eklemek istediğiniz başka bir şey var mı?" sorusuna verilen cevapların analizi sonucu öğretmenlerinin hiçbiri belirtilenler dışında görüş bildirmedikleri görülmüştür.

SONUÇ

Öğretmenlerin birinci sınıf öğrencilerinin okula uyum sürecinin nasıl olduğuna yönelik görüşleri incelendiğinde, öğretmenlerin büyük bir çoğunluğunun okula uyum sürecinin zor olduğunu, çok azının uyum sürecinin kolay olduğunu belirttikleri görülmektedir. Uyum sürecinin zor olmasının nedenleri; 60-66 aylık öğrencilerin okulu başlaması ve bu yaş grubunun çoğunun okulöncesi eğitimi alamaması, dolayısıyla da kalem tutamamaları, kuralları uygulayamamaları, ebeveynden ayrılamamaları, dikkatlerini toplayamamaları oyun oynayamamaları aynı zamanda farklı yaş grubundaki öğrencilerin aynı sınıfta olması ve velilerin bilinçsiz olması şeklinde ortaya çıkmıştır. Yapılan araştırmanın bu sonuçları Alisinanoğlu, F ve Şimşek, Ö. (2012) tarafından yapılan araştırma sonuçları olan okulöncesi eğitim alan ve aynı zamanda okuma ve yazamaya hazırlık programının uygulandığı 32-72 aylık çocukların olgunlaşmanın da etkisiyle daha başarılı oldukları sonucuyla uyuşmaktadır. Ayrıca Dağlı (2012) tarafından yapılan araştırmada 69-80 ay aralığındaki öğrencilerin yaşları arttıkça akademik başarılarının da arttığı sonucu da araştırma ile paralellik göstermektedir. Altun ve Tantekin Eden (2014) tarafından yapılan araştırmanın sonuçlarına göre, sınıf öğretmenleri okul öncesi eğitimini önemli bulmakta, okul öncesi eğitiminin yaygınlaştırılması ve zorunlu eğitim kapsamına alınması ile ilgili çalışmaları desteklemekte ve bu eğitimi almış kişilerce verilmesi gerektiğini vurgulanmaktadır.

Öğretmenlerin uyum sürecinde; öğrencilerin fiziksel gelişimlerini desteklemek amacıyla kesme yapıştırma çalışmaları, boyama çalışmaları, çizgi çalışmaları, tuvalet eğitimi verme çalışmaları yaptıkları, öğrencileri sosyalleştirmek amacıyla birlikte oyun oynadıkları ve birlikte şarkılar söyledikleri, okulun kurallarını benimsetmek amacıyla kuralları birlikte oluşturdukları, öğrenciye okulu sevdirmeye çalıştıkları, öğrenciye pekiştireç verdikleri, veli ile işbirliği yaptıkları ve bu amaçla öğrenci tanıma formu gönderdikleri, öğrencilerin duygusal gelişimlerini desteklemek amacıyla da öğrenciyi sevdiklerini belirtmişlerdir.

Öğretmenlerin, öğrencilerin okula uyumlarında yaşadıkları sorunlara ilişkin fiziksel yönden; öğrencilerin kalem tutmasında, yazı yazmasında, tuvalet ihtiyaçlarını gidermesinde, sosyal yönden; ebeveynden ayrılmada arkadaş edinmede birlikte oyun oynatmada, kendini ifade etmede, büyük yaş grubunda derste sıkılmada, küçük yaş grubunda özgüven eksikliği yaşamada, kurallara uymada, bilişsel yönden; öğrencilerin dikkatini toplamada, yönergeleri takip ettirmede, okumada, okuduğunu anlamada, veli desteğini sağlama yönünden ise; ekonomik durumun yetersizliğinde ve velinin okuryazar olmamasında sıkıntı yaşadıkları belirlenmiştir. Bu sonuçlar; Yılmaz, Taşçı, Fidan ve Nurlu(2014) tarafından yapılan araştırmada ulaşılan 60-66 aylık öğrenciler okul kültürü, sınıf kuralları, bilişsel algılama, öz bakım becerileri gibi okul olgunluğu bakımından formal eğitime tam olarak hazır olmadığı sonucuyla tutarlılık göstermektedir. Denton ve West (2003, s. 5) de yaptıkları çalışmalarında eğitim düzeyi yüksek olan annelerin çocuklarının okuma becerileri, eğitim düzeyi düşük olan annelerin çocuklarının okuma düzeyinden yüksek olduğu sonucuna ulaşmışlardır.

Öğretmen görüşlerine göre; 60 ayda okula başlayan öğrencilerin okula uyumlarının sağlanamamasının nedenleri; bu çocukların okula başlamak için yaşlarının küçük olması, velilerin ilgisiz olması ve bu öğrencilerin büyük bir kısmının okulöncesi eğitimi almaması olarak ortaya çıkmıştır. Bu bulgular Demir, Doğan & Pınar'ın 2014'te yaptığı araştırma sonuçları ile paralellik göstermektedir.

Öğretmenlerin medyada son zamanlarda yer alan 60-66 aylık çocukların sınıflarının ayrılması konusundaki görüşlerine yönelik bulgular incelendiğinde; öğretmenlerin çoğunun sınıfların yaş gruplarına göre ayrılmasının sınıfta yaş grubu farklılığından doğan uyumsuzlukları azaltacağına ve öğretmenlerin ders anlatmada öğrencilerin seviyelerinin farklılığından dolayı yaşadıkları sıkıntıları azaltacağına kanaat getirdiği, ancak öğretmenlerin bir kısmının da sınıf değişikliğinin çözüm olmadığını savunduğu tespit edilmiştir. Öğretmenlerin çoğundan alınan görüşlere göre çocukları yaşamlarının ilerleyen zamanlarında da aynı programa ve sınavlara tabi tutulacağı bu nedenle de sınıfların ayrılmasının kesin çözüm olmadığı sonucuna ulaşılmıştır. Demir, Doğan ve Pınar (2014) yaptıkları araştırmada katılımcıların tamamının okullarda var olan alt yapı problemlerinin çözülmeden 12 yıllık zorunlu eğitime geçildiğini, buna bağlı olarak da özellikle gelişim dönemleri 60 ve 66 ay arasında olan öğrencilerin okula uyumunda sorunlar yaşandığını belirttikleri görülmüştür.

Öğretmenlerin yaşanan sorunlara ilişkin çözüm önerilerine konusundaki görüşlerine göre öğretmenlerin çoğunun okula başlama yaşının tekrar 72 aya çekilmesi, programın hafifletilmesi, programda eşgüdüm sağlanması, sınıf mevcutlarının azaltılması, kesin bir çözüm olmasa dahi sınıfların ayrılması, velilerin bilinçlendirilmesi, okulların araç-gereç açısından donatılması, okulöncesi eğitimin zorunlu hale getirilmesi gerektiği ortaya çıkmıştır.. Olkun., Yeşilpınar ve Kışla (2014) tarafından yapılan araştırmada 6.5 ve 7 yaşındaki çocukların sayma gerektiren problem durumlarında gösterdikleri başarıların 5 ve 5,5 yaş grubuna göre anlamlı düzeyde yüksek olduğu sonucuna ulaşılmıştır.

ÖNERİLER

Okula uyum konusunda 72 ayını dolduran öğrencilerin daha az sıkıntı yaşadığı ve özellikle 60-66 aylık öğrencilerin problem davranışları daha fazla sergilediği tespit edildiği için okula başlama yaşı konusunda tekrar bir düzenleme yapılabilir. 60-66 aylık öğrencilerin okula başlamalarında son söz aileye değil öğretmene veya okul müdürüne bırakılabilir. Program büyük yaş grubunun sıkılıp okuldan soğumasını (72 ay ve üstü), küçük yaş (60-72 ay) grubunun özgüvenlerini yitirtmesini engelleyecek şekilde yeniden düzenlenebilir. Programın yurt genelinde eşgüdümü sağlanabilir.Veliler okul ve çocuk eğitimi konusunda belli aralıklarla belli bir program çerçevesinde bilinçlendirilebilir. Okullar araç- gereç açısından zenginleştirilebilir. Öğrencilerin oyun oynamaları için alanlar yapılabilir.Okulöncesi eğitim zorunlu hale getirilebilir.

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Ek-1

Cinsiyet: Bayan( ) Erkek( )

Kıdem:

Mezuniyet:

1. Birinci sınıf öğrencilerinin okula uyum süreci nasıl olmuştur?
2. Birinci sınıf öğrencilerinin okula uyum sürecinde siz neler yaptınız?
3. Birinci sınıf öğrencilerinin okula uyum sürecinde yaşadığınız sorunlar nelerdir ?
4. 60 ayda okula başlayan çocukların 1. sınıfa uyumları konusunda neler düşünüyorsunuz?
    a. Medyada son zamanlarda yer alan, 60-66 aylık çocukların sınıflarının ayrılması konusundaki haberlere ne dersiniz?
5. Bu sorunların çözümüne ilişkin ne gibi çözüm önerileriniz vardır?
6. Eklemek istediğiniz başka bir şey var mı?

THE OPINIONS OF PARENTS REGARDING THE SAFE USE OF THE INTERNET BY CHILDREN

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ABSTRACT: The aim of this study was to determine the opinions of parents regarding the safe use of the internet by school-age children between the ages of 6 and 11. The study was performed based on a qualitative study design, and study data were collected using a semi-structured interview form. As sampling method, the criterion sampling method was employed within the scope of this study. Ten parent couples who satisfied the study criterion were interviewed, and the interview meetings were recorded using a video camera. The data obtained during the interviews were then analyzed using the descriptive analysis method. Within the scope of the study, the positive aspects of the internet described by the parents included the assistance it provided to children with their homework/studies, and the internet's function as a source of entertainment. On the other hand, the negative aspects of the internet described by the parents included the excessive amount of time children spent on the internet; the possibility for children to encounter inappropriate images and advertisements; the children's tendency to imitate/emulate computer game characters; and the adverse effects it might have on the children's health. In this study, it was determined that parents considered advertisements, games, social networking sites, friendship/socialization sites, and sites with inappropriate images as sources of harmful content for children between the ages of 6 and 11. To ensure that their children could use the internet safely, the parents resorted to measures/precautions such as using internet safety software; limiting the time their children could access the internet; raising their children's awareness about using the internet; and making use of internet filtering. The parents considered that further measures should be taken by enacting laws that would ensure the safe use of the internet, and that parents should have a greater control on the internet access of their children. The study also demonstrated that while the parents were not knowledgeable about the legal regulations in Turkey regarding the internet, they were nevertheless of the opinion that further legal regulations are required for ensuring safe use of the internet by children.

Key words: safe internet services, children between the ages of 6 and 11, parent opinions.

ÇOCUKLARIN İNTERNETİ GÜVENLİ KULLANIMINA YÖNELİK ANNE-BABA GÖRÜŞLERİ

ÖZET: Bu araştırmada 6-11 yaş arasındaki okul çağı çocuklarının interneti güvenli kullanımına yönelik anne-baba görüşlerinin alınması amaç edinilmiştir. Araştırmada nitel araştırma yöntemi kullanılmış olup veriler yarı yapılandırılmış görüşme formu ile elde edilmiştir. Örnekleme yöntemlerinden ölçüt örnekleme yöntemi kullanılmıştır. Ölçütü karşılayan 10 anne-babayla görüşmeler yapılmış ve görüşmeler kamera ile kayıt altına alınmıştır. Görüşmeler sonunda elde edilen veriler betimsel analiz yöntemiyle analiz edilmiştir. Araştırmada ebeveynlerin internetin olumlu yanı olarak çocuklarının ödev/derslerine yardımcı olduğunu ve zamanlarını eğlenceli geçirmesini sağladıkları görüşüne sahip oldukları, internetin olumsuz yanı olarak çocukların fazla zaman harcaması, uygun olmayan görüntü ve reklamlarla karşılaşma olasılıklarının olması, oyun karakterlerine özenmeleri ve sağlıklarını etkilediğini düşündükleri tespit edilmiştir. Araştırmada ebeveynlerin internette yer alan reklamlar, oyunlar, sosyal paylaşım siteleri arkadaşlık siteleri ve uygun olmayan görüntü içeren siteleri 6-11 yaş arasındaki okul çağı çocukları için zararlı içerik olarak gördükleri sonucuna ulaşılmıştır. Araştırmada ebeveynler çocuklarının güvenli internet kullanabilmeleri için güvenlik yazılımı kullanma, süre kısıtlaması yapma, internet hakkında çocuğunu bilinçlendirme ve filtre kullanma gibi önlemler aldıkları sonucuna ulaşılmıştır. Ebeveynler çocukların interneti güvenli kullanması için yasalarla önlem alınması gerektiği ve ebeveyn kontrolünün sağlanması gerektiğini önermektedirler. Araştırmada ebeveynlerin Türkiye'de internetle ilgili yasal düzenlemeler hakkında bilgi sahibi olmadıklarını ancak çocukların interneti güvenli kullanmaları için yasal düzenlemelerin olması gerektiği görüşüne sahip oldukları sonucuna ulaşılmıştır.

Anahtar sözcükler: güvenli internet hizmeti, 6-11 yaş çocuklar, ebeveyn görüşleri

GİRİŞ

Günümüz toplumunda teknolojide yaşanan hızlı değişimle beraber artık her evde kişisel bilgisayar ve internet bulunmaktadır. Bu nedenle bilgisayar ve internet günlük hayatımızın bir parçası haline gelmiştir. Bilgisayar ve internet yaşamımıza öyle nüfuz etmiştir ki internetsiz bir iş, özel ya da sosyal ortam düşünülemeyecek hale gelinmiştir.

Bilgisayar ve akıllı telefonlarla internete her an ulaşmak mümkündür. 2012 yılı ortasında dünya nüfusunun internete erişimi % 34.3 iken, 2020 yılında bu oranın % 75-85'e çıkacağını öngörülmekte ve hatta gelişmiş ülkelerde bu oranın % 90'lara ulaşacağını tahmin edilmektedir (Schmidt, 2013). Öyle ki 2012 yılı verilerine göre Türkiye'de nüfusun yaklaşık yarısının (% 45,7) interneti kullandığı görülmektedir (internetworldstats.com, 2012). Günümüzde de belediyeler (İstanbul Büyük Şehir Belediyesi) şimdiden ortak yaşam alanlarında ücretsiz internet imkânı sağlamaya başlamıştır (ibb.gov.tr, 2014). İnternet, yetişkinler kadar çocuklar tarafından da kullanılmaktadır. Bu değişim ve gelişimlere paralel olarak çocukların da bilgisayar ve internet kullanma oranı artacaktır. Bu bağlamda önümüzdeki yıllarda internet kullanma oranının artacağı açık bir gerçektir.

Bilgisayar ve internet başında geçilen zaman çocukları fiziksel, sosyal ve psikolojik açılardan etkileyebilmektedir. Bilgisayar çalışma ortamlarının düzenlenmesinde ergonomik kuralların göz ardı edilmesi, baş, boyun, omuzlar ve kollar, el ve el bilekleri, bel, sırt ve bacak ağrılarına neden olmaktadır. Gerekli önlemler alınmadığı takdirde çeşitli ağrılar ile kendini gösteren sağlık sorunları yaşanabilinmektedir (Keser, 2005, s. 96-97). Bu bağlamda internette zaman geçiren çocuklar için bilgisayarın bulunduğu ortamların da düzenlenmesi gerekmektedir. İnternetin insan sağlığı üzerinde fiziksel etkilerinin yanında psikolojik etkileri de vardır. Çoğu çocuk bilgisayarın başında zamanın nasıl geçtiğinin farkına bile varmaz. Bu durum çocukta bağımlılık (bilgisayar/internet bağımlılığı) oluşturabilir. İnternet bağımlılığı, interneti kullanma isteğinin önüne geçilememesi, internete bağlı olmadan geçirilen zamanın önemini yitirmesi, yoksun kalındığında aşırı sinirlilik hali ve saldırgan davranışlar sergilemesi ve kişinin iş, sosyal ve aile hayatının giderek bozulması olarak tanımlanabilir İnternet bağımlılığının diğer bağımlılık türlerinden çok da farklı sonuçları bulunmamaktadır. Bağımlılık yaratan maddeler, kimyevi uyuşturuculardır. Sanal alışkanlıklarda beyinde iç kimyevi madde salgılatarak, madde kullanımıyla aynı etkiyi sağlamaktadır (Çelik, 2013, s. 138-139).

Bilgisayar ve internetin içerik yönünden sakıncaları hakkında da söylenebileceklerin başında cinsellik, şiddet ve yanlış özdeşim modelleri gelmektedir (Bak, 2011, s. 287). Günümüzde de 25 milyondan fazla çocuk internet'te saatlerce sörf yapmaktadır. İnternete zaman geçiren her dört çocuktan biri seks sitelerine girmektedir. Çocuklarla cinsel ilişkiye girmek isteyen erişkinler, çocukların daha sık kullandıkları sohbet odalarına girmekte ve bu sırada karşılaştıkları çocuklara erotik fotoğraflar göndererek gerçek ortamda da buluşma teklifleri yapabilmektedirler (Şahin, 2007). Oysa okul çağı çocukları, cinsel konularla ilgili ana babaya çok soru sormaz, bu konulardan kaçarlar (Yörükoğlu, 2012, s. 78). Bu dönemde çocuk enerjisini öğrenme, oyun ve diğer insanlarla ilişki kurmada kullanır (Bak, 2011, s. 48). Sevgi gösterilerini ev dışındaki arkadaşlarına yöneltir. Cinsiyet rol kimliğine güçlü bir ilgi duymaya başlar (Senemoğlu, 2011, s. 74). Amaç ise çocuğun hemcinsi olan ebeveyne özdeşimi ve cinsiyete ilişkin toplumsal rolünü güçlendirmektir. Aslında bu yaştaki içgüdüsel dürtülerin kontrolü ve cinsel yönden sessizlik, benliğin ve yeteneklerin gelişmesini ve belirginleşmesini sağlar (Bak, 2011, s. 48). Ama gelişimine uygun olmayan cinsel içerikli bilgilere ulaşan çocuklar, cinsel gelişimini sağlıklı bir şekilde tamamlayamaz. Çocuk cinsel kimliğini doğru bir şekilde tamamlamadan, farklı ve tasvip edilmeyen cinsel tercihlere eğilim gösterebilir. Kendinin veya başkalarının cinsel kimliğini doğru tanımlamada sıkıntı yaşamaya başlar. İnternette karşılaştığı yalan yanlış bilgileri doğru kabul edip hayal dünyasının zarar görmesine neden olabilir (Durmuş, 2007, s. 66).

Çocuklar internete ev, okul, kütüphane ve internet kafeler gibi pek çok yerden bağlanabilirler. Çocuklar internete en fazla oyun oynamak, sohbet odalarına girmek, e-posta göndermek ve almak için bağlanmaktadırlar (Odabaşı, Kabakçı, & Çoklar, 2007, s. 77). Özellikle küçük yaştaki çocuklar interneti oyun oynama aracı olarak görmektedir. Ancak, çocukların en fazla giriş yaptığı oyun sitelerinde oyunların çoğu şiddet içermektedir. Oyunlarda çocuklar, düşmana şiddet uygular. Çocuk, bilgisayarını kullanarak düşmana zarar vermek için hedefleri bombalar, ateş eder ve yumruk atar (Durmuş, 2007, s. 156).

Bilgisayar oyunlarının en önemli özelliği etkileşimli olmaları ve bireyi hırs çemberine almalarıdır (Pembecioğlu, 2006, s. 298). Bilgisayarda oyun oynayan birey, televizyonda olduğu gibi gözlemci olarak değil, oyunun aktif bir karakteri gibi hareket etmektedir. Bu nedenle şiddet içeren bilgisayar oyunları, şiddet içeren televizyon programlarından daha etkili ve zararlıdır (Yavuzer, 2011, s. 225). Ekran karşısında çok fazla vakit geçiren hayata dokunmayan çocukların gerçek dünyayı öğrenmeleri de pek mümkün değildir. Aşırı derecede bilgisayarda oyun oynamanın insanı gerçeklikten koparması söz konusudur. Gerçek dünyadan kopma ise akıl hastalıklarının başlangıcı olmaktadır (Çelik, 2013, s. 123-111).

Şiddet eylemlerinin izlenmesi, çocuk için ruhsal gerginliği arttırabilmektedir. Dengesi daha kolay değişebilen, öfke eğilimli bireylerde, dürtüsel ve duygusal kontrolü daha da zayıflatmaktadır (Yavuzer, 2011, s. 221-222). Aslında çocuklar küçük yaştan itibaren çevrelerindeki doğru ve yanlışlardan haberdardırlar. Davranışlarında da bu doğru ve yanlışları hatırlar ve yansıtırlar. Yani çocuklar ahlaki değerleri, gözledikleri davranışlar ve bu davranışların sonuçlarında öğrenirler. (Bayhan, Artan, 2004) Kitle iletişim araçlarıyla da, şiddeti meşru olarak görüp, algılayan çocuk, şiddet uygulamakta bir sakınca görmez (Mora, 2011, s. 163). Çocuk önce farkında olmadan taklit etmektedir, zamanla ise bu davranışlar alışkanlık haline gelir, böylece bilgi dağarcığı ve kişiliği oluşur (Aydın, 2008, s. 8).

Okul çağı çocuğunun gerçek hayattaki arkadaşlık ve aile ilişkileri önemlidir. Çünkü bu ilişkiler çocukların sosyal becerileri öğrenmelerini, başkalarının düşüncelerine ve haklarına duyarlılık geliştirmesini sağlar. Çocuk sosyalleşir, bireysel olgunluğu artar, toplumsal yargılar, kurallar ve tavırları öğrenir (Bak, 2011, s. 213). Zamanının çoğunu bilgisayar başında geçiren çocuk ise sanal arkadaşlıklar kurmaktadır. Bu durum çocuğun sosyal ilişkilerini güçleştirerek gerçek yeni arkadaşlıklar edinmesini ve iletişim becerilerini kullanarak dili doğru bir biçimde kullanma becerilerini geliştirmesini engeller. Akran paylaşımı azalan çocuk sanal ortamda her yaş grubundaki kişiyle iletişime geçebilir ancak yaşının ve gelişim düzeyinin üzerinde bilgilere ulaşması ve kendini yanlış yönelimlerin içinde bulması da mümkündür (Ülkü, milliyet.com.tr, 2014). Sohbet odalarında dolaşırken gerçek kimliklerini de saklama ya da değiştirmenin tehlikesi, ileri yıllarda gerçek sosyal hayattan çekilme davranışları ile kendini de gösterecektir (Caferov, 2014). Bu nedenle sosyal web sitelerine kaydolmak için tavsiye edilen yaş genellikle 13 ve üzeridir (Microsoft, 2014). 6-11 yaş arası okul çağı çocuklarının sosyal, dilsel gelişimlerinin arttığı bir dönemdir. Bu yüzden bu yaş grubu çocuklarının akranlarıyla sanal olmayan sosyal ortamlarda iletişim kurmalarını sağlamak gerekmektedir.

Ödüllü yarışmalar, etkileşimli oyunlar, chat odaları tartışmaları ve çocuk kulüpleri gibi birçok site reklam amacıyla adres, telefon numarası, kredi kartı numaraları gibi kişisel bilgiler, çocuğu ve yakın çevresini riske sokabilecek bilgiler istemektedir. Kişisel bilgilerin elde edilmesi ve paylaşılması izin almadan yürütülebilmektedir (Odabaşı & Odabaşı, 2001, s. 4). Örneğin, Türkiye'de 8 yaşındaki bir çocuk sanal alemde oynadığı oyun için, babasının kredi kartı şifresini girerek tam 2 tır sanal domates satın almıştır. (hurriyetaile.com, 2013). Bunun gibi çocuklar aracılığıyla gereksiz ve fazladan ödemelere ebeveynler muhatap olabilmektedir. Bu bağlamda çocuğa bilinçli tüketici olma konusunda bilgiler verilmelidir. Aynı zamanda çocuğun kişisel bilgilerini paylaşmaması konusunda bilgi verilmelidir.

İnternette birçok zararlı yazılım bulunmaktadır. Kötü amaçlı yazılımlar kişisel bilgisayarlara bulaşarak sahtekarlık ve kimlik hırsızlığı gibi suçların işlenmesine neden olur. Web'de gezinme, alışveriş, bankacılık, e-posta, anında mesajlaşma ve oyun oynama amacıyla gerekli koruması olmayan bir bilgisayar da dolayısıyla risk altındadır (ttnetguvenlik, 2014).

İnternet, istenmeyen içeriklerin yanı sıra çocuklar için daha az zararlı olmayan, örneğin siber zorbalık veya siber trol gibi diğer tehlikeleri de içermektedir. Saldırganlar, birlikte kullanıldığında kurban üzerinde tarifsiz ruhsal acılara neden olabilecek, sosyal ağlar, forumlar, sohbet odaları ve anlık mesajlaşma hizmetlerini içeren tüm olası çevrimiçi etkileşim kanallarını kendi çıkarları için kullanabilmektedir (Larkina, 2014). Çocuk İstismarı ve İnternet Koruma Merkezi'nin (CEOP) açıklamasına göre internette kendilerini çocuk ya da genç olarak tanıtan şahıslar, kurban seçtikleri çocuk ve gençleri ikna ederek cinsel hareketlere ya da müstehcen görüntülerini paylaşmaya ikna etmekte, daha sonra da bu görüntüleri çocuğun ailesine, arkadaşlarına ve tanıdıklarına yayma tehdidiyle şantajda bulunmaktadır. Açıklamada 8 yaşındaki çocukların bile köleleştirici hareketlere zorlandığı, cinsel faaliyetlerin dışında bazen çocuklardan kendilerini yaralamalarını istendiği ve çeşitli olaylarla para elde edilmeye çalışıldığı belirtilmektedir (BBCTurkce, 2013).

Türkiye'de 12-13 yaşlarında iki çocuğa internette gezinirken bilgisayarın kamerasından çekilmiş görüntüleri ekrana getirilerek çocuklar tehdit edilmiştir. Bu durumdan korkan çocuklar kendilerinden isteneni, hesaba para yatırmayı kabul edip, emredileni yapmışlardır (Erdoğan, 2014). Bu durumlardan kurtulmak için güvenlik yazılımı kullanılmalı ve güvenlik yazılımı sürekli güncel kalmalıdır.

İnternetin hayatımıza hızlı ve etkili girişi internet içeriğiyle ilgili önlemler almayı doğurmuştur. İnternetin güvenli hale gelmesi için çalışmalar başlamıştır. Türkiye'de güvenli internet dönemine 22.11.2011 tarihinde geçilmiştir. Güvenli İnternet Hizmeti Erişim Sağlayıcılar tarafından altyapısı oluşturularak isteyen kullanıcıların İnternetten güvenli hizmet alabilmesidir. Türkiye'de güvenli internet hizmeti erişim sağlayıcılar tarafından ücretsiz olarak sağlanmaktadır. Zaten Elektronik Haberleşme Kanunu uyarınca çıkarılan Tüketici Hakları Yönetmeliği'nin İnternetin Güvenli Kullanımı başlıklı 10. Maddesi işletmecilere İnternetin Güvenli Kullanımına yönelik ücretsiz alternatif hizmet sunma yükümlülüğü getirmektedir (Acarer, 2011).

İnternet içeriğini düzenlemek ve denetim altına almak için "İnternet Ortamında Yapılan Yayınların Düzenlenmesi ve Bu Yayınlar Yoluyla İşlenen Suçlarla Mücadele Edilmesi Hakkında Kanun" 2007 yılında

yürürlüğe girmiştir. 5651 sayılı bu kanun 2014 yılında yeniden düzenlenerek son şeklini almıştır. Günümüz uygulamasına göre (mevzuat.gov.tr, 2014),
"İnternet ortamında yapılan ve içeriği aşağıdaki suçları oluşturduğu hususunda yeterli şüphe sebebi bulunan yayınlarla ilgili olarak erişimin engellenmesine karar verilir:
a) 26/9/2004 tarihli ve 5237 sayılı Türk Ceza Kanununda yer alan;
1) İntihara yönlendirme (madde 84),
2) Çocukların cinsel istismarı (madde 103, birinci fıkra),
3) Uyuşturucu veya uyarıcı madde kullanılmasını kolaylaştırma (madde 190),
4) Sağlık için tehlikeli madde temini (madde 194),
5) Müstehcenlik (madde 226),
6) Fuhuş (madde 227),
7) Kumar oynanması için yer ve imkân sağlama (madde 228), suçları."

Yukarıda geçen durumların dışında kişilik hakkı ihlal edilen veya özel hayatın gizliğinin ihlal edildiğini düşünen kişilerde bu sitelerin erişime engellenmesini talep edebilecektir. Yasa ile erişim engelleme kararları, IP ve URL bazlı olarak verilir. Bir web sitesinin tamamının erişime engellenmesi yerine yalnızca belli bir bölümü engellenebilecek ve DNS ayarları değiştirilerek de erişime engelli sitelere giriş yapılamayacaktır. (Ahi, 2014). Ancak bu yasanın kısıtlayıcı yöntemlerle interneti izlemeyi kolaylaştıran ve bu ortamlarda yapılacak engellemeyi artıracak bu değişikliğin demokratik ve özgürlükçü bir yaklaşım olmadığı da dile getirilmektedir (TBD, 2014). Bunu yasakçı bir zihniyet olarak değerlendiren Kaplan, yasanın tek iyi yanının çocukları korumak olduğunu dile getirmektedir.

Bilgi Teknolojileri İletişim Kurumu Telekomünikasyon İletişim Başkanlığı tarafından 5651 sayılı İnternet Ortamında Yapılan Yayınların Düzenlenmesi ve Bu Yayınlar Yoluyla İşlenen Suçlarla Mücadele Edilmesi Hakkında Kanununun 10. maddesinin 4. fıkrasının (d) bendi uyarınca "Bilgi İhbar Merkezi" kurulmuştur. Bu doğrultuda ihbarweb.org.tr web sayfası yayına geçmiştir. "ihbarweb.org.tr" web sayfası 5651 nolu yasanın 8. maddesinde yer alan suçlarla ilgili içeriklerin "ihbarweb.org.tr" web sayfası üzerinden ihbar edilmesini sağlamaktadır. Ayrıca telefonlardan 166'yı arayarak ya da 1199'a kısa mesaj göndererek Bilgi İhbar Merkeziyle iletişime geçilebilinmektedir (ihbarweb.org, 2010).

5651 sayılı Kanunda sayılan katalog suçlar kapsamında Telekomünikasyon İletişim Başkanlığınca idari tedbir olarak uygulanan erişimin engellenmesi tedbirlerinin suç türlerine göre oransal dağılımı; müstehcenlik (% 74.99), çocukların cinsel istismarı (% 16.83), fuhuş (% 6.14), kumar oynanması için yer ve imkan sağlama (% 1.14), sağlık için tehlikeli madde temini (% 0.72), intihara yönlendirme (% 0.1), Atatürk aleyhine işlenen suçlar (% 0.07), uyuşturucu ve uyarıcı madde (% 0.03) şeklindedir. Buna göre erişim engellemelerinin büyük çoğunluğu 5651 sayılı Kanun'un 8/a maddesi gereğince 26/09/2004 tarihli ve 5237 sayılı Türk Ceza Kanununda yer alan suçlardan oluşmaktadır. Erişimin engellenmesi tedbirleri incelendiğinde müstehcenlik, çocukların cinsel istismarı ve fuhuş engelleme tedbirlerinin büyük çoğunluğunu oluşturmaktadır. Erişimin engellenmesi kararı verilmeden önce ilgili internet sitesine "uyar-kaldır" yöntemi uygulanmaktadır. Bu şekilde ilgili internet sitesinin tamamının erişiminin engellenmesi yerine yalnızca suç oluşturan konu içeriğine erişimin yayından kaldırılması sağlanmaktadır (guvenliweb.org, 2013).

Okul çağındaki çocuklar internete; okulda, evde ve internet kafelerdeki bilgisayarlar ile ebeveynlerine ait ya da sahip oldukları akıllı telefonlar ile ulaşabilmektedir. Bu çalışma, anne-babaların internetin çocuklar üzerindeki olumsuz etkilerine yönelik almış oldukları önlemleri ortaya koyarak internetin çocuklarca güvenli kullanımına katkı sağlayacağı düşünülmektedir.

Bu araştırmada 6-11 yaş arasındaki okul çağı çocuklarının, interneti güvenli kullanımına yönelik anne- baba görüşlerini almak amaçlanmıştır. Bu amaç doğrultusunda aşağıdaki sorulara yanıt aranmıştır:

1.Anne-babaların çocukların interneti kullanmasına yönelik görüleri nelerdir?
1.1 Anne-babaların çocukların interneti kullanmasına yönelik olumlu görüşleri nelerdir?
1.2Anne-babaların çocukların interneti kullanmasına yönelik olumsuz görüşleri nelerdir?
2.Anne-babaların internetin zararlı içeriği/içerikleri hakkındaki görüşleri nelerdir?
3.Anne-babaların çocuklarının interneti güvenli kullanması için aldığı önlemler nelerdir?
4.Anne-babaların görüşlerine göre çocukların interneti güvenli kullanmalarına yönelik alınması gereken önlemler nelerdir?
5.Türkiye'de çocuklar için internetle ilgili yasal düzenlemeler hakkında anne babaların görüşleri nelerdir?

YÖNTEM

Bu araştırmada nitel araştırma yaklaşımı benimsenmiştir. Araştırmada durum çalışması deseni kullanılmıştır. Araştırmada, nitel araştırmalarda kullanılan görüşme tekniği kullanılmıştır. Çalışmada, görüşme tekniğinin yarı yapılandırılmış görüşme şekli uygulanmıştır.

Evren ve Örneklem

Araştırmada amaçlı örnekleme yöntemlerinden ölçüt örnekleme yöntemi kullanılmıştır. Bu araştırmada da, Malatya ilinde eğitim seviyesi olarak ilkokul, ortaokul, lise, lisans ve lisansüstü eğitim kurumlarından mezun olan anne-babalar seçilmiştir. Seçilen anne babaların evlerinde aktif internet bağlantısına sahip olmaları ve 6-11 yaş arasında okul çağı çocuğu veya çocukları olmaları ölçüt olarak alınmıştır. Örneklemde bu ölçütü sağlayan toplam 10 kişi yer almaktadır. Örneklemde yer alan kişilerle 2014 yılı Mayıs ve Haziran aylarında görüşmeler gerçekleştirilmiştir. Araştırmanın evrenini Malatya ilinde yaşayan 6-11 yaş arasında çocuğu olan evlerinde aktif internet bağlantısına sahip anne ve babalar oluşturmaktadır. Araştırmaya katılan kişilerin özellikleri aşağıda yer alan Tablo 1 ve Tablo 2'de verilmiştir.

Tablo 1. Ebeveynlerin Özellikleri

Ebeveynler	Cinsiyet	Yaş	Öğrenim Durumu
A1	Kadın	35	İlkokul
A2	Kadın	29	Ortaokul
A3	Kadın	33	Lise
A4	Kadın	35	Lisans
A5	Kadın	34	Yüksek lisans
B1	Erkek	54	İlkokul
B2	Erkek	52	Ortaokul
B3	Erkek	50	Lise
B4	Erkek	34	Lisans
B5	Erkek	36	Yüksek Lisans

Tablo 1'de ebeveynler A ve B harfleriyle verilmiştir. Tabloda A harfi anneyi B harfi babayı temsil etmektedir. İlkokul mezunu 1, ortaokul mezunu 2, lise mezunu 3, lisans mezunu 4 ve yüksek lisans mezunu 5 sayısıyla kodlanmıştır. Buna göre örneğin bir ilkokul mezunu anne için A1 şeklinde bir kodlama yapılmıştır. Araştırmada 5 anne ve 5 baba olmak üzere toplam 10 ebeveyn yer almaktadır.

Tablo 2. Ebeveynler in Çocuk Ve İnternet Kullanım Süre Bilgisi.

Ebeveynler	Çocuk sayısı	Çocukların Cinsiyeti	Çocukların Yaşı	İnternet Kullanım Süreleri
A1	1	Erkek	9	2 yıl
A2	2	Erkek	8 ve 11	1 yıl
A3	1	Kız	7	4-5 yıl
A4	1	Kız	8	8 yıl
A5	1	Kız	8	8 yıldan fazla
B1	1	Kız	7	2-3 yıl
B2	1	Kız	10	6 yıl
B3	1	Kız	10	15 yıl
B4	1	Kız	9	5-6 yıl
B5	1	Kız	9	7-8 yıl

Tablo 2'de ebeveynlerin çocuk sayıları, çocuklarının yaşları ve cinsiyetleri verilmiştir. Tabloda ebeveynlerin aktif olarak evlerinde kullanmakta oldukları internetin süreleri yer almaktadır. Ebeveynlerin internet kullanım sürelerine bakıldığında en az 1 yıl en fazla 8 yıl ve üzeri olduğu görülmektedir. Ebeveynlerin internet kullanım süreleri incelendiğinde çocuklarının yaşlarına yakın ya da daha fazla sürede internete sahip oldukları görülmektedir.

Veri Toplama Aracı

Veri toplama aracı araştırmacı tarafından ilgili literatür taranıp literatür bilgilerinden yararlanılarak hazırlanan yarı yapılandırılmış görüşme sorularından oluşmaktadır. Araştırmacı tarafından hazırlanan sorular önce pilot uygulama olarak bir anne ve bir babaya uygulanmıştır. Ebeveynlerin verdiği cevaplar doğrultusunda görüşme soruları yeniden düzenlenmiştir. Düzenlenen sorular uzmanların görüşlerine sunulmuştur. Çalışmada 5 uzmanın görüşüne sunulan yarı yapılandırılmış görüşme soruları, uzmanlar tarafından değerlendirilip gerekli düzeltmeler yapılmıştır. Uzmanların yarı yapılandırılmış görüşme sorularına onayları alındıktan sonra görüşmeler gerçekleştirilmiştir. Ebeveynlere sorulan yarı yapılandırılmış görüşme soruları Ek-1'de sunulmuştur.

Verilerin Analizi

Araştırmada betimsel analiz kullanılarak veriler analiz edilmiştir. Bu çalışmada da araştırmanın amaçları doğrultusunda hazırlanan görüşme sorularının her birine verilerin yanıtlardan elde edilen verilerle tematik bir çerçeve oluşturulmuştur. Temalara görüşleriyle vurgu yapan ebeveyn sayıları örneğin 4 ebeveyn için (f=4) şeklinde belirtilmiştir. Alıntılar yapılırken de ebeveyn adları yerine A ve B harfleri ve sayılar kullanılmıştır. A harfi anneyi B harfi babayı temsil edecek şeklinde düzenlenmiş ve her anne ve babaya eğitim seviyelerine göre numara verilmiştir. Eğitim seviyesi ilkokul için 1, ortaokul için 2, lise için3 lisans için 4 ve yüksek lisans için 5 sayısı verilmiştir. Buna göre örneğin ilkokul mezunu anne için (A1), ilkokul mezunu baba için (B1) şeklinde bir kodlama yapılmıştır.

Geçerlik ve Güvenirlik

Araştırmada araştırmacı tarafından görüşme yapılan anne babaların verdiği yanıtlara müdahale edilmemiştir. Yanıtların analizinde araştırmacı tarafından, tarafsız olunmaya çalışılarak elde edilen bulguların aktarımı yapılarak geçerlik sağlanmıştır. Çalışmada görüşmeler kamera kaydı eşliğinde yapılmıştır. Görüşmenin güvenirliği için kamera kaydı yazılı döküm haline getirilmiştir. Uzman bir kişinin görüşü alınarak görüşme dökümlerinin güvenirliğine bakılmıştır.

BULGULAR

Bu bölümde araştırmanın amacı doğrultusunda hazırlanan yarı yapılandırılmış görüşme sorularına ebeveynlerin verdiği yanıtlardan elde edilen bulgulara yer verilmiştir. Yarı yapılandırılmış görüşme soruları doğrultusunda aşağıda verilen temalar oluşturulmuştur. Araştırmanın bulguları temalar doğrultusunda sunulmuştur:

Tablo 3. Araştırmanın Temaları

Temalar
Anne- babaların, çocukların internet kullanımı hakkındaki düşünceleri.
Çocuklar için internetteki zararlı içerikler.
Çocukların interneti güvenli kullanması için alınan önlemler.
Çocukların interneti güvenli kullanması için alınması gereken önlemler.
Türkiye'de çocuklar için internetle ilgili yasal düzenlemeler.

Bu bölümde yer alan çocuk ifadesi 6-11 yaş arasındaki okul çağı çocukları için kullanılmıştır.

"Anne-Babaların Çocukların İnternet Kullanımı Hakkındaki Düşünceleri" Temasına İlişkin Bulgular

Anne-babaların çocukların internet kullanımı hakkındaki düşünceleri temasına yönelik iki alt tema oluşturulmuştur. Bunlar, çocukların interneti kullanmasının olumlu yönleri ve çocukların interneti kullanmasının olumsuz yönleridir.

"Çocukların interneti kullanmasının olumlu yönleri" alt temasına ilişkin bulgulara bakıldığında, anne babaların çocukların internet kullanmasının olumlu yönlerine yönelik görüşleri aşağıdaki tabloda verilmiştir.

Tablo 4. Çocukların İnternet Kullanmasının Olumlu Yönleri

Alt Tema	Kategoriler	Frekans (f)	Yüzde (%)
Çocukların interneti kullanmasının olumlu yönleri	Ödev/derslerine yardımcı olması	6	60
	Bilgiye ulaşım sağlaması	1	10
	Zamanını eğlenceli geçirmesini sağlaması	2	20
	Olumlu bir yanı yok	1	10

Çocukların internet kullanmalarının olumlu yönleriyle ilgili "ödev/derslerine yardımcı olması" şeklinde görüş bildiren anne ve babalara ait örnek ifadeler şöyledir:

"… Olumlu yönü, derslerine çok faydası oldu. Hani bir araştırma önüne geliyor veya bir işte derslerle ilgili bir şey yapıyor, kafasına bir şey takılıyor. Misal bir yazarın doğum tarihi hani onu o an evde bulmak mümkün değil. O rahatlığı var. Hemen bir tık karşında" (A2). *"… Zamandan tasarruf sağladığını düşünüyorum. Daha geniş çaplı araştırma yapma imkanı bulduklarını düşünüyorum. Kaynak olarak, çeşitlilik sağladığını düşünüyorum. Görsel olarak karşılaştırma imkanı bulduklarını düşünüyorum"* (B5).

Çocukların internet kullanmalarının olumlu yönleriyle ilgili "bilgiye ulaşım sağlaması" şeklinde görüş bildiren ebeveyne ait örnek ifade şöyledir:

"Her bilgiye ulaşabileceğimiz bir pencere. Yani kullanması gerekiyor." (B3)

"Zamanını eğlenceli geçirmesini sağlaması" görüşünü belirten anne ve babalara ait örnek ifadeler aşağıdaki gibidir:

"*…benim kızım genelde eğlence amaçlı kullanıyor. Sıkıldığı zaman beraber ben de oluyorum tabi ki yanında. Mesela hayvanları seviyor, komik hayvan videoları diye arayıp izleyebiliyoruz. Ya da bazen sevdiği bir şarkı oluyor… Biz daha çok eğlence maksatlı kullandık"* (A5).

İnternetin olumlu bir yanının olmadığı görüşünü dile getiren ebeveynin ifadesi ise şöyledir:

"…benim evde çocuğum sadece bir interneti oyun amaçlı kullanıyor… İnterneti şu an ona hiçbir faydasının olduğunu düşünmüyorum, olumlu olduğunu, bir yanının olduğunu düşünmüyorum açıkçası" (A4).

"Çocukların İnterneti Kullanmasının Olumsuz Yönleri" alt temasına ilişkin bulgulara bakıldığında, anne babaların çocukların internet kullanmasının olumsuz yönlerine yönelik görüşleri aşağıdaki tabloda verilmiştir.

Tablo 5. Çocukların İnterneti Kullanmasının Olumsuz Yönleri

Alt Tema	Kategoriler	(f)	(%)
Çocukların interneti kullanmasının olumsuz yönleri	Çocukların fazla zaman harcaması	6	33
	Uygun olmayan görüntü ve reklamlar	5	28
	Yanlış bilgi sahibi olma	1	5.5
	Oyun karakterlerine özenme	3	17
	Sağlığı etkileme	2	11
	Güvenlik sorunu oluşturma	1	5.5

İnternetin olumsuz yönlerine ait "çocukların fazla zaman harcaması" görüşüne sahip ebeveynlere ait örnek ifadeler şöyledir:

"*Sürekli onla yani boş şeylerle vakit geçirmek istiyorlar. İşte Facebooka gireyim, işte oyun oynayayım, işte film izleyim…"* (A2). *"…fazla internetin başında durmak…"* (B1). *"Takılıp kalmaları, devamlı sitede kalmaları derslerini ihmal etmeleri bunlar olumsuz"(*B2). *"Bağımlılık, aşırı kullanma sonucu bağımlılık, oyun veya vs. bağımlılık olabilir. Bu bağımlılık da çocukları yapması gerekenlerin dışında işler yapmaya yönelterek zamanı boşa harcama noktasında olabilir"* (B4).

İnternetin olumsuz yönlerine ait "uygun olmayan görüntüler ve reklamlar" ı görüş olarak bildiren ebeveynlere ait örnek ifadeler şöyledir:

*"…pat diye bir reklam çıkıyor. Bu işte beni en çok rahatsız eden arkadaş arıyorum reklamları. Bayan*lar *bakıyorsun çıkıyor kenarda küçücük ama uygunsuz fotoğraflar çıkıyor. Bunlar beni çok rahatsız ediyor. Çocuğumun görmesini istemiyorum."* (A2). *"Bir oyun sitesi sitenin adını hatırlamıyorum şu anda. Oyun sitesi, çocuk oyunları ama yan tarafta böyle bir reklamlar yanıp sönüyor ki inanamazsınız… Hani böyle çok kötü ilişkiye davet falan tarzında, tıklasa çok abuk sabuk sitelere girecek."* (A5).

İnternetin olumsuz yönlerine ait "oyunlar ve oyun karakterlerine özenme" yi görüş olarak belirten ebeveynlere ait örnek ifadeler şöyledir:

"*Küçük bir çocuğun makyaj yapmasını heveslendirdi. Orada Sindy bebeklerin kendi kendine saç boyası şöyle giyinilir böyle giyinilir…Bu sefer kendi kıyafetlerini beğenmemeye başladı"* (A3). *"oyun için kullanılıyor olması çok üzücü, hep oyun ve o oyunların ben hep vurdulu kırdılı …zeka açısından kendini geliştiren oyunlar diyorsun çocuk bir defa giriyor. Ondan sonra kesinlikle o oyunlardan zevk almıyor. Farklı, hareketli işte ne bileyim farklı oyunlara yöneliyorlar. Ben bunun olumlu olacağını düşünmüyorum. Tamamen olumsuz*." (A4). *"olumsuz örneklerden hareketle olumsuz davranışlar sergileyebilirler."* (B4)

İnternetin olumsuz yönleri olarak "sağlık sorunu oluşturması" yönünde görüş bildiren ebeveynlere ait örnek ifadeler şöyledir:

"fiziki anlamda çocuk devamlı bir saat boyunca yeri geldiğinde bilgisayarın başında kalıyor. Yani o omurgaların o kemik yapısının kesinlikle zarar göreceğini düşünüyorum."(A4*). "Temel olarak ben obezitenin arttığını düşünüyorum. İnsanların hantallaştırdığını, tembelleştirdiğini düşünüyorum."* (B5).

İnternetin olumsuz yönü olarak "yanlış bilgi sahibi olma" yönünde görüş bildiren ebeveyne ait ifade şöyledir:

"Olumsuz yönleri gereksiz bilgi sahibi olabilirler. Doğru veya yanlışları kanıtlanmayan bilgilere sahip olabilirler." (B4).

İnternetin olumsuz yönü olarak "güvenlik sorunu oluşturma" yı görüş olarak bildiren ebeveyne ait örnek ifade şöyledir:

"Güvenlik sorunları yaşayıp, yani yanlış kişilerle irtibata geçebilir. Geçenlerde bir gazetede okumuştum. Çocuklar, iki erkek kardeş internette sörf yaparken bir karşı taraftan mesaj geliyor. Şu anda sizi gözetliyoruz diye. Ve çocukların bilgisayarın kamerasından çektikleri fotoğraflarını yolluyorlar. Sonra işte şu gün şu saatte, şuraya geleceksiniz gibi şantajlar yapıyorlar ...Dolayısıyla zararlarının güvenlik boyutuyla ve gayri ahlaki siteler boyutuyla çok fazla olduğunu düşünüyorum." (A5).

"Çocuklar İçin İnternetteki Zararlı İçerikler" Temasına İlişkin Bulgular

Araştırmanın "Çocuklar İçin İnternetteki Zararlı İçerikler" temasının analizi sonucu elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 6. Çocuklar İçin İnternetteki Zararlı İçerikler

Ana Tema	Alt Temalar	(f)	(%)
Çocuklar için internetteki zararlı içerikler	Reklamlar	4	18
	Uygun olmayan görüntü içeren siteler	3	14
	Kumar siteleri	2	9
	Arkadaşlık siteleri	3	14
	Oyunlar	4	18
	Bölücülük içeren siteleri	1	4
	Sosyal paylaşım siteleri	5	23

Çocuklar için zararlı içerik olarak anneler genel olarak uygun olmayan reklamları, babalar ise arkadaşlık sitelerini dile getirmişlerdir.

Çocuklar için zararlı içerik olarak "reklamlar" görüşüne sahip ebeveynlere ait örnek ifadeler şöyledir:

"*Mesela şu ürünün satılması ister istemez o ürünü almak istiyor ne olduğunu bilmeden, tam anlamadan çünkü benim çocuğumun yaşı küçük daha. Daha tam bilinçlenmemiş…hemen önce reklamlara giriyor. Tamam, ben reklamımı geçtim diyelim, girdim içeriye o an belki çocuğum açmış olabilir. O yüzden korkuyorum." (A1). "…Her türlü reklamın çıkıyor olması rahatsızlık verici."* (A4).

Çocuklar için zararlı içerik olarak "arkadaşlık sitelerini" dile getiren ebeveyne ait örnek ifade şöyledir:

"*Arkadaş siteleri, kötü oyun siteleri ondan sonra nasıl diyeyim diğer her türlü kötü sitelere olumsuz olarak görüyorum… tanışma siteleri var. Yani bunlar olacak şeyler değil.*" (B2).

Çocuklar için zararlı içerik olarak "kumar sitelerini" dile getiren ebeveynlere ait örnek ifadeler şöyledir:

"*…kumar siteleri vs. var. Şu an benim kızım 8 yaşında, çok dikkatini çekmiyor. Belki erkek çocuğu olsaydı, biraz daha dikkatini çekip, bu ne diyip kurcalayabilirdi. Bu tarz bahis siteleri, kumar siteleri…"*(A5)

Çocuklar için zararlı içerik olarak "bölücülük içeren siteleri" dile getiren ebeveyne ait örnek ifade şöyledir:

" … bölücü hoş olmayan bu tarz sitelere her şeye çok rahat ulaşılabilindiği için internette bunlar tehlike." (A5)

Çocuklar için zararlı içerik olarak "uygun olmayan görüntü içeren siteleri" dile getiren ebeveynlere ait örnek ifadeler şöyledir:

"*anne olarak şu an yaşadığım, bir gayri ahlaki şeylere girilebilme ihtimalini okulda yaşamışlar... Özel okulda okuyor kızım, bilgisayar dersleri var. Bilgisayar laboratuarına gittiklerinde daha birinci sınıftaydı, geçen yıl. Böyle şikayet geldi birkaç veliden, işte bunlar abuk sabuk yerler açmışlar derste. Hoca biraz bir şeyle işleyip son on dakika serbest bırakmış bunları, oyun oynayın diye. Bunlar da böyle birbirine hadi şuna bakalım, buna* *bakalım. Böyle açık seçik resimlere bakmışlar…baya bir sıkıntı olmuştu veliler arasında. Ben de çocuğuma çok kızmıştım. Niye böyle bir şey yaptın diye ama biraz merak duygusu da oluyor tabi çocuklarda.”* (A5).

Çocuklar için “oyunları” zararlı içerik olarak dile getiren ebeveynlere ait örnek ifadeler şöyledir:

“Zararlı içerikler, oyunlar, bazı oyunlar özellikle çizgi film karakterleri, Superman gibi uçan, Örümcekadam gibi bunlardan olumsuz şekilde etkilenebilir…Süper kahraman gibi olmaya çalışabiliyor veya onlar gibi konuşmaya çalışıyor. Bu noktada bunları olumsuz olarak görüyorum. Yine olumsuz örnek teşkil edecek, aile ilişkilerini zedeleyecek farklı şeyler oluyor. Bunları gördüklerinde olumsuz şekilde etkilenebilirler.” (B4).

“…o kadar canavarlı böyle vurdu kırdılı öldürdü kanlı şeyler var onlar beni çok rahatsız ediyor…İstemiyorum ama çocuğum oynamak istiyor. İzin vermiyorum. O konuda da sıkıntımız oluyor olmuyor değil…Yani normal geliyor çocuğa. Onu oynuyor karşısındakini öldürüyor, onun kanı akıyor. Yani bu tür şeylerin normal olmaması yani normal gelmemesi lazım. Onu çocuk oynaya oynaya…bak şu kadar adam öldürdüm... Bilinç altında ilerde normal olarak karşılayabileceğini düşünüyorum. Etkileneceğini düşünüyorum çocukların.” (A2).

Çocukların “sosyal paylaşım sitelerine” girmelerini uygun bulmayan ebeveynlere ait örnek ifadeler şöyledir:

“…görüşmelerine birkaç defa şahit oldum. Arkadaşlarıyla o kadar kötü, küfürlü denecek derecede konuşmaları var. Kendi kullanmasa bile arkadaşı yazıyor…yazarken de insanlar çok daha rahat yazıyor galiba arkadaşları. Birinde hatta uyarı yazdım arkadaşına. Ben işte şu arkadaşının annesiyim. Bunu yazmandan çok rahatsızlık duydum. Sana yakıştıramadım. Hatta bana cevap verdi. Özür diliyorum, dedi bana. Ben onu isteyerek kullanmadım, dedi. Ama ben her zaman böyle takip etmeyebilirim. Senin de annen görse çok üzülürdü diye, ona bir uyarı yazdım. Çok rahatsızım…Yani gerek yok, paylaşımlarını aşağıda sokakta yapsınlar…bir şeyden yazışmaya gerek yok. Çünkü onların, bence yüz yüze paylaşıma ihtiyacı var. Beraber oynamaya beraber vakit geçirmeye ihtiyaçları var.”(A4).

“Kesinlikle doğru bulmuyorum. Eğer çocuklar gerçekten Facebooku merak ediyorlarsa mesela annelerinin veya babalarının olabilir. Buradan yazışabilirler ama kendi hesaplarının olmasını doğru bulmuyorum. Çünkü çok nahoş teklifler gelebilir. Tanımadıkları insanlardan veya başka bir çocuk gibi birisi profille arkadaşlık teklifi gönderebilir ama. Çocuk su istimalleri son zamanlarda fazla arttığı için sosyal medya, bu saf, temiz, cahil çocuklar için gerçekten bir tuzak olabiliyor. Doğru bulmuyorum.” (A5)

“Çocukların İnterneti Güvenli Kullanmaları İçin Alınan Önlemler” Temasına İlişkin Bulgular

Araştırmanın “Çocukların İnterneti Güvenli Kullanmaları İçin Alınan Önlemler” teması analiz edilerek elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 7. Çocukların İnterneti Güvenli Kullanmaları İçin Alınan Önlemler

Ana Tema	Alt Temalar	(f)	(%)
Çocukların interneti güvenli kullanmaları için alınan önlemler	Filtre kullanma	5	12
	Süre kısıtlaması yapma	8	19
	Çoğunlukla interneti beraber kullanma	7	17
	Takip etme	3	7
	Güvenlik yazılımları kullanma	9	21
	İnternet hakkında çocuğu bilinçlendirme	7	17
	Bilgisayarı ortak alanlarda bulundurma	3	7

Çocukların interneti güvenli kullanmalarına yönelik “filtre kullanma” önlemini alan ebeveynlere ait örnek ifadeler şöyledir:

“*Bir aile profiline geçtim mesela. Her içerik görüntülenmiyor.”* (B4). *“Aile profili kullanıyoruz. Yani en azından hani uygunsuz sitelere giremiyorlar”* (A2).

Çocukların interneti güvenli kullanmalarına yönelik “süre kısıtlaması yapma” önlemini alan ebeveynlere ait örnek ifadeler şöyledir:

“*…tatillerde bir saati aştırmıyoruz zaten bunu oyunda kullanıyorlar ama yine de sürekli göz altında tutuyoruz”* (A2). *“Yani en fazla 15-20 dakika kadar. Beraber bir şeyler izliyoruz. Bazen bir çizgi film, animasyon, sinema açıp beraber izleriz. O zaman belki süre uzayabiliyor ama sıkıldıysa biraz bir şeyler bakacaksa 15-20 dakika kadar biraz videolara vs. bakıp kapatıyoruz daha sonra”* (A5).

Çocukların interneti güvenli kullanmalarına yönelik "çoğunlukla interneti beraber kullanma" önlemini alan ebeveynlere ait örnek ifadeler şöyledir:

"eğer ödev noktasında yardımcı olacaksa beraber kullanıyoruz. Eğer oyun oynayacaksa belirli bir süre yarım saat hakkınız var deyip yine ben açarak veya annesi açarak bu şekilde önlem alıyorum." (B4*)." Ödevini yaptı, bir boş saati var…zararlı programlar olduğu için yani tek de bırakamıyorum çocuğumu."* (A1).

Çocukların interneti güvenli kullanmalarına yönelik "takip etme" önlemini alan ebeveynlere ait örnek ifadeler şöyledir:

"Kendisi bilgisayarın başına geçtiği vakit, biz uzaktan, o farkında olmadan kontrol ediyoruz. Tabi kontrol sürekli değil ara ara. Sakınca görmüyoruz girdiği yerlere, girdiği sitelere. Bu şekil devam ediyor." (B5). *"kontrollü olduğunu kendileri öyle zannediyor ama aslında çok da takip edemiyorum… yanımda ama beraber değilim."* (A4).

Çocukların interneti güvenli kullanmalarına yönelik "güvenlik yazılımı kullanma" önlemini alan ebeveynlere ait örnek ifadeler şöyledir:

"Anti virüs programları… onu kullanıyoruz…Muhakkak faydası vardır. Bilgisayara farklı yerlerden mailler gelmesini önlüyor." (A4).

Çocukların interneti güvenli kullanmalarına yönelik "internet hakkında bilinçlendirme" önlemini alan ebeveynlere ait örnek ifadeler şöyledir:

"Ders siteleri, oyun sitelerinin kendisine yönelik biraz yaşına uygun olarak oynamasını, kötü sitelere girmemesini, çıkan kötü sitelerin kapatılmasını bilinçlendirerek…açıklamasını yaptım." (B2). *"Çocuğun sürekli internette değil gerektiği zaman internet kullanması gerektiğini o bilinci vermeye çalışıyoruz. Zaten onu verdiğimiz gibi görüyorum. Onun için çocuk kendisi ne zaman isterse giriyor çıkıyor."* (B3).

Çocuğunu kontrol edebilmek için bilgisayarı ortak alanlarda bulunduran ebeveyne ait örnek ifade:

"…yanımda olması sanki bana daha güven veriyor. Mutfakta kullandırtıyorum.…İlk başta odada olmasını istemiyorum. Çünkü orada sanki daha kontrol elimden çıkmış, her şeye çok rahat girebileceği hissi çocukta oluşmasın istiyorum." (A4).

"Çocukların İnterneti Güvenli Kullanmaları İçin Alınması Gereken Önlemler" Temasına İlişkin Bulgular

Araştırmanın "Çocukların İnterneti Güvenli Kullanmaları İçin Alınması Gereken Önlemler" teması analiz edilerek elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 8. Çocukların İnterneti Güvenli Kullanmaları İçin Alınması Gereken Önlemler

Ana Tema	Alt Temalar	(f)	(%)
Çocukların internet güvenli kullanmaları için alınması gereken önlemler	Ebeveyn kontrolü olmalı	6	33
	Çocukları internet konusunda bilinçlendirme	3	17
	Yasalarla önlem alınmalı	8	44
	Web sitelerinde uyarıcılar olmalı	1	6

Çocukların interneti güvenli kullanmaları konusunda "ebeveyn kontrolü olmalı" görüşüne sahip anne babalara ait örnek ifadeler şöyledir:

"*Şimdi en büyük sorumluluk aileye düşüyor kesinlikle. Ailenin küçük yaşlar için koruyucu kollayıcı olması lazım, büyük yaşlar için de rehberlik edici olması lazım."* (A5). *"En iyi kontrol altında tutmak."* (B1).

Çocukların interneti güvenli kullanmaları konusunda "çocukları internet konusunda bilinçlendirme" görüşüne sahip anne babalara ait örnek ifadeler:

"…anne babanın kontrol altında çocuklarını kontrol edebilecek belki veya çocuklara belirli bir yani sürekli başında duran değil de yani o otokontrolü sağlayarak uygun bir şekilde kullanmayı öğretebilmeli."(B4). *"…kesinlikle çocuk, çocuklarımız internetin, hangi amaçlarla kullanılması gerektiğini, ne kadar süreyle*

kullanılması gerektiğini, bilmeli, bilinçlendirilmeli bu konuda. İhtiyaç duydukça interneti kullanmalı. İnternet bir lüks olmaktan çıkıp, hani ihtiyaç duyuldukça kullanılan bir durum haline getirilmeli. Hani insanlar acıkınca yemek yerler. Yemeğini yer kalkarlar. Böyle normal sıradan bir şey olmalı. İhtiyaç duyulursa girilir. İşte problem, sıkıntı her neyse, ihtiyaç giderilip normal yaşamına devam etmeli. Öncelikle bunun çocuklara verilmesi gerekiyor."(B5).

Çocukların interneti güvenli kullanmaları konusunda "yasalarla önlem alınmalı" görüşüne sahip anne babalara ait örnek ifadeler şöyledir:

"Bu konuda kesinlikle yasal düzenlemelerin olması gerekiyor. Hani ebeveyn olarak bir yere kadar kısıtlarsın. Diyorum almak istemediğim halde almak zorunda kaldım interneti eve. Elimden geldiğince kısıtlıyorum ama yeterli olmadığını düşünüyorum."(A2). *"…önlem kesinlikle tabi ki devletimiz var. Devletimiz kesinlikle önlem almalı. Eğer bize zarar verecek bir şeyler varsa çocuklarımıza zarar verebilecek, topluma zarar verebilecek, toplumu yanlış yönlendirmeye zarar verecek şeyler yapılıyorsa kesinlikle devlet buna Çin Seddi gibi Seddi koymalı. Zararlı olan topluma, milletimize, vatanımıza, bayrağımıza zararlı olan ne varsa devlet kesinlikle buna Seddi koymalı ki ben bu Seddi koyacağına inanıyorum, güveniyorum."* (B3).

Çocukların interneti güvenli kullanmaları konusunda "web sitelerinde uyarıcılar olmalı" görüşüne sahip anne babalara ait örnek ifadeler şöyledir:

"…sürekli alt yazı geçsin altından…bilgisayarın altından ya da o siteye girdiğin anda. Mesela bunun olumlu veya olumsuz olduğuna dair örnek bir işaret olsun orda." (A1).

"Türkiye'deki Çocuklar İçin İnternet İle İlgili Yasal Düzenlemeler" Temasına İlişkin Bulgular

Araştırmanın "Türkiye'deki Çocuklar İçin İnternet ile İlgili Yasal Düzenlemeler" teması analiz edilerek elde edilen bulgular aşağıdaki tabloda verilmiştir.

Tablo 9. Türkiye'de Çocuklar İçin İnternetle İlgili Yasal Düzenlemeler

Ana Tema	Alt Temalar	(f)	(%)
Türkiye'de çocuklar için internetle ilgili yasal düzenlemeler	Bilgi sahibi değilim	4	33
	Olumsuz durumlar olduğunda yasal düzenlemelerin olması gerekir	8	67

Türkiye'de çocuklar için internet ile ilgili yasal düzenlemeler konusunda "bilgi sahibi değilim" şeklinde görüş bildiren ebeveynlere ait örnek ifadeler şöyledir:

"*Yasal düzenlemeler nedir? Hangi durumdadır? Neler gerekiyor? Bunlarla ilgili çok fazla bilgimiz yok."* (B5)
"*Yasal düzenlemeler hakkında fazla bir bilgim yok şu an."* (A3)

Türkiye'de çocuklar için internet ile ilgili yasal düzenlemeler konusunda "yasal düzenlemelerin olması gerekir" şeklinde görüş bildiren ebeveynlere ait örnek ifadeler şöyledir:

"*Bazı şeylerin ben de isterim kapatılmasını….daha önce olumsuz olanların kapatılmasını isterim. Yasaya saygımız sonsuz. Yani onlar daha iyi bilir bizden…Türk aile yapısına göre nasıl olumsuz örnekler var? Onların güzel anlatılması için kapatılmasını isterim." (A1).* "*Bir dönem çok tepki gösterildi, ama ben doğru olduğunu düşünüyorum. Çünkü zaten zorunlu bir şey değildi. Yani isteyen bu filtreleri kullanacaktı. Çünkü olması gereken bir şey, böyle her türlü şeyin internette olmasının serbestçe dolaştığını düşünürsek bir filtreleme sistemi olması lazım. Ama bu baştan yanlış lanse edildi. Sanki böyle sansürmüş gibi, birileri bir şeyleri kısıtlıyormuş gibi lanse edildi ve gereksiz tepkilere yol açtı bence. Her halde bu işin aslı anlaşıldıktan sonra da insanlar tepkilerinde pişman olmuşlardır diye düşünüyorum. İsteyen filtresini aldı. İstemeyen aynı şekilde her türlü siteye girebiliyor. Zaten demokrasi de bunu gerektirir. Olması gereken bir şey ama. Bu imkanı, filtreleme imkanının sağlanması lazım"* (A5). *"…çocuklar şu an belirli bir yaş döneminde oldukları için doğruyu veya yanlışı ayırt etme noktasında yanlışa düşebilirler. Bu noktada böyle bir yasal düzenlemenin olmasını yerinde buluyorum.*"(B4)

SONUÇ VE ÖNERİLER

Sonuçlar

Çocukların internet kullanımıyla ilgili anne babaların görüşleri incelendiğinde ebeveynler internetin olumlu yanı olarak çoğunlukla çocukların ödev/derslerine yardımcı olacağını belirtmekteler. RTÜK (2006) tarafından yapılan araştırmada da aileler çocukların daha çok interneti ödev ve derslere yardımcı olması, oyun/eğlence ve chat/e-mail amacıyla kullandıklarını düşündükleri sonucuna ulaşılmıştır. Araştırmada internetin en fazla çocukların ödev/ derslerine yardımcı olacağı görüşü, Devlet İstatistik Kurumu (2013) tarafından gerçekleştirilen araştırmada çocukların en çok ödev veya öğrenme amacıyla interneti kullanma sonucuyla paralel doğrultudadır. Aynı şekilde Avrupa Çevrim İçi Çocuklar Projesi (2010) Türkiye bulgularında yer alan çocukların internet kullanma durumlarıyla da örtüşmektedir.

Araştırmada anne ve babalar internetin olumsuz yanı olarak çocukların internette fazla zaman harcaması, uygun olmayan görüntü ve reklamlarla karşılaşma olasılıklarının olması, oynadıkları oyundaki karakterlere özenmeleri ve internet başında geçirilen süreden dolayı sağlık sorunlarının oluşmasını belirtmişlerdir. İnternet başında geçirilen süreden dolayı sağlık sorunları oluşturması, T.C Başbakanlık Aile ve Sosyal Araştırmalar Genel Müdürlüğü (2008) tarafından yapılan araştırma sonucunda ebeveyn ve çocukların internet başında geçirdikleri süre arttıkça çevreleriyle olan iletişimde sıkıntı yaşamaları ile fizyolojik ve psikolojik sorunlar yaşamaları sonucuyla örtüşmektedir.

Anne ve babaların internette çocukları için, reklamlar, uygun olmayan görüntü içeren siteler, kumar siteleri, arkadaşlık siteleri, oyunlar ve sosyal paylaşım sitelerini zararlı içerik olarak görmektedirler. Anne ve babaların zararlı içerik olarak gördüğü siteler antivirüs yazılımı firmaları Bitdefender (2013) ve Karpeksy Lab (2014) araştırmasında da ebeveynlerin en çok engellediği, istemedikleri siteler arasında yer almaktadır. Aynı zamanda T.C. Başbakanlık Aile ve Sosyal Araştırmalar Genel Müdürlüğü (2008) tarafından yapılan araştırmada yer alan ebeveynlerin tehlike oluşturabilecek içerik konusunda pornografi, şiddet, terör ve kumar oynama siteleri olduğu görüşüyle de uyuşmaktadır. Ulaştırma bakanlığı (2011) tarafından yapılan araştırmaya göre çocukların büyük bir kısmının sosyal paylaşım sitelerini kullandıkları belirlenmiştir. Aksüt, Ateş, Balaban ve Çelikkanat (2012)'ın çalışmasında ilköğretim öğrencileri sosyal paylaşım sitelerine (Facebook) yararlı ve populerliğin göstergesi bakış açısına sahip iken, araştırmaya katılan ebeveynler zararlı içerik olarak görmektedirler.

Anne babalar çocuklarının interneti güvenli kullanması için filtre kullanma, süre kısıtlaması yapma, interneti çocuğuyla beraber kullanma, çocuğu internete girdiğinde takip etme, internet hakkında çocuğunu bilinçlendirme ve güvenlik yazılımları kullanma şeklinde önlemler aldıkları belirlenmiştir. Aksüt, Özer, Gündüz ve Kaşıkçı (2008)'nın araştırmasında ise ebeveynler ise çocukların internete girdiğinde uygun olmayan sitelere karşı önlem alınması, internet evleri ve okuldaki bilgi teknoloji sınıflarının sık sık denetlenmesi, çocukların internet evlerine büyükleriyle birlikte gitmesi ve habersiz gittiklerinde ceza verdikleri şeklinde bir tutum sergiledikleri sonucuna ulaşılmıştır. Ayas ve Horzum (2013)' un çalışmasında ise ailelerin çocukların internet kullanımıyla ilgili en çok ihmalkar aile tutumunda oldukları sonucuna ulaşılmıştır. Odabaşı (2005)' nın yaptığı çalışmada ise ebeveynlerin güvenlik konularından habersiz olduğu, Kırık (2014)'ın yaptığı araştırmada ise ebeveynlerin büyük çoğunluğunun internetin zararlı içeriklerinden çocuklarını korumak için herhangi bir girişimlerinin olmadığı belirli bir kısmının ise filtre ve özel yazılımlar kullandığı sonucuna ulaşılmıştır. Demirel, Yörük ve Özkan'ın (2012) yaptıkları çalışmalarında katılımcıların % 36.9'u filtre kullanmakta ve filtre kullanan ebeveynlerin % 87.1'i aile profili kullanmaktadır. Günel, Turhal ve İmal (2010)'ın çalışmasında da internette en fazla aile koruma şifresi tercih edilmektedir. Araştırmada da ebeveynlerin filtre kullanım oranı % 12'dir. Filtre kullanan ebeveynler ise en çok aile profilini tercih etmektedir.

Araştırmada çocukların interneti güvenli kullanmaları için alınan önlemlerde bilgisayarı ortak alanlarda bulundurulması (f=3) en az alınan önlemlerden biri olmuştur. RTÜK (2013) tarafından yapılan araştırmada iletişim araçlarından ilk sırada bilgisayar/tablet ikinci sırada olarak internetin çocukların kendilerine ait odada bulunduğu sonucuyla aynıdır.

Çocukların güvenli internet kullanabilmeleri için anne-babalar, ebeveyn kontrolü, internet konusunda çocuğu bilinçlendirme ve yasalarla önlem alınması gerektiğini düşünmekteler. Çocukların güvenli internet kullanmaları konusunda anne ve babalar Türkiye'deki yasal düzenlemeler hakkında bilgi sahibi olmadıklarını belirtmişlerdir. Ancak anne ve babalar çocukların interneti güvenli bir şekilde kullanabilmeleri için yasal düzenlemelerin olması gerektiğini düşünmekteler.

Öneriler

Uygulayıcılar İçin Öneriler

1. Okul çağı çocuklarına sahip anne ve babalar için bilgisayar ve internet kullanımıyla ilgili okullarda ya da Halk Eğitim Merkezlerinde ücretsiz kurslar açılmalı ve bu kurslara anne ve babaların katılımı sağlanmalıdır.

2. İnternet sağlayıcılar tarafından eski ve yeni internet kullanıcılarına aile ve çocuk profili seçenekleri hakkında bilgi verilmesi sağlanmalıdır. Böylece ailelerin profil seçenekleri hakkında bilgi sahibi olması sağlanmalıdır.

3. Kamu spotu adı altında en yaygın iletişim aracı olan televizyonlarda aile ve çocuk profili, güvenlik yazılımları, bilinçli internet kullanma, internet bağımlılığı gibi başlıklarda bilgilendirici reklamlar yayınlanmalıdır.

4. Okullarda anne ve babalara, çocukları için internetin olumlu-olumsuz etkileri hakkında ve internet konusunda yaşanabilecek sıkıntılar doğrultusunda yol gösterici seminerler düzenlenmelidir.

Araştırmacılar İçin Öneriler

1. Bu çalışmada nitel araştırma yaklaşımı benimsenerek görüşme tekniği kullanılmış ve 10 anne-babaya ulaşılmıştır. Çocukların güvenli internet kullanmaları konusunda daha geniş çaplı çalışmalar daha fazla anne ve babaya ulaşılabilir.

2. Bu çalışmada 6-11 yaş arasındaki okul çağı çocuklarının anne ve babalarıyla görüşme yapılmıştır. Farklı yaş gruplarıyla çalışma yapılabilir.

3. Ebeveynlere çocukların güvenli internet kullanımlarına yönelik seminer verilerek uygulamalı çalışmalar yapılabilir.

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EKLER

Ek 1. Görüşme Formu

Kişisel Bilgiler

Anne ( ) Baba ( )

Yaş: …………......……………………………………………………………..

Meslek:…………………………………………………………………………

Öğrenim Durumu:……………………………………………………………….

Çocuk Sayısı ve Yaşı:……………………………………………………………

İnternet Kullanım Süreniz:……………………………………………………..

Çocuklarca İnternet Kullanımı Araştırmasında Anne-Baba Görüşme Formu

Bu araştırmada 6-11 yaş arasındaki çocukların interneti güvenli kullanmalarına yönelik anne-baba görüşlerinin alınması amaçlanmaktadır. Bu nedenle sizin gibi okul çağı çocukları olan, evlerinde bilgisayar ve internet bağlantısına sahip anne- babaların görüşlerinden yararlanmak istiyorum. Özellikle belirtmek isterim ki yaptığım görüşmeler sadece bu araştırma için kullanılacaktır. Kişisel bilgileriniz gizli kalacaktır. Zamanı daha verimli kullanmak için görüşmeyi kaydetmek istiyorum. Araştırmaya katılıp görüşme yaptığınız için size şimdiden teşekkür ederim.

Sorular

1. Çocukların internet kullanımı hakkında düşünceleriniz nelerdir?
    1.1 Sizce çocukların interneti kullanmasının olumlu yönleri nelerdir?
    1.2 Sizce çocukların interneti kullanmasının olumsuz yönleri nelerdir?
2. Çocuklarınız için internette zararlı içerik olarak neyi/neleri düşünüyorsunuz?
3. Çocuklarınızın interneti güvenli kullanmaları konusunda ne gibi önlemler almaktasınız?
4. Türkiye'deki internet ile ilgili yasal düzenlemeleri nasıl değerlendiriyorsunuz?
5. Sizce çocukların interneti güvenli kullanmaları konusunda alınması gereken önlemler nelerdir?

ATTITUDES OF PRE-SCHOOL TEACHERS TOWARDS USING INFORMATION AND COMMUNICATION TECHNOLOGIES

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ABSTRACT: The aim of the study is to determine the attitudes of pre-school teachers towards using technological tools and to analyze it in terms of different variables. The research was conducted based on descriptive study model.

Working group was consisted of 103 teachers working at kindergartens in city center of Kırsehir and Malatya in the fall semester of 2014-2015 academic years. A personal information form created by researchers and "The Scale of Attitudes towards Using Technological Tools in Preschool Education "developed by Kol (2012) were used to collect data

Frequency, percentage, mean and standard deviation were used in order to analyze the data T-test for independent samples and one-way variance analysis were used in order to determine the relationships between variables.

As a result of the study, the teachers showed a very positive attitude towards using technological tools. It was found out that pre-school education graduate teachers showed a more positive attitudes towards using technological tools as comparing with the distance education graduate pre-school teachers.

Key words: information and communication technologies, early childhood education

OKUL ÖNCESİ ÖĞRETMENLERİNİN BİLGİ VE İLETİŞİM TEKNOLOJİLERİ KULLANIMINA YÖNELİK TUTUMLARI

ÖZET: Bu çalışmanın amacı okul öncesi öğretmenlerinin teknolojik araç-gereç kullanımına yönelik tutumlarının belirlenmesi ve çeşitli değişkenler açısından incelenmesidir. Araştırma, tarama modeline dayalı betimsel bir çalışmadır.

Araştırmanın çalışma grubu, 2014-2015 eğitim öğretim yılı güz yarıyılında Malatya ve Kırşehir il merkezinde faaliyet gösteren bağımsız anaokullarında çalışan 103 öğretmenden oluşmaktadır. Veri toplamak amacıyla, araştırmacılar tarafından oluşturulan kişisel bilgi formu ve Kol (2012) tarafından geliştirilen "Okul Öncesi Eğitimde Teknolojik Araç-Gereç Kullanımına Yönelik Tutum Ölçeği" kullanılmıştır.

Verilerin betimlenmesi amacıyla frekans, yüzde, ortalama, standart sapma kullanılmıştır. Değişkenler arası ilişkileri belirlemek amacıyla ise bağımsız gruplar için t testi ve tek yönlü varyans analizi kullanılmıştır.

Araştırma sonunda öğretmenlerin teknolojik araç gereç kullanımına yönelik oldukça pozitif bir tutum sergiledikleri görülmüştür. Eğitim fakültesi mezunu okul öncesi öğretmenlerinin açıköğretim mezunu okul öncesi öğretmenlerine göre teknolojik araç gereç kullanımı hususunda daha olumlu bir tutum sergiledikleri belirlenmiştir.

Anahtar sözcükler: bilgi ve iletişim teknolojileri, okul öncesi eğitim

GİRİŞ

Günümüzde insanlar hızla artan bir şekilde çeşitli bilgi ve becerilerle karşı karşıya kalmaktadırlar. Öğretmenlik mesleği sadece yeni bir dersi öğretmeyle sınırlı kalmayarak pedagojik bir rol geliştirilmesini de gerektirmektedir. Öğretmenler yeni metodları ve teknolojileri kulanmak istemeleri durumunda pedagojik rollerini değiştirmeleri gerekmektedirler (Kalogiannakis, 2010). Bu değişime neden olacak teknolojilerin başında ise bilgi ve iletişim teknolojileri (BİT) gelmektedir.

2000'li yıllara kadar öğretmen eğitim programları öğretmenleri okulların işlevlerine ve geleneksel rollerine paralel görevleri yapmaları amacını taşımıştır. Son onbeş yılda ise BİT okullarda günlük yaşamın bir parçası haline gelmiştir. Bugün, "Eğitimde bilgisayar kullanılmalı mı?" sorusu yerini "Bilgisayarları eğitimde en etkili ve verimli biçimde nasıl kullanmalıyız?" sorusuna bırakmıştır (Yaşar, 2004). Ancak, öğretmen eğitiminin yapısını değiştirmek bürokratik ve kurumsal meseleleri barındırdığı için kolay bir süreç olarak gözükmemektedir.

Okul öncesi ortamları teknoloji kullanımına yönelik pek çok çözülmemiş tartışmayı barındırmaktadır. Bazı eğitimciler okul öncesi eğitimde teknoloji kullanımının zararlı ve verimsiz olduğunu savunurken, diğerleri BİT'in çocukların gelişimi destekleyebilecek eşsiz bir araç olduğunu belirtmişlerdir (McPake, Plowman & Stephen, 2013).

Okul Öncesi Öğretmenlerine Göre Okul Öncesi Eğitimde Teknoloji

Okul öncesi öğretmenleri çocukların öğrenmesine etki eden başlıca kişiler arasında olduğu için BİT'e karşı tutumlarını anlamak son derece önemlidir. Ancak Türkiye'de okul öncesi öğretmenlerinin BİT'e karşı tutumlarını inceleyen çok az çalışma mevcuttur.

Literatürde mevcut çalışmalar incelendiğinde okul öncesi öğretmenlerinin teknoloji kullanımına yönelik olumlu tutum sergiledikleri görülmektedir (Konca, 2014). Okul öncesi öğretmenleri teknoloji kullanımının çocukların başarısını ve öğrenmesini desteklerken aynı zamanda bu teknolojiyi kullanmanın zor olduğunu belirtmektedirler. Ayrıca öğretmenler çalıştıkları kurum tarafından donanım ve teknik destek konusunda sıkıntı yaşadıkları belirlenmiştir (Kabadayı, 2006). Okul öncesi öğretmenlerinin eğitim süreçlerinde BİT kullanımları incelendiğinde ise çoğunlukla plan hazırlarken ve müzik aktivitelerinde kullandıkları görülmüştür. Aynı zamanda, okul öncesi öğretmenlerinin BİT'e karşı tutumları, çocukların BİT'e karşı tutumlarını etkileyerek motivasyonlarını artırdığı tespit edilmiştir (Yurt, Cevher-Kalburan, 2011).

Okul öncesi öğretmen adaylarının BİT'e karşı tutumları incelendiğinde, öğretmen adaylarının da BİT kullanımına yönelik olumlu tutum sergiledikleri tespit edilmiştir (Oğuz, Ellez, Akamca, Kesercioğlu, Girgin, 2011). Ancak araştırmalar okul öncesi öğretmen adaylarının lisansta BİT ile ilgili aldıkları derslerle okul öncesi eğitim ortamlarında ulaşmaları beklenen BİT kullanım düzeyleri arasında bir boşluk olduğunu göstermektedir (Kalogiannakis, 2010). Temel bilgisayar kullanım becerileri BİT okuryazarlığının temellerini oluşturmaktadır ancak okul öncesi öğretmenlerinin BİT'i eğitim süreçlerine dâhil etmelerine yeterli değildir (Wetzel, Wilhelm, Williams, 2004). Okul öncesi öğretmenleri ve öğretmen adaylarının yeni teknolojileri kullanmaya yönelik nasıl eğitim aldıklarını belirlemek ve bu eğitimi geliştirmek, okul öncesi öğretmenlerinin teknoloji kullanımlarında son derece önemlidir (Yıldırım, 2000; Chen, Chang, 2006). Okul öncesi öğretmen adaylarının bu alanda eğitilmesi, BİT'in okul öncesi eğitimdeki rolünü belirleyici olacaktır (Kalogiannakis, 2010).

YÖNTEM

Bu araştırma nicel araştırma niteliğindedir. Popülâsyonun özelliklerini ve farklılıklara neden olabilecek muhtemel nedenleri belirlemek amacıyla veri toplama sürecinde tarama yöntemi kullanılmıştır (Frankel & Wallen, 2009). İlk olarak, okul öncesi öğretmenlerinin BİT'e yönelik tutumları betimlenmeye çalışılmıştır. Daha sonra okul öncesi öğretmenlerinin BİT'e yönelik tutumları demografik özelliklerine göre karşılaştırılmıştır.

Örneklem

Araştırmaya Kırşehir ve Malatya illerinde görev yapmakta olan 103 okul öncesi öğretmeni katılmıştır. Basit seçkisiz örnekleme yöntemi kullanılarak tüm popülâsyonu temsil edebilecek bir örneklem oluşturulması hedeflenmiştir (Frankel & Wallen, 2009). Örneklemde yer alan öğretmenlere ilişkin kişisel bilgiler ile ilgili bulgulara aşağıda yer verilmiştir.

Tablo 1.

Değişkenler		N	%
Yaş	21-30	47	45,6
	31-40	46	44,7
	41+	10	9,7
Cinsiyet	K	98	95,1
	E	5	4,9
Eğitim	Açıköğretim	12	11,7
	Eğitim F	91	88,3
Kıdem	1-5 yıl	27	27,3
	6-10 yıl	42	42,4
	11-15 yıl	19	19,2
	16+	11	11,1

Veri Toplama Süreci ve Analiz

Araştırma kapsamında veri toplamak amacıyla Kol (2012) tarafından geliştirilen "Okul Öncesi Eğitimde Teknolojik Araç-Gereç Kullanımına Yönelik Tutum Ölçeği" kullanılmıştır. Bu ölçek 14'ü olumlu, 6'si olumlu olmak üzere beşli likert tipi 20 maddeden oluşmaktadır. Güvenirlik çalışması sonucu Cronbach Alpha güvenirlik katsayısı 0,92 olarak hesaplanmıştır. Ölçekte alınabilecek en düşük puan 1, en yüksek puan ise 5'tir. Ölçekten yüksek puan alınması, okul öncesi öğretmeninin teknolojik araç-gereç kullanımına yönelik olumlu tutuma sahip olduğu anlamına gelmektedir.

BULGULAR

Okul Öncesi Öğretmenlerinin Teknolojik Araç-Gereç Kullanımına Yönelik Tutumları ve Etkileyen Faktörler

Araştırmaya katılan okul öncesi öğretmenlerinin teknolojik araç-gereç kullanımına yönelik tutumları örneklem bazında incelendiğinde yüksek bir tutuma sahip oldukları görülmektedir. Ayrıca, öğretmenlerin %90,26'sı yüksek, %8,74'ü orta düzeyde tutuma sahiptir. Bu bulgular ışığında okul öncesi öğretmenlerinin teknolojik araç-gereç kullanımına yönelik oldukça olumlu bir tutuma sahip oldukları sonucuna ulaşılmıştır.

Tablo 2. Öğretmenlerin Teknolojik Araç-Gereç Kullanımına Yönelik Tutum Ölçeği'ne Verdikleri Puanlar

	Ortalama	Std.Sapma	Minimum	Maksimum
Puan	4,21	0,51	2,3	5,00

Tablo 3. Öğretmenlerin Teknolojik Araç-Gereç Kullanımına Yönelik Tutum Ölçeği'ne Verdikleri Puanların Gruplanması

Aralık	Grup	N	%
1-2,33	Düşük	1	1
2,34-3,67	Orta	9	8,74
3,68-5,00	Yüksek	93	90,26

Öğretmenlerin mezun olduğu fakülte türünün, öğretmenlerinin teknolojik araç-gereç kullanımına yönelik tutumları üzerinde anlamlı bir etkisinin olup olmadığını ortaya koymak için yapılan ilişkisiz örneklemler için t testinde, eğitim fakültesinden mezun olan öğretmenlerin test puan ortalaması ile ($\overline{X}$ =4,25, *SS*= 0,49) açıköğretim fakültesinden mezun olan öğretmenlerin test puan ortalaması ($\overline{X}$ =3,90, *SS*= 0,56) arasında anlamlı bir fark olduğu görülmüştür ($t(101)=-2{,}32$, $p<0{,}05$). Bu durumda, okul öncesi öğretmenlerinin mezun olduğu fakülte türlerinin, teknolojik araç-gereç kullanımına yönelik tutumları üzerinde anlamlı bir etkisinin olduğu söylenebilir. Bu bulgular ışığında, eğitim fakültesi mezunu okul öncesi öğretmenleri, açıköğretim fakültesi mezunu okul öncesi öğretmenlerine göre teknoloji kullanımına yönelik daha olumlu bir tutuma sahiplerdir.

Tablo 4'te görüldüğü gibi, hem eğitim fakültesi hem de açıköğretim fakültesi mezunu öğretmenlerin tutumları ölçeğin her maddesi incelendiğinde dahi oldukça yüksektir. Ancak, okul öncesi öğretmenlerinin ölçeğin 7, 14, 15, 17 ve 20. maddelerine verdikleri cevaplar mezun oldukları fakülte türüne göre anlamlı derecede farklılık göstermektedir ($p< 0{,}05$). Bu bulgular, yukarıda bahsedildiği gibi eğitim fakültesi mezunu okul öncesi öğretmenlerinin, açıköğretim fakültesi mezunu okul öncesi öğretmenlere göre teknoloji kullanımına yönelik daha olumlu bir tutuma sahiptir sonucunu desteklemektedir.

Tablo 4. Öğretmenlerin Teknolojik Araç-Gereç Kullanımına Yönelik Tutum Ölçeği'ne Verdikleri Puanların Mezun Oldukları Fakülte Türüne Göre Karşılaştırılması

No	Madde	Eğitim Fakültesi		Açıköğretim F.		t	p
		$\overline{X}$	SS	$\overline{X}$	SS		
1	Teknolojik araç gereçler benim için vazgeçilmez araçlardır.	4,16	,992	4,42	,515	,862	,391
2	Teknolojik araç-gereçlerin kullanımı okul öncesi eğitime katkı sağlar.	4,48	,673	4,33	,492	-,746	,457
3	Etkinliklerde teknolojik araç gereçler kullanmak zaman kaybıdır.	4,55	,671	4,25	,622	-1,46	,146
4	Teknolojik araç gereçler okul öncesi öğretmeninin işini bir hayli kolaylaştırır.	4,22	,940	3,83	,937	-1,34	,184
5	Teknolojik araç gereç kullanımı okul öncesi eğitimin kalitesini yükseltir.	4,30	,876	4,00	,853	-1,11	,271
6	Teknolojik araç gereçler sınıfta öğretmenin rolünü azaltır.	4,15	,868	3,75	1,22	-1,44	,153
7	Teknolojik araç-gereçler okul öncesi dönem çocuklarını üst düzeyde güdüler.	4,08	,833	3,50	1,00	-2,20	,030*
8	Teknolojik araç-gereçler okul öncesi etkinliklerini daha zevkli hale getirir	4,37	,798	4,08	,669	-1,20	,231
9	Teknolojik araç-gereçler okul öncesi dönem çocuğunun dikkatini dağıtır.	4,12	,786	3,75	,866	-1,52	,132
10	Teknolojik araç gereçleri kullanabilmek için teknik bilgilerim yeterlidir.	4,00	,699	3,75	,452	-1,20	,232
11	Okul öncesi eğitimde teknolojik araç-gereç kullanımı gereksizdir.	4,43	,762	4,08	,669	-1,49	,138
12	Teknolojik araç-gereçler okul öncesi eğitimde kullanılan öğretim yöntemlerine uygundur.	3,98	,632	3,75	,754	-1,15	,253
13	Deneyimli öğretmenlerin nitelikli bir eğitim verebilmeleri için Teknolojik araç-gereçlere ihtiyaçları yoktur.	4,26	,828	3,83	1,03	-1,65	,103
14	Görsellik açısından okul öncesi etkinliklerde teknolojik araç-gereçleri kullanmak önemlidir.	4,43	,617	3,83	,835	-3,01	,003*
15	Teknolojik araç-gereçler eğitimde okul öncesi öğretmenini daha etkili kılar.	4,19	,829	3,58	,900	-2,35	,021*
16	Teknolojik araç-gereçler öğretmen-öğrenci etkileşimini azaltır.	4,10	,857	3,67	1,23	-1,56	,123
17	Teknolojik araç-gereçler bilginin daha kalıcı olmasını sağlar.	4,35	,656	3,92	,900	-2,06	,042*
18	Teknolojik araç-gereçler ile yapılan etkinlikler okul öncesi dönem çocuğunun gelişim düzeyini arttırmaktadır.	4,19	,842	3,75	,866	-1,68	,095
19	Teknolojik araç-gereçler çocuğun gelişimine olumlu katkı sağlar.	4,21	,691	3,83	,718	-1,76	,081
20	Teknolojik araç-gereçler etkinlikler sürecinde soyut kavramların somutlaştırılmasında oldukça etkilidir.	4,46	,638	4,00	1,128	-2,12	,036*

*$p<0,05$, sd=101

SONUÇ

Araştırma sonuçları okul öncesi eğitimde teknoloji kullanımının gerekliliği ve önemini hem öğretmen hem de çocukların gelişimi açısından ortaya çıkarmaktadır. Ayrıca, okul öncesi öğretmenlerinin teknolojik araç-gereçleri eğitim ortamlarına dahil etme sürecinde karşılaşabilecekleri zorluklara karşı motivasyon sahibi oldukları da görülmektedir. Ancak, eğer öğretmen bu süreçte nasıl ve ne öğreteceği konusunda desteklenmezse, hem öğretmen hem de çocuklar deneme yanılma yoluyla öğrenme süreci yaşama zorunda kalabilirler. Bu süreç ise teknoloji entegrasyonunun temelinde yatan verimlilik ilkesine aykırıdır (Fraser, 1998). Öğretmenlerin teknoloji entegrasyonu sürecinde desteklenmesi için, öğretmenler arasında işbirliğinin desteklenmesi verimli olacaktır. Teknoloji entegrasyonuna yönelik iyi tasarlanmış bir mentoring programı sayesinde öğretmenlerin teknoloji kullanımına yönelik tatmini artacak ve yeni teknolojileri kullanmaya yönelik motivasyon sahibi olacaklardır (Kerry, Farrow, 1996).

Öğretmenler çocukların teknoloji sayesinde motive olduklarını ve daha iyi öğrendiklerini belirtmektedirler. Haugland (1995)'a göre okul öncesinde teknolojinin etkisinin olması için dört etken söz konusudur. Öğretmenler teknolojiye açık olmalıdır ve teknolojinin eğitim sürecine dâhil edilmesine olumlu yaklaşmalıdırlar. Ayrıca teknolojinin potansiyel faydalarının farkında olarak eğitim sürecinde önemli bir rol oynayabileceğini kavramalıdırlar. Bu farkındalığı sağlamak için öğretmenler okul öncesi eğitime teknoloji entegrasyonu konusunda eğitim görmelidirler.

Öğretmenlerin teknolojik araç-gereç kullanımına yönelik olumlu tutuma sahip oldukları yapılan farklı çalışmalarla tespit edilmiştir (Kabadayı, 2006; Cevher-Kalburan, Yurt, Ömeroğlu, 2011; Gök, Turan, Oyman, 2011; Yurt, Cevher-Kalburan, 2011; Önkol, Zembat, Uyanık Balat, 2011; Kol, 2006; Oğuz ve ark. 2011). Ancak yapılan araştırmalar sonucunda okul öncesi öğretmenlerinin çoğu teknolojiyi günlük planlarını hazırlamada kullandıkları, etkinliklerde teknolojiye çok az yer verdikleri, çoğunlukla müzik etkinliklerinde teknolojiden faydalandıkları ve haftada 1-2 kez teknolojiyi kullandıkları belirlenmiştir (Yurt, Cevher-Kalburan, 2011). Öğretmenlerin olumlu tutumları desteklenerek teknolojiyi okul öncesi eğitimde nasıl kullanabilecekleri hususunda desteklenmeleri gereklidir.

Bulgular kısmında belirtildiği gibi açıköğretim fakültesi mezunu okul öncesi öğretmenlerinin teknolojik araç-gereç kullanımına yönelik tutumları yüksektir. Ancak eğitim fakültesi mezunları ile aralarında anlamlı bir fark mevcuttur. Açıköğretim fakültesi mezunu okul öncesi öğretmenleri teknolojinin sağlayabileceği güdüleme, görselleştirme, kalıcı öğrenme gibi faydalarda eğitim fakültesi mezunu öğretmenlere göre daha düşük bir tutuma sahiplerdir. Her ne kadar açıköğretim fakülteleri artık okul öncesi öğretmeni mezun etmese de açıköğretim fakültesi mezunu öğretmenlerin araştırmanın örnekleminin %10'unu temsil ettiği düşünüldüğünde, bu durumun önemi anlaşılabilir ve düzenlenecek nitelikli hizmet içi eğitimler sayesinde hem açıköğretim fakültesi hem de eğitim fakültesi mezunu okul öncesi öğretmenleri teknoloji entegrasyonu konusunda desteklenebilir.

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INVESTIGATION OF QUALIFICATION MODELS FOR THE GRADUATES OF DEPARTMENT OF PRINTING TECHNOLOGIES TO BE A VOCATIONAL TEACHER

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ABSTRACT: Education has a great importance and role for the societies which can adapt to changes, continuously improve themselves and consist of happy individuals. Around the world and in Turkey, Typography and Printing sector is a dynamic key and important sector which maintains its own development and innovations depending on the developments in other sectors. Various machines, hardware, software and materials, which are the products of advanced technology and studies, are used in this sector. A qualified manpower trained in different fields is needed in order to use all these factors in an effective and accurate manner. For the supply of manpower trained in printing sector, printing vocational high schools and printing departments of several vocational high schools providing education at high school level are available in our country. Printing teachers who will work at these high schools in the future have to bear many qualifications. Technical teachers graduated from Printing Education department of Technical Education Faculty are appointed for printing vocational high schools. Technical Education Faculties are closed with Council of Ministers decision No. 2009/15612. The Graduate School of Applied Sciences, Marmara University is opened in 2013 (with Council of Ministers decision No. 2013/4428). Printing Technologies Department is established within the Graduate School of Applied Sciences at the same year. The first students are enrolled in the department in 2014. It is considered as reasonable that students to be graduated from the Printing Technologies department should have some criteria such as initial teacher training and a master degree as qualifications to be appointed as teachers. However, no concrete study has been set forth yet by the Ministry of National Education regarding this issue. A literature survey is performed in this study in relation to the qualifications a vocational teacher has to have. Furthermore, 23 survey questions are prepared and then, these are applied to experienced academics and teachers who are working at the universities and vocational high schools training personnel for typography and printing sector. Percentage and frequency distributions of the obtained data will be presented and then, they evaluated by way of their arithmetic means.

Key Words: teacher qualifications, printing teacher, professional development, printing technologies.

BASIM TEKNOLOJİLERİ BÖLÜMÜ MEZUNLARININ MESLEK ÖĞRETMENİ OLABİLME MODELLERİNİN ARAŞTIRILMASI

ÖZET: Üretken, değişime uyum sağlayabilen, kendini sürekli geliştirebilen ve mutlu bireylerden oluşan toplumlar için eğitimin büyük bir önemi ve rolü vardır. Dünyada ve Türkiye'de Matbaacılık ve Basım sektörü, diğer sektörlerdeki gelişmelere bağlı olarak kendi gelişimini ve yeniliklerini sürdüren dinamik ve önemli bir sektördür. Bu sektörde ileri teknoloji ve araştırmaların ürünü olan çeşitli makine, donanım, yazılım ve malzemeler kullanılmaktadır. Bütün bu unsurların etkili ve doğru bir şekilde kullanılması için farklı alanlarda yetişmiş insan gücüne ihtiyaç vardır. Basım sektöründe yetişmiş iş gücünün sağlanması için ülkemizde lise düzeyinde eğitim veren matbaa meslek liseleri ve bazı meslek liselerinin matbaa bölümleri vardır. Bu liselerde çalışacak olan matbaa öğretmenlerinin sahip olması gereken pek çok nitelik vardır. Matbaa meslek liselerine Teknik Eğitim Fakültesi Matbaa Eğitimi bölümünden mezun olan teknik öğretmenler atanmaktadır. Teknik Eğitim Fakülteleri, 2009/15612 sayılı Bakanlar kurulu kararı ile kapatılmıştır. 2013 yılında Marmara Üniversitesi Uygulamalı Bilimler Yüksekokulu açılmıştır. (Bakanlar Kurulu Karar Sayısı : 2013/4428) Aynı yıl Uygulamalı Bilimler Yüksekokuluna bağlı Basım Teknolojileri Bölümü açılmıştır. Bu bölüm 2014 yılında ilk öğrencilerini almıştır. Basım Teknolojileri bölümünden mezun olacak olan kişilerin öğretmen olarak atanabilmeleri için öğretmenlik formasyonu ve yüksek lisans yapma gibi bazı kriterlerin aranması makul görülmektedir. Ancak bu konuda Milli Eğitim Bakanlığı tarafından hazırlanmış somut bir çalışma henüz yoktur. Bu araştırmada meslek öğretmeninde bulunması gereken özelliklerle ilgili literatür taraması yapılmıştır. Ayrıca 23 anket sorusu hazırlanarak, matbaacılık ve basım endüstrisi için eleman yetiştiren üniversite ve meslek liselerinde çalışan tecrübeli akademisyen ve öğretmenlere uygulanmıştır. Elde edilen verilerin yüzde ve frekans dağılımları hesaplanarak, yorumlar yapılmıştır.

Anahtar Kelimeler: öğretmen yeterlilikleri, matbaa öğretmeni, mesleki gelişim, basım teknolojileri

GİRİŞ

Küreselleşme ile birlikte her ülkenin sadece seçkin bir kesimini eğitmenin çıkar yol olmadığı, kalkınma için halkın tabanına kadar ulaşan bir eğitim sistemiyle kitlesel olarak yetişmiş nitelikli nüfusa ihtiyaç olduğu gerçeği kavranılmıştır (Balay, 2004).

Küresel düzeyde nitelikli işgücünün önemi giderek artmaktadır. Eğitim seviyesinin ve işgücünün niteliğinin yükselmesi, ülkelerin ve bireylerin ekonomik gelişmişliğini etkilemeye devam edecektir. Eğitim seviyesinin yanında işgücünün niteliğinin de işgücü hareketlerinde belirleyici bir unsur olması beklenmektedir. Tüm ülkelerde nitelikli işgücüne olan talebin artacağı öngörülmektedir. Düşünme, algılama ve problem çözme yeteneği gelişmiş, demokratik değerleri ve milli kültürü özümsemiş, paylaşıma ve iletişime açık, sanat ve estetik duyguları güçlü, özgüven ve sorumluluk duygusu ile girişimcilik ve yenilikçilik özelliklerine sahip, bilim ve teknoloji kullanımına ve üretimine yatkın, bilgi toplumunun gerektirdiği temel bilgi ve becerilerle donanmış, üretken ve mutlu bireylerin yetişmesi, eğitim sisteminin temel amacıdır (Onuncu Kalkınma Planı, 2013).

Bir ülkenin kalkınmışlık düzeyini belirlemede kullanılan en önemli ölçütlerden biri, o ülkenin sahip olduğu insan kaynaklarının niteliğidir. Bu doğrultuda, değişen koşullara uyum sağlayabilen, sorun giderebilen, çevresi ile iyi iletişim kurabilen, takım çalışması yapabilen, mesleğinin gerektirdiği temel bilgi ve becerilere sahip, yetişmiş mesleki ve teknik insangücü, kalkınmanın itici gücüdür. Birey bu etkinliğin gerektirdiği bilgi, beceri ve uygulama yeterliklerini belirli bir eğitim sürecinden geçerek edinir. Bu eğitim sürecinin bir boyutunu genel eğitim, bir boyutunu da mesleki ve teknik eğitim oluşturur (Adıgüzel, Berk, 2009).

Mesleki teknik eğitimin amacı, genel olarak, bireyleri sanayi, ticaret ve hizmet sektörlerinde istihdam için nitelikli iş gücü olarak eğitmek ve yetiştirmek, mesleklerinin devamı olan yüksek öğretim kurumlarına geçiş için gerekli temel eğitimi vermektir (Eşme, 2007).

Gelişmekte olan ülkeler arasında bulunan Türkiye'de mesleki ve teknik ortaöğretim tarihsel süreç içerisinde politik ve ekonomik gelişmeler doğrultusunda birçok kez yeniden düzenlenmiştir. Uzun yıllar okul merkezli bir model doğrultusunda yapılandırılmış olan mesleki ve teknik ortaöğretim sistemi, 1977–1978 öğretim yılında başlatılan ve pilot bölgelerde uygulanan "Okul Sanayi Ortaklaşa Eğitim Projesi (OSANOR)" ile değişmeye başlamıştır. Proje mesleki-teknik ortaöğretim kurumlarının iş dünyası ile daha fazla ortak çalışma alanlarının geliştirilmesini sağlamıştır. Mesleki teknik ortaöğretimdeki önemli dönüm noktalarından bir diğerini ise 1986 tarihli 3308 sayılı kanun oluşturmaktadır. Bu kanun ile mesleki-teknik ortaöğretim kurumları okul işletme işbirliğine dayalı olarak yeniden yapılandırılmışlardır. Bu dönemden sonra, mesleki-teknik ortaöğretimin geliştirilmesine yönelik projeler hızlanmıştır. "Mesleki ve Teknik Eğitim Projesi (METEP)", "Mesleki ve Teknik Eğitimi Geliştirme Projesi (METGE)" ve "Mesleki Eğitim ve Öğretim Sisteminin Güçlendirilmesi (MEGEP)" projeleri bu dönemde başlatılan önemli projelerdendir (Adıgüzel, Berk, 2009).

Ülkemizde hazırlanan onuncu kalkınma planına göre; Yirmi birinci yüzyıl; nitelikli insan gücünü yetiştirmenin yanında küresel ölçekte bu insanları kendisine çekebilen, bu gücü doğru ve yerinde değerlendiren, küresel bilgiyi kullanarak yeni bilgiler üretebilen, bilgiyi ekonomik ve sosyal faydaya dönüştürebilen, bu süreci bilgi ve iletişim teknolojileri ile bütünleştirebilen ve insan odaklı kalkınma anlayışını benimseyen ülkelerin yüzyılı olacaktır

Öğretmenlik mesleği daha cazip hale getirilecek; öğretmen yetiştiren fakülteler ile okullar arasındaki etkileşim güçlendirilecek; öğretmen yetiştirme ve geliştirme sistemi, öğretmen ve öğrenci yeterliliklerini esas alan, kişisel ve mesleki gelişimi sürekli teşvik eden, kariyer gelişimi ve performansa dayanan bir yapıda düzenlenecektir.

Eğitimde alternatif finansman modelleri geliştirilecek, özel sektörün eğitim kurumu açması, özel kesim ve meslek örgütlerinin mesleki eğitim sürecine idari ve mali yönden aktif katılımı özendirilecektir.

Eğitim sistemi ile işgücü piyasası arasındaki uyum; hayat boyu öğrenme perspektifinden hareketle iş yaşamının gerektirdiği beceri ve yetkinliklerin kazandırılması, girişimcilik kültürünün benimsenmesi, mesleki ve teknik eğitimde okul-işletme ilişkisinin orta ve uzun vadeli sektör projeksiyonlarını dikkate alacak biçimde güçlendirilmesi yoluyla artırılacaktır.

Ortaöğretim ve yükseköğretim düzeyindeki mesleki ve teknik eğitimde, program bütünlüğü temin edilecek ve nitelikli işgücünün yetiştirilmesinde uygulamalı eğitime ağırlık verilecektir (Onuncu Kalkınma Planı, 2013).

TÜİK'e Göre Bazı Mesleki ve Teknik Ortaöğretim İstatistikleri

Tablo 1'i incelediğimizde, 2006-2014 yılları arasında mesleki teknik ortaöğretimde okullaşma oranında sürekli bir artışın olduğu görülmektedir. Özellikle son yıllarda özel mesleki ve teknik ortaöğretim kurumlarında okullaşma ve öğretmen sayıları bakımından ciddi bir artış olmuştur. Bu bağlamda mesleki ve teknik eğitimin yatırım finansmanı açısından devletin yükünün biraz azaldığı görülmektedir. Bu durum önemli bir gelişmedir. Özel mesleki ve teknik ortaöğretim kurumlarının artış oranı bu hızla devam ederse birkaç yıl sonra devlet ve özel mesleki ve teknik ortaöğretim kurumlarının sayıları arasında büyük bir fark kalmayacaktır.

Tablo 1'de öğretmenlerin cinsiyeti açısından sayılarını karşılaştırdığımızda, kadın ve erkek öğretmenlerin sayısının, resmi mesleki ve teknik ortaöğretim okullarında, yıllara göre hemen hemen aynı oranda arttığını görebiliriz. Ancak bu durum özel okullarda farklılık göstermektedir. Özellikle 2011-2014 yılları arasında bayan öğretmenlerin sayısı yüksek bir oranda artmıştır.

Tablo 1. Mesleki ve Teknik Ortaöğretimde Öğretim Yılına Göre Okul, Öğretmen Sayısı (TÜİK, 2015)

Okul Türü ve Öğretim Yılı / Type of School and Educational Year	Okul[6] / School[6]	Teacher[2][4] Toplam / Total	Erkek / Males	Kadın / Females
Mesleki ve Teknik Ortaöğretim - Vocational and Technical Secondary Education				
2006/' 07	4 244	84 276	51 149	33 127
2007/' 08	4 450	84 771	51 027	33 744
2008/' 09	4 622	88 924	53 229	35 695
2009/' 10	4 846	94 966	56 259	38 707
2010/' 11	5 179	104 327	61 053	43 274
2011/' 12	5 501	113 098	65 599	47 499
2012/' 13	6 204	135 502	76 202	59 300
2013/' 14	7 211	161 288	87 894	73 394
Resmi - Public				
2006/' 07	4 223	84 032	51 051	32 981
2007/' 08	4 429	84 449	50 884	33 565
2008/' 09	4 595	88 615	53 077	35 538
2009/' 10	4 824	94 649	56 114	38 535
2010/' 11	5 155	104 003	60 899	43 104
2011/' 12	5 456	112 409	65 272	47 137
2012/' 13	6 078	133 321	75 325	57 996
2013/' 14	6 785	153 816	85 032	68 784
Özel - Private				
2006/' 07	21	244	98	146
2007/' 08	21	322	143	179
2008/' 09	27	309	152	157
2009/' 10	22	317	145	172
2010/' 11	24	324	154	170
2011/' 12	45	689	327	362
2012/' 13	126	2 181	877	1 304
2013/' 14	426	7 472	2 862	4 610

Bilgi Toplumunda Öğretmen

Küreselleşen bilgi toplumunda değişim sürecinin doğurabileceği muhtemel sonuçlara karşı önlem almak, insanı ve toplumu değişimle baş edebilecek şekilde gelecek için hazırlamak önemli hale gelmiştir. O halde bu sürece hazırlığa, eğitim kurumları ve bu kurumlarda görev yapacak öğretmenlerden başlanmalıdır. Bireyin hızla değişen bilgi toplumuna katılımı ve bu süreçte hak ettiği yeri alması, yeni bilgiler kazanması, becerilerini zenginleştirmesi, yaşam boyu öğrenme ve eskisine oranla daha çok nitelikli olmayla başarılabilir (Balay, 2004).

Bilgi toplumunun yarattığı okul kültüründe öğretmenlerin yeni roller ve görevler üstlenmesi bir zorunluluk halini alacaktır. Öğretmen, çok hızlı bilgi üretimi karşısında sürekli olarak bilgilerini güncellemek zorundadır. Bilgi toplumunun eğitimcisi olan öğretmenler, bilginin eğitimsel değerinin farkında olacak, ona ulaşma konusunda da etkili bir rehberlik ortaya koyacaklardır. Bunun için öğretmenlerin bundan sonraki süreçte daha değişik ve yeni yeterliliklerle yetiştirilmeleri gerekmektedir. Öğretmenlerin değişik kültürlerden gelen, sosyal yönden zayıf öğrencilerin öğrenmelerini gerçekleştirebilen, mevcut çatışmaları barışçıl yollarla çözebilen, kişilerin kimliklerine ve kültürlerine saygı duyan, toplumsal sorumluluk taşıyan yurttaşlar olarak yetişmeleri, bunun için gerekli bilgi, beceri ve değerlerle donanmış olmaları arzulanmaktadır (Balay, 2004).

Mevcut sistem öğretmeni temel bilgi kaynağı olarak görmektedir. Bu durumda öğretmen, büyük ölçüde anlatan ve aktaran konumunda iken, öğrenci de sadece kendisine aktarılanı alan pasif bir konumda bulunmaktadır. Bu yaklaşım, öğrencideki girişimci ruhu köreltmekte; öğrenci, kendi kendine öğrenme becerisi geliştirememekte ve eğitim sürecinde yetenekleri doğrultusunda ilerlemesine olanak tanınmamaktadır (Balay, 2004).

Bilgi toplumunda öğretmenin temel rolü, öğrenme ortamının merkezine öğrenciyi alarak, bilgiye nasıl ulaşılacağını ve bundan nasıl yararlanılacağını uygun ortamlar hazırlayarak öğretmektir. Bilginin seçimi konusunda uzman olan öğretmenler, temel bilgiyi öğrenciye kazandırabilmelidir. Bu da öğrenci için öğrenmeyi öğrenmek anlamına gelir. Ancak burada öğretmen, öncelikle öğrencisini iyi tanımalı, onun öğrenme düzeyine uygun öğrenme imkânları sunmalı, öğrenmeyi öğrencisine kolaylaştırarak, onu doğru yönde yönlendirmelidir (Balay, 2004).

Öğretmen Öz-Yeterliği

Zamana bağlı olarak toplumsal değişim kaçınılmaz bir olgudur. Öğretmenlerin sadece hizmet öncesi almış oldukları bilgi, deneyim ve formasyonla ömür boyu görevlerini yapmaları mümkün değildir. Sürekli değişen toplumun ve çağın ihtiyaçlarına uygun olarak öğretmenden beklenen görev ve sorumluluklar da değişmektedir. Bu bağlamda öğretmenlerin hayat boyu öğrenme süreci içerisinde kendilerini hem mesleki hem öz yeterlik hem de sosyo kültürel bakımdan yenilemeleri ve toplumun onlardan beklentilerini karşılacak düzeyde geliştirmeleri gerekmektedir (Sanal, 1999).

Okullardaki başarı grafiği, nitelikli öğretmenler olmadan önemli düzeyde yükseltilemez. Başka bir ifadeyle, iyi öğrencilere sahip olunabilmesi için iyi öğretmenlere ihtiyaç vardır. Öğretmenler ve öğretmenlik mesleğindeki nitelik konusu sadece Türkiye'de değil dünyanın pek çok ülkesinde çok sık gündeme gelen bir konudur. Öğretmenlik mesleği ve bu mesleği yürüten profesyonellerin mesleğin gereklerini yerine getirişleriyle ilgili düzenlemeler Türkiye Cumhuriyeti'nin kuruluşundan beri üzerinde hep konuşulan bir konu olagelmiştir. Özellikle son 30 yılda gerçekleştirilen ve gerçekleştirilmeye çalışılan düzenlemeler bu konuda çok uzun yıllar sürebilecek çalışmaların da işaretçileridir (Seferoğlu, 2004).

Goddard, Hoy, Woolfolk, Tschannen-Moran öğretmen öz-yeterliğini; bir öğretmenin sahip olduğu becerilerle, öğrencide bağlılık ve öğrenme gibi istenen sonuçları oluşturup oluşturamayacağına ilişkin yargısı olarak tanımlamaktadır. Bir diğer ifadeyle öğretmen öz yeterliği bir öğretmenin "görevlerimi yerine getirmek için gerekli düşünceleri ve eylemleri planlayıp uygulayabilir miyim?" sorusuna verdiği cevaptır (Üstüner ve Arkadaşları, 2009).

Öz yeterlik kavramı özellikle eğitim ile ilgili süreçlerde, öğretmen ve öğrencilerin stresle mücadelesi için, öğretmenlerin öğretmenlik görev ve sorumlulukları ile ilgili davranışlarını tahmin etmek ve eğitim alanında öğretmen etkinliklerindeki bireysel farklılıkları açıklamak amacıyla kullanılmaktadır

Öz-yeterlik ile ilgili yapılan araştırmaların sonuçları, ögretmen öz-yeterliği ile bazı öğretmen davranışları ve ögrencilerde meydana gelen öğrenme ürünleri arasında ilişki olduğunu göstermektedir. Örneğin bazı araştırma sonuçları öğretmen öz-yeterliği ile öğrenci başarısının, motivasyonunun ve öğrenci öz-saygısının ilişkili olduğunu göstermektedir. Benzer biçimde öğretmenlerin öz-yeterlik algısı ile öğretimsel yenilikleri uygulamaya çalışma, öğretime daha fazla zaman ayırma sınıfta istenmeyen öğrenci davranışlarını önleme, sınıf yönetimi becerilerine sahip olma, mesleki bağlılık gibi etkili öğretmen özelliklerinin ilişkili olduğunu gösteren pek çok çalışma bulunmaktadır (Üstüner ve Arkadaşları, 2009).

Üstüner ve arkadaşlarının yapmış oldukları araştırmaya göre; öğretmenlerin öz yeterliklerine ilişkin algılarının cinsiyet değişkenine göre analizleri incelendiğinde, ortaöğretimde çalışan kadın ve erkek öğretmenlerin anlamlı bir şekilde farklılaşmadıkları ve öz yeterliklerine ilişkin benzer algılara sahip oldukları tespit edilmiştir. Her iki grubun aritmetik ortalamaları dikkate alındığında, kadın ve erkek öğretmenlerin, kendilerini "orta" düzeyde yeterli olarak algıladıkları, ancak kadınların aritmetik ortalamalarının erkeklere göre daha yüksek olduğu görülmektedir. (Üstüner ve Arkadaşları, 2009).

Üstüner ve arkadaşlarının yapmış oldukları araştırmaya göre; branş değişkeni açısından öğretmenlerin öz yeterliklerine ilişkin algılarının anlamlı biçimde farklılaşmadığı tespit edilmiştir. Öğretmenlerin aritmetik ortalamaları dikkate alındığında, her üç branş (sosyal, fen, mesleki-teknik) grubundan öğretmenlerin, öz yeterliklerine ilişkin algılarının hem ölçeğin alt boyutları hem de tamamı açısından "orta" düzeyde olduğu görülmektedir. Ancak katılımcıların aritmetik ortalamaları incelendiğinde mesleki-teknik branş öğretmenlerinin diğer öğretmenlere göre daha yüksek aritmetik ortalamaya sahip oldukları tespit edilmiştir (Üstüner ve Arkadaşları, 2009).

Aynı araştırmaya göre; kıdem değişkeni açısından öğretmenlerin öz yeterliklerine ilişkin algılarının anlamlı biçimde farklılaşmadığı tespit edilmiştir. Katılımcıların aritmetik ortalamaları dikkate alındığında, farklı kıdem gruplarında yer alan öğretmenlerin öz yeterliklerine ilişkin algılarının hem ölçeğin alt boyutları hem de tamamı açısından "orta" düzeyde olduğu görülmektedir. Bulgular incelendiginde, 21 yıl ve üzeri kıdeme sahip öğretmenlerin en yüksek aritmetik ortalamaya, 1– 5 yıl kıdeme sahip öğretmenlerin ise en düşük aritmetik ortalamaya sahip oldukları görülmektedir. Bu bağlamda, öğretmenlerin meslekte çalısma yılı arttıkça öz-yeterliklerine ilişkin algı düzeylerinin de artma eğiliminde olduğu düşünülebilir (Üstüner ve Arkadaşları, 2009).

Öğretmenlerin Hizmetiçi Eğitimi

Öğretmenler mezun oldukları okullardan, mesleğin gerektirdiği tüm yeterlilik ve donanımları alamamış olabilirler. Bu nedenle hizmetiçi eğitim faaliyetleriyle ve yaşam boyu öğrenme sürecine katılarak öğretmen, bu eksikliklerini giderebilir.

Öğretmenler gerek hizmet öncesi gerekse hizmet anında eksiklerini tamamlamak için hizmet içi eğitime gereksinim duymaktadırlar. Özellikle "hizmet öncesinde verilen bilgilerin iş ortamında yetersiz kalması, çalışan-larda kariyer yapma isteğinin artması, değişime ve gelişmelere uyum zorunluluğu, bazı bilgi ve becerilerin sadece iş başında öğrenilmesi, öğrenme ve kendini geliştirme isteğinin olması gibi nedenler, hizmet içi eğitimi zorunlu kılmaktadır (Gökyer, 2002).

Hizmetiçi eğitim, öğretimin niteliğini, yeni eğitim sistemlerinin kalitesini ve verimliliğini artırmak, bilimsel ve teknolojik gelişmelerin ve yeniliklerin oluşmasına yardımcı olmak için bir araç olarak kabul edilmektedir. Şu anda devam eden teknolojik, sosyal ve kültürel alandaki değişimlere uyum sağlayarak, bugünkü toplumun özelliklerini aklımızda tutabilirsek, insanların bilgiye, işe ve kültüre ulaşmalarının yanı sıra, bu değişimlerle karşı karşıya kalacak tek değişim aracı hizmetiçi eğitimdir. 1980'lerden bu yana hizmetiçi eğitimin, mesleki gelişimde ve özellikle eğitim alanında önemi herkes tarafından kabul edilmektedir (Gökyer, 2002).

Bir mesleki gelişim programı tasarlanırken alan dışından profesyoneller yerine bizzat öğretmenlerin görüş ve düşüncelerine başvurulmalıdır. Berman ve McLaughlin'in (1978) de vurguladığı gibi alan dışından kişilerin sunduğu yardımlar veya çözüm önerileri çok genel ve bazen de sorunları çözmekten uzak olabilmektedir. Oysa sorunun bizzat içinde olan öğretmenler çözüm önerebilecek en iyi pozisyondadırlar. Konuya bu açıdan bakıldığında sorunları bizzat yaşayan öğretmenlerin, en gerçekçi saptamaları yapabilecekleri ve uygulanabilir çözüm önerileri sunabilecekleri söylenebilir. Öte yandan mesleki eğitim programı önemli ölçüde öğretmenin katkısını içeriyorsa, onların programı sahiplenmeleri ve programın verimli olması için daha çok çaba harcamaları da doğal olacaktır (Seferoğlu, 2004).

Bakanlığımızın hizmetiçi eğitim konusunda yeterli bir desteği sağlayamadığı bilinmektedir. Aslında bu durum sadece ülkemize özgü bir durum da değildir. Bir takım gelişmiş batılı ülkelerde de hizmet-içi eğitim konusunda benzer sıkıntılar yaşanmaktadır. Nitelikli öğretmen ve nitelikli öğretim için mesleki gelişim konusunda öğretmenlere sağlanmış sürekli bir desteğin varlığı çok büyük önem taşımaktadır. Ancak, eğer bu sürekli destek merkezi yönetimlerce karşılanamıyorsa alternatif yollar aranmalıdır. Bu yollardan birisi okul temelli programlar düzenlenerek kurum içinde var olan kaynakların kullanılması olabilir. Yani öğretmenlerin birbirlerini eğitmelerinin sağlanmasıyla bir hayli yol alınabilir (Seferoğlu, 2004).

İş hayatında kullanılan teknoloji çok hızlı değişmektedir. İşletmelerin talep ettiği kaliteli işgücü, ancak okul ile işletmelerin işbirliği ile yetiştirilebilir. Mesleki ve Teknik eğitimde yeniden yapılanma, okul ile işletme işbirliği temeli üzerinden geliştirilmelidir. Kısa dönemde yapılması gerekli olan diğer bir etkinlik de, sistemde çalışan öğretmenlerin yeni teknolojileri izleyebilmeleri için, belirli bir süre sanayide deneyim kazanmalarını temin etmek olmalıdır (Doğan, 1997).

Meslek yüksekokullarının sahip olduğu binaların bir kısmında çeşitli yetersizlikler vardır. Oysa, uygulama ağırlıklı olan bu okulların, tasarımı özel yapılmış binalarda eğitim ve öğretimi sürdürmeleri, eğitimin kalitesi yönünden büyük önem taşımaktadır. Endüstrinin gereksinim duyduğu standartlarda bir eğitim gerçekleştirebilmek için, bu okulların iyi teçhiz edilmiş ve laboratuvar ile atölyelerin sanayinin uyguladığı teknolojiye uygun olarak donatılmış olmaları gerekmektedir. Ancak, sayıları sürekli olarak artan meslek yüksek okullarında, maliyeti yüksek olan bu donanımlar eksiktir (Binici, Arı, 2004)

2012, Mesleki ve Teknik Eğitim Çalıştayından Bazı Öneriler

Mesleki ve teknik eğitim veren kurumlara mali ve idari esneklik kazandırılması gerektiği belirtilen raporda, öğretmen ihtiyacının da ilgili yüksek öğretim programları mezunlarına lisansüstü eğitim verilerek karşılanmasının önemi kaydedildi.

Mevcut öğretmenlerin yeni teknolojilere ayak uydurabilmeleri için Bakanlık tarafından belli aralıklarla hizmet içi eğitim verilmesinin önemi vurgulanan raporda, dört yıllık eğitimin 3. senesinde 2 gün okul 3 gün işletme sisteminin oluşturulması, 4. yılda öğrencilerin sene boyunca işletmelerde eğitim görmelerinin gerektiği belirtildi. Mesleki ve teknik eğitimde kalite güvencesinin sağlanması gerektiği kaydedilen raporda, staj imkanın sağlayan işletmelere aldığı öğrenci oranında teşvik verilmesi talep edildi. Her meslek için dil seviyesinin belirlenmesi ve yabancı dil eğitiminin geliştirilmesi de çözüm önerileri arasında yer aldı (Çalıştay, 2012).

2015, Mesleki Eğitim Sistemi: Sorunlar, Çözüm Yolları ve Model Önerisi Çalıştayından Bazı Öneriler

Nitelikli insan gücünün yetiştirilebilmesi için nitelikli öğretmenlerin olması gerekir. Meslek öğretmeninin yeterlilikleri, çağımızın beklentilerini karşılayacak düzeyde olmalıdır. Teknik Eğitim Fakülteleri kapatıldığı için günümüzde meslek öğretmenlerinin/teknik öğretmenlerin nasıl yetiştirileceğine dair bir model yoktur. Öğretmen adaylarından lisans diplomalarının yanı sıra formasyon sertifikası, en az bir yıllık sektörde çalışma ya da yüksek lisans yapma gibi şartlar aranabilir ama bu gün için meslek öğretmeni olarak atanabilmek için geçerli olan bir model yoktur. Meslek öğretmenleri ve eğiticileri, öğretmenlik formasyonlarının ve teorik mesleki bilgilerinin yanısıra sektörün onlardan beklediği becerilere de sahip olabilmeleri için profesyonel bir şekilde yetiştirilmelidirler. Meslek öğretmenlerine yeteri kadar iş yeri başında eğitim, staj, hizmetiçi eğitim gibi faaliyetlere katılma olanakları sağlanmalıdır. Böylece meslek öğretmenleri uygulama becerilerini geliştirip güncelleyebileceklerdir (Çalıştay, 2015).

YÖNTEM

Araştırma Modeli

Bu araştırmada meslek öğretmeninde bulunması gereken özelliklerle ilgili literatür taraması yapılmıştır. Araştırma betimsel tarama modeliyle yürütülmüştür. Ayrıca dörtlü sıralama ölçeğine göre 23 anket sorusu hazırlanarak, matbaacılık ve basım endüstrisi için eleman yetiştiren üniversite ve meslek liselerinde çalışan tecrübeli akademisyen ve öğretmenlere uygulanmıştır. Elde edilen verilerin yüzde ve frekans dağılımları sunularak, yorumlar yapılmıştır.

Evren ve Örneklem

Araştırmanın evrenini, İstanbul'da yer alan ön lisans ve lisans düzeyinde basım teknolojileri bölümü, basım yayım teknolojileri programı olan üniversitelerde çalışan öğretim elemanları ile İstanbul'da Milli Eğitim Bakanlığına bağlı matbaa teknolojileri alanı ya da programı bulunan teknik ve endüstri meslek liselerinde görev yapan öğretmenler oluşturmaktadır. Okulların listesi aşağıdadır:

- T.C. İstanbul AREL Üniversitesi Meslek Yüksekokulu, Basım ve Yayım Teknolojileri Programı
- T.C. İstanbul Aydın Üniversitesi Anadolu Bil Meslek Yüksekokulu, Basım ve Yayın Teknolojileri Programı
- T.C. Marmara Üniversitesi Teknik Bilimler Meslek Yüksekokulu, Basım ve Yayın Teknolojileri Programı
- T.C. Marmara Üniversitesi Uygulamalı Bilimler Yüksekokulu Basım Teknolojileri Bölümü
- T.C. Milli Eğitim Bakanlığı Ataşehir İbrahim Müteferrika Teknik ve Endüstri Meslek Lisesi, Matbaa Teknolojisi Alanı
- T.C. Milli Eğitim Bakanlığı Dr.Oktay Duran Mesleki ve Teknik Anadolu Lisesi, Matbaa Teknolojisi Alanı
- T.C. Milli Eğitim Bakanlığı İstanbul Ticaret Odası Mesleki ve Teknik Anadolu Lisesi, Matbaa Teknolojileri Bölümü
- T.C. Milli Eğitim Bakanlığı Kazım Beyaz Özel Eğitim Mesleki Eğitim Merkezi Okulu, Matbaa Teknolojisi-Ciltçilik Alanı

Bu araştırmanın örneklemini ise, Marmara Üniversitesi Teknik Eğitim Fakültesi Matbaa Eğitimi Bölümünden Matbaa Öğretmeni ünvanıyla mezun olmuş ve yukarıda belirtilen eğitim kurumlarında öğretim elemanı ya da meslek öğretmeni olarak çalışan 56 kişi oluşturmaktadır.

Veri Toplamada Kullanılan Ölçme Aracının Geliştirilmesi

Araştırmada veri toplamak amacıyla; öğretim elemanı ve öğretmen görüş ve beklentilerinin belirlenebilmesi için 23 soruluk anket formu geliştirilmiştir. Araştırmaya katılanların anketteki ifadelere katılım derecesinin belirlenmesi amacıyla; (1) Hiç katılmıyorum, (2) Katılmıyorum, (3) Katılıyorum, (4) Tamamen Katılıyorum şeklinde 4'lü likert kullanılmıştır.

Verilerin Analizi

Verilerin analizinde öğretmenlerin görüş ve beklentilere ilişkin verdikleri cevaplara ait frekans, yüzde değerleri hesaplanmıştır.

BULGULAR

Araştırmanın bu bölümünde anket uygulanan 56 kişinin; ünvan, cinsiyet, yaş, kıdem yılı ve mezuniyet derecelerine bağlı frekans ve yüzde dağılımları, ilgili tablolarla (tablo 2, 3, 4, 5, 6) verilerek, ankette yer alan 23 ifadeye ait görüşleri üzerinden frekans ve yüzde değerleri tablo 7'de sunulmuştur.

Tablo 2. Araştırmaya Katılanların Ünvan Dağılımları

		Frekans	Yüzde
Ünvan	Akademisyen	23	41,1
	Öğretmen	33	58,9
	Toplam	56	100,0

Tablo 2'yi incelendiğinde; araştırmaya katılanların %41,1'i akademisyen, %58,9' unun ise öğretmen olduğu görülmektedir.

Tablo 3. Araştırmaya Katılanları Cinsiyete Göre Dağılımı

		Frekans	Yüzde
Cinsiyet	Erkek	34	60,7
	Kadın	22	39,3
	Toplam	56	100,0

Tablo 3'ü incelendiğinde; araştırmaya katılanların %60,7'sinin erkek, %39,3'ünün ise kadın olduğu görülmektedir.

Tablo 4. Araştırmaya Katılanların Yaş Dağılımları

		Frekans	Yüzde
Yaş grupları	20-30 yaş	3	5,4
	31-40 yaş	28	50,0
	41-50 yaş	22	39,3
	51 yaş ve üzeri	3	5,4
	Toplam	56	100,0

Tablo 4'ü incelendiğinde; araştırmaya katılanların %5,4'ünün 20-30 yaş aralığında, %50'sinn 31-40 yaş aralığında, %39,3'ünün 41-50 yaş aralığında, %5,4'ünün ise 51 yaşının üstünde olduğu görülmektedir.

Tablo 5. Araştırmaya Katılanların Kıdem Yılı Dağılımları

		Frekans	Yüzde
Kıdem grupları	1-10 yıl	16	28,6
	11-20 yıl	26	46,4
	21-30 yıl	11	19,6
	31 yıl ve üzeri	3	5,4
	Toplam	56	100,0

Tablo 5. İncelendiğinde; araştırmaya katılanların %28,6'sının 1-10 kıdem yılı aralığında, %46,4'ünün 11-20 kıdem yılı aralığında, %19,6'sının 21-30 kıdem yılı aralığında, %5,4'ünün ise 31 yıl ve üzeri kıdem yılı süresince çalışmış olduğu görülmektedir.

Tablo 6. Araştırmaya Katılanların Mezuniyet Derecesine Göre Dağılımları

		Frekans	Yüzde
Mezuniyet derecesi	Lisans	27	48,2
	Yüksek lisans	11	19,6
	Doktora	18	32,1
	Toplam	56	100,0

Tablo 6'yı İncelendiğinde; araştırmaya katılanların %48,2'sinin Lisans derecesine, %19,6'sının Yüksek lisans derecesine, %32,1'inin Doktora derecesine, sahip olduğu görülmektedir.

Araştırmaya katılanların; yaş dağılımlarına bakıldığında %94,6'sının 31 yaş ve üzerinde olduğu, kıdem yılı dağılımlarına bakıldığında %71,4'ünün 11 kıdem yılı ve üzerinde çalışmakta olduğu, mezuniyet dereceleri dağılımlarına bakıldığında ise %51,8'inin Lisanüstü derecesine sahip olduğu görülmektedir.

Bütün bu oranlara baktığımızda, araştırmanın anket bölümüne katılanların büyük bir çoğunluğunun konuyla ilgili eğitim kurumlarında çalışan tecrübeli akademisyen ve öğretmenlerden oluştuğunu söyleyebiliriz.

Aşağıda verilen tabloda, anket formu üzerinde sorulara verilen cevapların frekans ve yüzde değerleri toplu olarak gösterilmiştir.

Tablo 7. Anket Sorularına Verilen Cevapların Frekans Ve Yüzde Değerleri

Ünvan : Akademisyen (1), Öğretmen (2) 1 2 3 4

Cinsiyeti : E(1) , K(2) Yaşı : Kıdem yılı : Mezuniyet : Lisans(1), Yüksek Lisans(2), Doktora(3) f: Frekans Katılan kişi sayısı :56	**Kesinlikle katılıyorum**		**Katılıyorum**		**Katılmıyorum**		**Kesinlikle katılmıyorum**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
1- Mezuniyet sonrası en az sektörde 1 yıl iş tecrübesi olmalı	36	64,3	15	26,8	5	8,9	-	-
2-Eğitim alanında yüksek lisans yapmalı.	10	17,9	21	37,5	19	33,9	6	10,7
3-Kendi alanında yüksek lisans yapmalı	18	32,2	22	39,3	12	21,4	4	7,1
4-Mezun olmadan önce formasyon almalı.	36	64,3	12	25,0	4	7,1	2	3,6
5-Mezun olduktan sonra formasyon almalı	8	14,3	13	23,2	24	42,9	11	19,6
6-Etkili öğretebilmeli.	47	83,9	9	16,1	-	-	-	-
7-Öğrenme psikolojisini bilmeli.	41	73,2	15	26,8	-	-	-	-
8-Sınıf yönetiminde yeterli olmalı.	48	85,7	7	12,5	1	1,8	-	-
9-Öğretim yöntem ve tekniklerini etkili kullanabilmeli	49	87,5	6	10,7	1	1,8	-	-
10-Öğretmenliğe başvuranlar için mülakat yapılmalı.	15	26,8	16	28,6	14	25,0	11	19,6
11-Bilgi ve iletişim teknolojilerinde yeterli olmalı.	31	55,3	24	42,9	1	1,8	-	-
12-Alanla ilgili fuarları, sempozyumları takip etmeli.	29	51,8	26	46,4	1	1,8	-	-
13-Etkili iletişim kurabilmeli.	40	71,4	14	25,0	2	3,6	-	-
14-Farklı ölçme değerlendirme yöntemlerini bilmeli.	32	57,1	23	41,1	1	1,8	-	-
15-Alanıyla ilgili yeni gelişmeleri takip etmeli.	43	76,8	12	21,4	1	1,8	-	-
16-Alanıyla ilgili bir yabancı dil bilmeli.	26	46,4	26	46,4	3	5,4	1	1,8
17-Belirli bir süre yurt dışında alanıyla ilgili staj yapmış olmalı.	2	3,6	25	44,6	26	46,4	3	5,4
18-Mezuniyet sonrası alanıyla ilgili hizmet içi eğitimler almalı.	21	37,5	31	55,4	4	7,1	-	-
19-Hizmet öncesi eğitimler almalı.	18	32,1	29	51,8	9	16,1	-	-

20-Özel eğitime gereksinim duyan öğrenciler için özel eğitim dersleri almalı.	29	51,8	23	41,1	4	7,1	-	-
21-Öğretmenliğe atamada öğrenci hakkında öğretim elemanlarının da görüşleri alınmalı.	10	17,9	17	30,4	14	25	15	26,8
22-İş güvenliği alanında sertifikaya sahip olmalı.	12	21,4	27	48,2	15	26,8	2	3,6
23-Mezuniyet öncesi alanıyla ilgili temel kitapları okumuş olmalı.	28	50,0	24	42,8	3	5,4	1	1,8

SONUÇLAR

1- "Mezuniyet sonrası en az sektörde 1 yıl iş tecrübesi olmalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %64,3'ünün bu ifadeye kesinlikle katıldığı, %26,8'inin katıldığı, %8,9'unun ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%91,1) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının mezuniyet sonrası matbaa sektöründe en az 1 yıl iş tecrübesi olması gerektiği görüşünde oldukları söylenebilir.

2- "Eğitim alanında yüksek lisans yapmalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %17,9'u bu ifadeye kesinlikle katıldığı, %37,5'i katıldığı, %33,9'unun katılmadığı, %10,7'sinin kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların çoğunluğunun (%55,4) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının eğitim alanında yüksek lisans yapması gerektiği görüşünde oldukları söylenebilir.

3- "Kendi alanında yüksek lisans yapmalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %32,2'sinin bu ifadeye kesinlikle katıldığı, %39,3'ünün katıldığı, %21,4'ünün katılmadığı, %7,1'inin kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların çoğunluğunun (%71,5) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının kendi alanında yüksek lisans yapması gerektiği görüşünde oldukları söylenebilir.

4- "Mezun olmadan önce formasyon almalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %64,3'ünün bu ifadeye kesinlikle katıldığı, %25'inin katıldığı, %7,1'inin katılmadığı, %3,6'sının kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların büyük bir çoğunluğu (%89,3) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının mezun olmadan önce formasyon alması gerektiği görüşünde oldukları söylenebilir.

5- "Mezun olduktan sonra formasyon almalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %14,3'ünün bu ifadeye kesinlikle katıldığı, %23,2'sinin katıldığı, %42,9'unun katılmadığı, %19,6'sının kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların çoğunluğun (%62,5) bu ifadeye katılmadıkları, diğer bir deyişle öğretmen adaylarının mezun olduktan sonra formasyon alması gerektiği görüşünde olmadıkları söylenebilir.

6- "Etkili öğretebilmeli" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %83,9'unun bu ifadeye kesinlikle katıldığı, %16,1'inin katıldığı, görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamının (%100) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının etkili öğretebilme becerisinin olması gerektiği görüşünde oldukları söylenebilir.

7- "Öğrenme psikolojisini bilmeli" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %73,2'sinin bu ifadeye kesinlikle katıldığı, %26,8'inin katıldığı, görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamının (%100) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının öğrenme psikolojisini bilmesi gerektiği görüşünde oldukları söylenebilir.

8- "Sınıf yönetiminde yeterli olmalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %85,7'sinin bu ifadeye kesinlikle katıldığı, %12,5'inin katıldığı, %1,8'inin ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%98,2) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının sınıf yönetiminde yeterli olması gerektiği görüşünde oldukları söylenebilir.

9- "Öğretim yöntem ve tekniklerini etkili kullanabilmeli" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %87,5'inin bu ifadeye kesinlikle katıldığı, %10,7'sinin katıldığı, %1,8'inin ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%98,2) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının öğretim yöntem ve tekniklerini etkili kullanabilmeleri gerektiği görüşünde oldukları söylenebilir.

10- "Öğretmenliğe başvuranlar için mülakat yapılmalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %26,8'i bu ifadeye kesinlikle katıldığı, %28,6'sı katıldığı, %25'inin katılmadığı, %19,6'sının kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların çoğunluğunun (%55,4) bu ifadeye katıldıkları, diğer bir deyişle öğretmenliğe başvuran adaylar için mülakat yapılması gerektiği görüşünde oldukları söylenebilir.

11-"Bilgi ve iletişim teknolojilerinde yeterli olmalı." ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %55,3'ünün bu ifadeye kesinlikle katıldığı, %42,9'unun katıldığı, %1,8'inin ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%98,2) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının bilgi ve iletişim teknolojilerinde yeterli olması gerektiği görüşünde oldukları söylenebilir.

12-"Alanla ilgili fuarları, sempozyumları takip etmeli" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %51,8'inin bu ifadeye kesinlikle katıldığı, %46,4'ünün katıldığı, %1,8'inin ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%98,2) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının alanlarıyla ilgili fuarları, sempozyumları takip etmeleri gerektiği görüşünde oldukları söylenebilir.

13-"Etkili iletişim kurabilmeli." ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %71,4'ünün bu ifadeye kesinlikle katıldığı, %25'inin katıldığı, %3,6'sının ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%96,4) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının etkili iletişim kurabilmelerinin gerektiği görüşünde oldukları söylenebilir.

14-"Farklı ölçme değerlendirme yöntemlerini bilmeli" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %57,1'inin bu ifadeye kesinlikle katıldığı, %41,1'inin katıldığı, %1,8'inin ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%98,2) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının farklı ölçme değerlendirme yöntemlerini bilmeleri gerektiği görüşünde oldukları söylenebilir.

15-"Alanıyla ilgili yeni gelişmeleri takip etmeli" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %76,8'inin bu ifadeye kesinlikle katıldığı, %21,4'ünün katıldığı, %1,8'inin ise katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%98,2) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının alanıyla ilgili yeni gelişmeleri takip etmelerinin gerektiği görüşünde oldukları söylenebilir.

16-"Alanıyla ilgili bir yabancı dil bilmeli" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %46,4'ünün bu ifadeye kesinlikle katıldığı, %46,4'ünün katıldığı, %5,4'ünün katılmadığı, %1,8'inin ise kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%92,8) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının alanlarıyla ilgili bir yabancı dil bilmelerinin gerektiği görüşünde oldukları söylenebilir.

17-"Belirli bir süre yurt dışında alanıyla ilgili staj yapmış olmalı." ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %3,6'sının bu ifadeye kesinlikle katıldığı, %44,4'ünün katıldığı, %46,4'ünün katılmadığı, %5,4'ünün ise kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların çoğunluğunun (%51,8) bu ifadeye katılmadıkları, diğer bir deyişle öğretmen adaylarının belirli bir süre yurt dışında alanıyla ilgili staj yapmış olmalarının gerekmediği görüşünde oldukları söylenebilir.

18-"Mezuniyet sonrası alanıyla ilgili hizmet içi eğitimler almalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %37,5'inin bu ifadeye kesinlikle katıldığı, %55,4'ünün katıldığı, %7,1'inin katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%92,9) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının mezuniyet sonrası alanıyla ilgili hizmet içi eğitimler almasının gerektiği görüşünde oldukları söylenebilir.

19-"Hizmet öncesi eğitimler almalı." ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %32,1'inin bu ifadeye kesinlikle katıldığı, %51,8'inin katıldığı, %16,1'inin katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların büyük bir çoğunluğunun (%83,9) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının hizmet öncesi eğitimler almalarının gerektiği görüşünde oldukları söylenebilir.

20-"Özel eğitime gereksinim duyan öğrenciler için özel eğitim dersleri almalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %51,8'inin bu ifadeye kesinlikle katıldığı, %41,1'inin katıldığı, %7,1'inin katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%92,9) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının özel eğitime gereksinim duyan öğrenciler için özel eğitim dersleri almasının gerektiği görüşünde oldukları söylenebilir.

21-"Öğretmenliğe atamada öğrenci hakkında öğretim elemanlarının da görüşleri alınmalı" ifadesine ilişkin cevap dağılımlarında araştırmaya katılanların %17,9'unun bu ifadeye kesinlikle katıldığı, %30,4'ünün katıldığı, %25'inin katılmadığı, %26,8'inin ise kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların çoğunluğunun (%51,8) bu ifadeye katılmadıkları, diğer bir deyişle öğretmen adaylarının öğretmenliğe atamada öğrenci hakkında öğretim elemanlarının da görüşlerin alınmasının gerekmediği görüşünde oldukları söylenebilir.

22-"İş güvenliği alanında sertifikaya sahip olmalı." ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %21,4'ünün bu ifadeye kesinlikle katıldığı, %48,2'sinin katıldığı, %26,8'inin katılmadığı, %3,6'sının kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların çoğunluğunun (%69,6) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının iş güvenliği alanında sertifikaya sahip olmalarının.gerektiği görüşünde oldukları söylenebilir.

23-"Mezuniyet öncesi alanıyla ilgili temel kitapları okumuş olmalı" ifadesine ilişkin cevap dağılımlarında; araştırmaya katılanların %50'sinin bu ifadeye kesinlikle katıldığı, %42,8'inin katıldığı, %5,4'ünün katılmadığı, %1,8'inin ise kesinlikle katılmadığı görülmektedir. Elde edilen bulgular genel olarak değerlendirildiğinde katılımcıların tamamına yakınının (%92,8) bu ifadeye katıldıkları, diğer bir deyişle öğretmen adaylarının mezuniyet öncesi alanıyla ilgili temel kitapları okumuş olmalarının gerektiği görüşünde oldukları söylenebilir.

ÖNERİLER

Bu araştırmanın sonuçlarına göre, üniversitelerin çeşitli fakülte ve yüksekokullarında basım teknolojileri üzerine lisans düzeyinde eğitim veren ilgili bölümlerden (Örneğin Uygulamalı Bilimler Yüksekokulu, Basım Teknolojileri Bölümü) mezun olan kişilerin Teknik ve Endüstri Meslek Liselerinin ilgili bölümlerinde meslek öğretmeni olarak atanabilmeleri için aranacak kriterler hakkındaki öneriler aşağıda verilmiştir:

- Öğretmen adaylarından lisans diplomalarının yanı sıra formasyon sertifikası, en az bir yıllık sektörde çalışma ya da yüksek lisans yapma gibi şartlar aranabilir ama bu gün için meslek öğretmeni olarak atanabilmek için geçerli olan bir model yoktur (Çalıştay, 2015). İş hayatında kullanılan teknoloji çok hızlı değişmektedir. İşletmelerin talep ettiği kaliteli işgücü, ancak okul ile işletmelerin işbirliği ile yetiştirilebilir. Mesleki ve Teknik eğitimde yeniden yapılanma, okul ile işletme işbirliği temeli üzerinden geliştirilmelidir. Kısa dönemde yapılması gerekli olan diğer bir etkinlik de, sistemde çalışan öğretmenlerin yeni teknolojileri izleyebilmeleri için, belirli bir süre sanayide deneyim kazanmalarını temin etmek olmalıdır (Doğan, 1997). Öğretmenler gerek hizmet öncesi gerekse hizmet anında eksiklerini tamamlamak için hizmet içi eğitime gereksinim duymaktadırlar. Özellikle "hizmet öncesinde verilen bilgilerin iş ortamında yetersiz kalması, çalışanlarda kariyer yapma isteğinin artması, değişime ve gelişmelere uyum zorunluluğu, bazı bilgi ve becerilerin sadece iş başında öğrenilmesi, öğrenme ve kendini geliştirme isteğinin olması gibi nedenler, hizmet içi eğitimi zorunlu kılmaktadır (Gökyer, 2002).

Yukarıda verilen literatür bilgisinde belirtildiği gibi öğretmenlerin atanmadan önce mutlaka öğretmenlik formasyon bilgisine sahip olması gerekir. Öğrencilerin öncelikle üniversitede okurken öğretmenlik formasyon sertifikası almalarına imkan sağlanmalıdır. Ayrıca öğrencilikleri sırasında bu sertifikayı alamayanlara mezuniyetten sonra da alma imkanı sağlanmalıdır. Bu araştırmanın anket sonuçları da bunu desteklemektedir.

- "Mezun olmadan önce formasyon almalı" ifadesine 56 kişinin büyük bir çoğunluğu (%89,3) katılmıştır.
- "Mezun olduktan sonra formasyon almalı" ifadesine 56 kişinin çoğunluğu (%62,5) katılmamıştır.

Bu ifadeye katılmayanlar, üniversitede okurken formasyon alma imkanının verilmesini daha doğru bulmaktadırlar çünkü mezun olduktan sonra formasyon almanın zaman kaybı olduğunu düşünebilirler. Bu görüşlerinde haklı olabilirler. Ancak çeşitli nedenlerden dolayı mezun olmadan önce formasyon alamamış mezunlara da formasyon alma hakkı tanınmalıdır.

Yukarıda verilen literatür bilgisinden de anlaşılacağı gibi, çağımızın meslek öğretmeninin sadece okuldan aldığı bilgilerle yetinmemesi ve sektörün beklediği uygulama becerileri açısından da yeterli olması gerekmektedir. Meslek öğretmeni adaylarından kendi alanında mezuniyet sonrası 1 yıl iş tecrübesi alması ve bunu belgelendirmesi beklenmelidir. Ayrıca kendi alanıyla ilgili olarak hizmet öncesi eğitimler alması ve mezuniyet sonrası hizmetiçi eğitimler alması gerekmektedir. Bu araştırmanın anket sonuçları da bunu desteklemektedir.

- "Mezuniyet sonrası en az sektörde 1 yıl iş tecrübesi olmalı" ifadesine 56 kişinin tamamına yakını (%91,1) katılmıştır.
- "Mezuniyet sonrası alanıyla ilgili hizmet içi eğitimler almalı" ifadesine 56 kişinin tamamına yakını (%92,9) katılmıştır.
- "Hizmet öncesi eğitimler almalı." ifadesine 56 kişinin büyük bir çoğunluğu (%83,9) katılmıştır.

- "Belirli bir süre yurt dışında alanıyla ilgili staj yapmış olmalı." ifadesine 56 kişinin çoğunluğu (%51,8) katılmamıştır. Yurt dışı stajı katılımcıların çoğu tarafından çeşitli nedenlerle zor ya da gereksiz görülmüş olabilir. Bu nedenler; yurt dışı stajının maliyetinin yüksek olması, yabancı dil yetersizliği ve çeşitli zorluklarının olduğunun düşünülmesi olabilir. Ancak, öğretmen adaylarının yabancı dil seviyeleri yeterli olsa ve stajla ilgili bürokratik işlemler hakkında, staj yeri bulma, ve stajyerlerin yaşamsal giderleri için biraz maddi destek sağlanması konularında devlet, üniverisiter, işletmeler ve STK'lar tarafından destek sağlanması durumunda, yurt dışında staj çok cazip olabilir ve öğretmen adaylarına mesleki bilgi ve görgülerini artırmalarının yanısıra farklı bir bakış açısı kazandırabilir.

Yukarıda verilen literatür bilgisinden de anlaşılacağı gibi, çağımızın meslek öğretmeninin sadece üniversite mezunu olması yeterli görülmemekte Yüksek Lisans yapması ve çeşitli faaliyetlere katılarak yenilikleri ve gelişmeleri takip etmesi, alanıyla ilgili temel kitapları okuması, araştırması ve kendini geliştirmesi gerekmektedir. Bu araştırmanın anket sonuçları da bunu desteklemektedir.

- "Kendi alanında yüksek lisans yapmalı" ifadesine 56 kişinin çoğunluğu (%83,9) katılmıştır.
- "Eğitim alanında yüksek lisans yapmalı" ifadesine 56 kişinin çoğunluğu (%55,4) katılmıştır.
- "Alanıyla ilgili yeni gelişmeleri takip etmeli" ifadesine 56 kişinin tamamına yakını (%98,2) katılmıştır.
- "Bilgi ve iletişim teknolojilerinde yeterli olmalı" ifadesine 56 kişinin tamamına yakını (%98,2) katılmıştır.
- "Alanla ilgili fuarları, sempozyumları takip etmeli" ifadesine 56 kişinin tamamına yakını (%98,2) katılmıştır.
- "İş güvenliği alanında sertifikaya sahip olmalı" ifadesine 56 kişinin çoğunluğu (%69,6) katılmıştır.
- "Mezuniyet öncesi alanıyla ilgili temel kitapları okumuş olmalı" ifadesine 56 kişinin tamamına yakını (%92,8) katılmıştır.
- Bilgi toplumunda öğretmenin temel rolü, öğrenme ortamının merkezine öğrenciyi alarak, bilgiye nasıl ulaşılacağını ve bundan nasıl yararlanılacağını uygun ortamlar hazırlayarak öğretmektir. Bilginin seçimi konusunda uzman olan öğretmenler, temel bilgiyi öğrenciye kazandırabilmelidir. Bu da öğrenci için öğrenmeyi öğrenmek anlamına gelir. Ancak burada öğretmen, öncelikle öğrencisini iyi tanımalı, onun öğrenme düzeyine uygun öğrenme imkânları sunmalı, öğrenmeyi öğrencisine kolaylaştırarak, onu doğru yönde yönlendirmelidir (Balay, 2004). Öğretmenlerin hayat boyu öğrenme süreci içerisinde kendilerini hem mesleki hem öz yeterlik hem de sosyo kültürel bakımdan yenilemeleri ve toplumun onlardan beklentilerini karşılayacak düzeyde geliştirmeleri gerekmektedir (Sanal, 1999). Öğretmenlik mesleği daha cazip hale getirilecek; öğretmen yetiştiren fakülteler ile okullar arasındaki etkileşim güçlendirilecek; öğretmen yetiştirme ve geliştirme sistemi, öğretmen ve öğrenci yeterliliklerini esas alan, kişisel ve mesleki gelişimi sürekli teşvik eden, kariyer gelişimi ve performansa dayanan bir yapıda düzenlenecektir (Onuncu Kalkınma Planı, 2013).

Yukarıda verilen literatür bilgilerinin de desteklediği gibi öğretmenlerin atanmadan önce pek çok kişisel özelliklere ve öğretmenlik mesleğinin gerektirdiği bilgi ve yeterliklere sahip olması gerekir. Bu araştırmanın anket sonuçları da bunu desteklemektedir.

- "Etkili öğretebilmeli" ifadesine 56 kişinin tamamı (%100) katılmıştır.

- "Öğrenme psikolojisini bilmeli" ifadesine 56 kişinin tamamı (%100) katılmıştır.

- "Sınıf yönetiminde yeterli olmalı" ifadesine 56 kişinin tamamına yakını (%98,2) katılmıştır.

- "Öğretim yöntem ve tekniklerini etkili kullanabilmeli" ifadesine 56 kişinin tamamına yakını (%98,2) katılmıştır.

- "Etkili iletişim kurabilmeli" ifadesine 56 kişinin tamamına yakını (%96,4) katılmıştır.

- "Farklı ölçme değerlendirme yöntemlerini bilmeli" ifadesine 56 kişinin tamamına yakını (%98,2) katılmıştır.

- "Alanıyla ilgili bir yabancı dil bilmeli" ifadesine 56 kişinin tamamına yakını (%92,8) katılmıştır.

- "Özel eğitime gereksinim duyan öğrenciler için özel eğitim dersleri almalı" ifadesine 56 kişinin tamamına yakını (%92,9) katılmıştır.

- "Öğretmenliğe başvuranlar için mülakat yapılmalı" ifadesine 56 kişinin çoğunluğu (%55,4) katılmıştır. Bu ifadeye katılmayanların oranı da yüksektir (%44,6). Katılmayanların çekincesi, mülakatı yapacak kişilerin subjektif ya da kişisel değerlendirme yapabilecekleri ihtimali olabilir. Bu ihtimali önlemek için, mülakatı yapacak kişilerin farklı kesimlerden ve tarafsızlıkları bilinen kişilerden seçilmesi ve standartlaştırılmış bir mülakat sınavını uygulamaları için, gerekli düzenlemeler yapılmalıdır.

- "Öğretmenliğe atamada öğrenci hakkında öğretim elemanlarının da görüşleri alınmalı" ifadesine 56 kişinin çoğunluğu (%56,8) katılmamıştır. Bu ifadede katılımcılar, öğretmen adayları için öğretim elemanlarının görüşlerinin alınmasını gereksiz görmüş olabilirler. Çünkü, ‘‘aday ilgili bölümden mezun olup diplomayı almaya hak kazandıysa neden tekrar öğretim elemanlarının referansına ihtiyaç duyuluyor’’ sorusu akla gelebilir. Ancak, burada şöyle bir ayrıntı vardır. Öğrenci, öğretmenlik ünvanı veren bir fakülteden mezun olmadığına göre, bütün mezunların öğretmenlik mesleğini yapabilecek kişilik özellikleri, yetenek, yeterlilik ve kapasiteye sahip olması mümkün olmayabilir. Bu konuda öğretim elemanları 4 yıl süresince gözlemledikleri öğrenciler hakkında doğru yorumlar yapabilirler. Ayrıca öğretmen adaylarına, göreve başlamadan önce güvenilirliği kanıtlanmış psikolojik yeterlilik testleri de uygulanmalıdır.

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DETERMINING VOCATIONAL AND TECHNICAL EDUCATIONAL PROBLEMS AND ANALYZING THE SOLUTION OFFERS

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ABSTRACT: Technical education has a huge importance in societies' reaching the developed level of prosperity. Vocational and technical education must be planned rationally according to the man power, economical activity and sectoral requirements of this country. Plannings and investments which are not done according to the needs of the country cause to waste of resources and disappointment. One of the most important issues that must be paid attention after planning is students' being guided to the occupations according to their abilities and achievements. It is an obligation that in this period in which the notion of lifelong learning is valid, formal and non-formal education that proceeds from pre-school to postdoctoral is determined appropriate for today's needs and continuity in education is ensured. Another important issue is the necessity of appropriateness of vocational teachers' abilities for our age. High investment finance of vocational and technical education is the other issue. In vocational and technical education there are lots of problems similar to the primary problems mentioned in this study. Different vocational education models and applications exist in the world. Success level of these also differs from others. In the solution of vocational and technical educational problems of our country, models and structures of other countries should also be considered. The aim of this research is to make suggestions to be able to perform vocational technical education according to today's needs and to be able to get successful results. In this study, the problems of vocational and technical education in our country are determined by considering the research and activities about this issue. In addition, while researching solution offers, the relevant workshops organized previously in our country is also examined.

Key Words: vocational technical education, current problems of vocational education, vocational educational workshop, professional development, high-quality workforce, finance of vocational education, school-industry cooperation

MESLEKİ VE TEKNİK EĞİTİMİN SORUNLARININ BELİRLENMESİ VE ÇÖZÜM ÖNERİLERİNİN İNCELENMESİ

ÖZET: Toplumların gelişmiş refah düzeyine ulaşmasında mesleki teknik eğitimin büyük bir önemi vardır. Bir ülkenin insan gücü, ekonomik faaliyetleri ve sektörel ihtiyaçlarına göre mesleki ve teknik eğitimi, rasyonel bir şekilde planlanmalıdır. Ülkenin ihtiyaçlarına uygun yapılmayan planlama ve yatırımlar, kaynak israfına ve hayal kırıklığına neden olmaktadır. Planlamadan sonra dikkate alınması gereken en önemi konulardan birisi, öğrencilerin kabiliyetleri ve başarılarına göre doğru mesleğe yönlendirilmeleridir. Yaşam boyu öğrenme kavramının geçerli olduğu bu dönemde, okul öncesinden doktora sonrasına kadar süren örgün ve yaygın eğitim kurumlarının, günümüz ihtiyaçlarına uygun olarak belirlenmesi ve eğitimde sürekliliğin sağlanması bir zorunluluktur. Diğer önemli bir konu ise meslek öğretmenlerinin yeterliliklerinin çağımıza uygun olmasının gerekliliğidir. Mesleki ve teknik eğitimin yatırım finansmanının çok yüksek olması da başka bir sorundur. Mesleki ve teknik eğitim alanında bu çalışmada bahsedilen başlıca sorunlara benzer çok sayıda sorun vardır. Dünyada farklı mesleki eğitim modelleri ve uygulamaları görülmektedir. Bunların başarı düzeyleri de farklılık göstermektedir. Ülkemizde var olan mesleki ve teknik eğitimin problemlerinin çözülmesinde, farklı ülkelerdeki modeller ve yapılar da dikkate alınmalıdır. Bu araştırmanın amacı, mesleki teknik eğitimin günümüz ihtiyaçlarına uygun olarak yapılabilmesi ve başarılı sonuçların alınabilmesi için önerilerde bulunmaktır. Bu çalışmada ülkemizde var olan mesleki ve teknik eğitimin sorunları, konuyla ilgili yapılmış olan araştırmalar ve faaliyetler dikkate alınarak belirlenmiştir. Ayrıca çözüm önerileri araştırılırken, ülkemizde daha önce konuyla ilgili yapılan çalıştaylar da incelenmiştir.

Anahtar Kelimeler: mesleki teknik eğitim, mesleki eğitimin güncel sorunları, mesleki eğitim çalıştayı, mesleki gelişim, yüksek kaliteli işgücü, mesleki eğitimin finansmanı, okul-sanayi işbirliği

GİRİŞ

Günümüzde bir ülkenin kaynaklar bakımından ve fiziksel olarak büyük olması gerçekten güçlü ve büyük olduğu anlamına gelmemektedir. Bir ülkenin en önemli gücü yetişmiş insan gücüdür. Bu gerçeği erken kavramış olan toplumlar eğitime gereken önemi vererek eğitimi günümüz ihtiyaçlarına göre ve teknolojinin gereklerini yerine getirecek şekilde yeniden yapılandırmışlardır.

Türk ekonomisinin gelişmiş ülkeler ile küresel dünya pazarında rekabet edebilmesi için nitelikli bir eğitim sistemine ihtiyacı vardır. Okul öncesi eğitimden yükseköğretim düzeyine kadar bütüncül olarak ele alınması gereken eğitim sistemi, ülkemizin kalkınması ve coğrafyasında söz sahibi olabilmesi için temel koşuldur. Araştıran, geliştiren, girişimci, mesleki yeterlikleri yüksek yirmibirinci yüzyıl becerilerine sahip bireyler yetiştirmek bu amaca ulaşabilmek için gerekli koşullardan bazılarıdır. **(**Adıgüzel, Çardak, 2009)

Geçmişten günümüze Dünya'da söz sahibi olan ülkelerin ekonomilerinin güçlü olduğunu görmekteyiz. Ekonomileri güçlü ülkelerin dünyada söz sahibi olmaları, nitelikli insan gücünü yetiştirmede eğitimin özellikle de mesleki teknik eğitimin üstlendiği rolü 21.yüzyılın teknolojisi ile bütünleştirmesinden kaynaklanmaktadır. Mesleki ve teknik eğitim en genel anlamda, bireysel ve toplumsal yaşam için zorunlu olan bir mesleğin gerektirdiği bilgi, beceri, tavır ve meslek alışkanlıkları kazandırarak bireyi zihinsel, duygusal, sosyal, ekonomik ve kişisel yönleriyle dengeli biçimde geliştirme sürecidir **(**Uçar, Özerbaş, 2013).

Ülkeler, sanayinin ihtiyaç duyduğu iş gücü gereksinimini, uluslararası deneyimlerden de yararlanarak kendi dinamiklerine göre oluşturdukları mesleki teknik eğitim yöntemleri ile karşılamaktadırlar. Dünyada bu amaçla üç farklı sistem uygulanmaktadır. Bunlar; Okul-işyeri temeline dayalı eğitim uygulayanlar, sadece okula dayalı eğitim uygulayanlar ve her iki anlayışı da benimseyen ama sürekli arayışlar içerisinde olan ülkelerdir. Genç ve dinamik nüfus yapısıyla Türkiye gelişmiş ülkelere göre önemli bir avantaja sahiptir. Bu yüzden, Türkiye'de de yukarıda belirtilen her iki anlayışta benimsenmiş ama sürekli yeni arayışlar mevcuttur (Binici, Arı, 2004).

Yeniden yapılanmada okul-işletme işbirliği, yapılanmanın odak noktasını oluşturmaktadır. MEB'in elinde bulunan bazı yetki sorumluluk ve olanaklar yerel düzeye verilmelidir. Okullar, çevredeki iş hayatının ihtiyaçlarını belirleyebilmeli, bu ihtiyaçları karşılayacak şekilde programları geliştirebilmeli, geliştirilen programları yürütebilecek şekilde öğretmenleri yetiştirebilmeli ve gerekli araç ve gereci hazırlayabilmelidir. Okullar işgücü piyasasını analiz etmeli ve mezunları izlemek suretiyle bilgi toplamalı ve gerekli düzenlemeleri yapabilmelidir (Doğan, 1997).

Mesleki teknik eğitimin amacı, genel olarak, bireyleri sanayi, ticaret ve hizmet sektörlerinde istihdam için nitelikli iş gücü olarak eğitmek ve yetiştirmek, mesleklerinin devamı olan yüksek öğretim kurumlarına geçiş için gerekli temel eğitimi vermektir (Eşme, 2007).

Başka bir deyişle, meslekî ve teknik eğitimin temel amaçları; gençleri hayata ve bir üst öğrenime hazırlamak, sektöre nitelikli iş gücü yetiştirmek ve istihdamdaki iş gücünün bilgi, beceri ve yetkinliklerini arttırmaktır **(**T.C. MEB, 2013).

Teknolojideki ve mesleklerdeki hızlı değişim, gelişen her teknolojiyi okula taşımanın sürdürülebilirliğini adeta imkânsız kılmaktadır. Okullarda mesleğe ait temel bilgiler, değerler ve beceriler verilmeli, mesleğe ait ileri düzeyde beceri eğitimi ise gerçek ortamlarda yani işyerlerinde verilmelidir. Öğretmenlerin meslekî yeterlilikleri işgücü piyasalarının talepleri ile örtüşmeli, okullarda bulunan her türlü donanım ile ilgili fırsat eşitliği sağlanmalı, bütün müfredat yeterliliğe dayalı ölçülebilir ve kalite güvencesi sağlanmış bilgi, beceri ve yetkinlikleri içermelidir (T.C. MEB, 2013).

Ortaokulu bitiren öğrencilerden akademik başarısı yüksek olanlar çoğunlukla genel ortaöğretim okullarını tercih ederken orta ya da düşük akademik başarı gösterenler ise meslekî ve teknik eğitim okul ve kurumlarını tercih etmektedirler (T.C. MEB, 2013).

Yüksek öğrenimde Mesleki Teknik Eğitim iki yıllık Meslek Yüksekokulları ve dört yıllık Mesleki ve Teknik Eğitim Fakülteleri aracılığıyla yürütülmekteydi. İki yıllık meslek yüksekokulları sanayinin ihtiyacı olan eleman (Tekniker) ihtiyacını sağlamaya yönelik olarak kurulmuşlardır. Dört yıllık eğitim verilen Mesleki, Endüstriyel Sanatlar, Teknik ve Ticaret Turizm Eğitim Fakültelerinin temel amacı ise mesleki ortaöğretim kurumlarının öğretmen ihtiyacını karşılamaktı. (Şahin, Fındık, 2008). Teknik Eğitim Fakülteleri, 2009/15612 sayılı Bakanlar kurulu kararı ile kapatılmıştır. Onun yerine Teknoloji Fakülteleri ve Uygulamalı Bilimler Yüksekokulu açılmıştır. Teknik Eğitim Fakültesi diploması olanlar halen %5 gibi çok düşük bir oranda teknik öğretmen olarak atanabilmektedir. Ancak Teknoloji Fakülteleri ve Uygulamalı Bilimler Yüksekokullarının ilgili bölümlerinden mezun olanların öğretmen olabilmesi için henüz bir model oluşturulmamıştır.

OECD'nin 2007-2010 yılları arasında sürdürdüğü "İş İçin Öğrenme" (Learning for Jobs) konulu çalışmanın sonuç raporunda katılımcı tüm ülkelere ve kamuoyuna iş piyasasının ihtiyaçları, öğretmenler ve eğitimciler, işyeri eğitimi ve politika araçları konularında politika önerilerinde bulunulmuştur. Bu önerilere göre öğrenmeyi daha etkin ve verimli hale getirmek için eğitim ile iş bağlantısı iyi kurulmalı ve aynı zamanda öğrenme doğrudan işyerlerine, çıraklık eğitimine ve diğer işyerindeki eğitim ortamlarına taşınmalıdır. Eğitim ile çalışma hayatı arasındaki bağlantıyı bütün düzeylerde sağlayabilmek için hükümet ile işverenler ve sendikalar arasında etkili bir ortaklık kurulmalıdır. Öğrenciler ve mezunlar istatistikî veriler ve güçlü kariyer sistemi ile işgücü piyasasına giriş öncesinde bilgilendirilmelidir (T.C. MEB, 2013).

Günümüzdeki mesleki ve teknik eğitim sistemine bakıldığında iki mesleki eğitim modeline rastlanmaktadır. Bu mesleki ve teknik eğitim modelleri tam zamanlı mesleki eğitim ve çıraklık eğitimi modelleridir. Tam zamanlı mesleki ve teknik eğitim modelinde eğitim okul içinde 8-10 yıllık zorunlu temel eğitime dayalı olarak verilmektedir. Zorunlu temel eğitim alındıktan sonra bazı gençler iş yaşamına yönlendirilirken, belirli başarıyı sağlamış gençler ise yükseköğretime yönlendirilmektedir. Aynı zamanda pahalı olan bu model okul donanımının sürekli olarak yenilenmesini de gerektirir. Diğer bir model olan çıraklık sisteminde ise devlet ve özel işletmelerin mesleki eğitim hususunda işbirliği yaptığı görülmektedir. Bazı Avrupa Birliği (AB) ülkelerinde, Amerika Birleşik Devletleri'nde (ABD) ve Japonya'da 8-10 yıllık zorunlu temel eğitimi tamamladıktan sonra bu eğitime başlanmaktadır. İkili sistem olarak da tanımlanan bu modelde okullarda teorik eğitim verilirken uygulama işyerlerinde yapılmaktadır. Gençler bazı günler işyerine giderken bazı günlerde okullarda eğitim görmeye devam etmektedir. Tam zamanlı mesleki teknik eğitim modeline ağırlık veren ülkeler Belçika, İsveç, Fransa ve İtalya iken; çıraklık eğitimi modeline Almanya, İsviçre, Danimarka ve Avusturya gibi ülkeler ağırlık vermektedir. Bunun yanı sıra ABD, Hollanda ve İngiltere gibi her iki modele ağırlık veren ülkeler de bulunmaktadır. (Uçar, Özerbaş, 2013).

Almanya'da Mesleki ve Teknik Eğitim

Avrupa Birliği'nin en önemli ekonomik gücü olan Almanya'yı mesleki ve teknik eğitim sistemleri açısından diğer ülkelerle kıyaslarsak Almanya'da tam zamanlı meslek okulları çıraklık okulları gibi yaygın değildir. Tam zamanlı meslek okulları en azından orta büyüklükteki kentlerde yer almaktadır. Küçük yerleşim birimlerindeki bireyler bu okullara toplu taşıma araçlarını kullanarak gidip gelmektedirler. Bazı meslek okullarında öğretmen/eğitimciler için yatılı kalma olanağı vardır. Ayrıca, özürlüler için kırsal kesimlerde yatılı meslek okulları bulunmaktadır (Foster, 2005). Almanya'da meslek okulları dikey olarak genelde temel ve uzmanlaşma olarak adlandırılan iki bölüme ayrılmaktadır. Birinci bölüm, okulun ilk yılını kapsamaktadır ve tam zamanlı olarak meslek öncesi eğitim olarak ya da "dual" sistemde yarım zamanlı olarak tamamlanabilmektedir (Arnold ve Münch, 1996). Almanya'da mesleki ve teknik eğitim "ikili" (dual) ya da çıraklık sistemiyle olan ilişkisine göre tanımlanır. Diğer ülkelerde ise, mesleki ve teknik eğitim kurumsal olarak ya sistemin üniversiteye yönelik olmayan okul sonrası programlarla ya da üniversiteye giden yolu göreceli olarak ne derecede kapatmasına bağlı olarak tanımlanır. Fransa gibi bazı Avrupa ülkelerinde akademik, teknik ve mesleki eğitim arasında bir ayrım yapılmamaktadır (Keating ve ark., 2002), (Uçar, Özerbaş, 2013).

Japonya'da Mesleki ve Teknik Eğitim

Japon mesleki teknik eğitim sistemi 2. Dünya Savaşı sonrasında Almanya mesleki teknik eğitim sistemi örnek alınarak oluşturulmuştur. Günümüzde bu iki mesleki ve teknik eğitim sistemi dünyada en başarılı uygulamalar arasında gösterilmektedir. Japonya'da 9 yıllık zorunlu eğitim sonrası öğrenciler ortaöğretimde genel ve teknik eğitim olarak ikiye ayrılırlar. Teknik okullardan mezun olan öğrenciler 2 yıllık meslek yüksek okulları ya da ileri meslek kurslarına devam edebilirler. Liseler öğrencilerin devam etme durumuna göre 3 yıl süren tam, 4 yıl süren yarım ve uzaktan eğitim olmak üzere üç gruba ayrılmaktadır. Çoğu genel lise akademik konulara ek olarak bir meslek programı seçebilmektedirler. Öğrenci sayıları yalnızca akademik program uygulayan liselerde % 40 iken, yalnız mesleki eğitim veren liselerde % 24 dolayındadır. Ancak, liselerin % 60'ı öğrencileri yükseköğretime hazırlamaktadır (Uçar, Özerbaş, 2013).

ABD'de Mesleki ve Teknik Eğitim

ABD'de 1. sınıftan 12. sınıfa kadar eğitim finansmanını kamu sağlamaktadır. Bu eğitim parasız olarak sağlanmaktadır. Eğitim sistemine 6 yaşında giren bir öğrenci 18 yaşında mezun olmaktadır. Ancak, mesleki eğitim lise eğitimine kadar (9.-12. sınıflar) başlamamaktadır. Eyaletlere ve eyaletlerin eğitim sistemine bağlı olarak, öğrenciler ortaöğretim düzeyinde meslek eğitimi almak için birkaç seçeneğe sahiptir. Bu 9., 10., 11. hatta bazen yalnızca 12. sınıfta olabilmektedir. Bu programlar genellikle öğrencileri şu seçeneklerden birine hazırlamaktadır (Uçar, Özerbaş, 2013):

1) Meslek yüksekokullarına devam etmek,
2) Diğer yükseköğretim kurumları ve çıraklık eğitimine gitmek.

Türkiye'de Mesleki ve Teknik Eğitim

Gelişmiş ülkeler, bireylere verilen mesleki ve teknik eğitimde bireylerin teknolojiyi anlayıp kullanabilecek temel becerilere, iletişim ve problem çözme becerilerine ve işbirliği içinde çalışabilecek disipline sahip olmasına önem vermektedirler. Türkiye'de bugün verilen mesleki ve teknik eğitimde Onuncu (2014-2018) Beş Yıllık Kalkınma Planları'nın önemi büyüktür. Onuncu Beş Yıllık Kalkınma Planına göre; (Onuncu Kalkınma Planı, 2013)

- Eğitim sistemi ile işgücü piyasası arasındaki uyum; hayat boyu öğrenme perspektifinden hareketle iş yaşamının gerektirdiği beceri ve yetkinliklerin kazandırılması, girişimcilik kültürünün benimsenmesi, mesleki ve teknik eğitimde okul-işletme ilişkisinin orta ve uzun vadeli sektör projeksiyonlarını dikkate alacak biçimde güçlendirilmesi yoluyla artırılacaktır.

- Ortaöğretim ve yükseköğretim düzeyindeki mesleki ve teknik eğitimde, program bütünlüğü temin edilecek ve nitelikli işgücünün yetiştirilmesinde uygulamalı eğitime ağırlık verilecektir.

Türkiye ile Avrupa Birliği arasında 2000 yılında imzalanan "Türkiye'deki Mesleki Eğitim ve Öğretim Sisteminin Güçlendirilmesi Projesi" (MEGEP) anlaşması kapsamında eğitim programlarında yer alan modüller Türkiye'nin istihdam ihtiyaçlarına göre, genç işgücünü nitelikli eleman olarak sektörün talebine cevap verecek şekilde yetiştirmeyi amaçlamaktadır. Proje kapsamında mesleki eğitim alanındaki yeni oluşum ile meslek okullarındaki programlarda modüler sistem uygulamasına geçilmiştir (Uçar, Özerbaş, 2013).

MEGEP kapsamında programlar, uluslararası meslek sınıflandırması doğrultusunda, meslek standartları, eğitim standartları ve meslekî yeterliklere göre hazırlanmıştır. Türkiye'de MEGEP 2004-2005 eğitim ve öğretim yılından itibaren pilot okullarda uygulanmaya başlanmış ve 2006-2007 eğitim ve öğretim yılı itibariyle tüm meslekî ve teknik eğitim kurumlarında kademeli olarak uygulamaya konulmuştur. Mesleki ve teknik eğitimin programlarındaki değişikliklerin yanı sıra mesleki ve teknik eğitim alanında kurumsal ve yasal değişiklikler gerçekleşmiştir. AB'ye üyelik sürecinde mesleki eğitim ve öğretim alanında kurumsal yenilikler yapılmıştır. AB Topluluk Programlarına katılımında sorumluluk üstlenecek Ulusal Ajans ve bir mesleğin başarılı olarak yürütülmesi için gerekli standartları belirleyen Mesleki Yeterlilik Kurumu oluşturulmuştur (Uçar, Özerbaş, 2013).

Ülkemizde mesleki ve teknik eğitimin gelişmesi için eğitim–öğretim programlarında, kurumsal yapıda ve yasal anlamda değişiklik yapılmıştır. Milli Eğitim İstatistiklerine bakıldığında yıllar geçtikçe mesleki ve teknik eğitim okullarına talep artışı olduğu görülmektedir (Tablo 1), (TÜİK, 2015).

Tablo 1. Mesleki ve Teknik Ortaöğretimde Yılına Göre Okul, Öğretmen Sayısı (TÜİK, 2015)

Okul Türü ve Öğretim Yılı Type of School and Educational Year		**Okul**$^{(6)}$ School$^{(6)}$	Teacher$^{(2)(4)}$ **Toplam** Total	**Erkek** Males	**Kadın** Females
Mesleki ve Teknik Ortaöğretim - Vocational and Technical Secondary Education					
	2006/' 07	4 244	84 276	51 149	33 127
	2007/' 08	4 450	84 771	51 027	33 744
	2008/' 09	4 622	88 924	53 229	35 695
	2009/' 10	4 846	94 966	56 259	38 707
	2010/' 11	5 179	104 327	61 053	43 274
	2011/' 12	5 501	113 098	65 599	47 499
	2012/' 13	6 204	135 502	76 202	59 300
	2013/' 14	7 211	161 288	87 894	73 394
Resmi	**- Public**				
	2006/' 07	4 223	84 032	51 051	32 981
	2007/' 08	4 429	84 449	50 884	33 565
	2008/' 09	4 595	88 615	53 077	35 538
	2009/' 10	4 824	94 649	56 114	38 535
	2010/' 11	5 155	104 003	60 899	43 104
	2011/' 12	5 456	112 409	65 272	47 137
	2012/' 13	6 078	133 321	75 325	57 996
	2013/' 14	6 785	153 816	85 032	68 784
Özel	**- Private**				
	2006/' 07	21	244	98	146
	2007/' 08	21	322	143	179
	2008/' 09	27	309	152	157
	2009/' 10	22	317	145	172
	2010/' 11	24	324	154	170
	2011/' 12	45	689	327	362
	2012/' 13	126	2 181	877	1 304
	2013/' 14	426	7 472	2 862	4 610

Tablo 1'i incelediğimizde 2006-2014 yılları arasında mesleki teknik ortaöğretimde okullaşma oranında sürekli bir artışın olduğu görülmektedir. Özellikle son yıllarda özel mesleki ve teknik ortaöğretim kurumlarında okullaşma ve öğretmen sayıları bakımından ciddi bir artış olmuştur. Bu bağlamda mesleki ve teknik eğitimin yatırım finansmanı açısından devletin yükünün biraz azaldığı görülmektedir. Bu durum önemli bir gelişmedir. Özel mesleki ve teknik ortaöğretim kurumlarının artış oranı bu hızla devam ederse birkaç yıl sonra devlet ve özel mesleki ve teknik ortaöğretim kurumlarının sayıları arasında büyük bir fark kalmayacaktır.

Tablo 1'de öğretmenlerin cinsiyeti açısından sayılarını karşılaştırdığımızda, kadın ve erkek öğretmenlerin sayısının resmi mesleki ve teknik ortaöğretim okullarında yıllara göre hemen hemen aynı oranda arttığını görebiliriz. Ancak bu durum özel okullarda farklılık göstermektedir. Özellikle 2011-2014 yılları arasında bayan öğretmenlerin sayısı yüksek bir oranda artmıştır.

YÖNTEM

Bu araştırmada, mesleki ve teknik eğitimin ülkemizdeki mevcut durumu ve var olan sorunları, daha önce bu konuda yapılan araştırmalar ve çalışmalar da dikkate alınarak, gözden geçirilmiştir. Ülkemizde daha önce konuyla ilgili olarak 2012 yılında Trabzon'da ve 2015 yılında İstanbul'da yapılan çalıştayların sonuçları da incelenmiştir. Ayrıca mesleki teknik eğitimin günümüz ihtiyaçlarına uygun olarak yapılabilmesi ve başarılı sonuçların alınabilmesi için geliştirilen farklı görüşler analiz edilerek önerilerde bulunulmuştur.

BULGULAR

Bu çalışmada öncelikle mesleki ve teknik eğitimin sorunları, çözüm önerileri ve uygulanabilecek örnek model önerileri için ülkemizde yapılmış olan iki çalıştayın sonuç ve önerileri incelenmiştir. Ayrıca konuyla ilgili olarak daha önce yapılmış olan akademik çalışmalar da araştırılmıştır.

Mesleki ve Teknik Eğitim Çalıştayı (2012), Trabzon

Mesleki ve teknik eğitimin mevcut durumunu görmek ve geleceğini belirlemek için düzenlenen bu çalıştayda; çeşitli çalışma grupları oluşturularak mesleki ve teknik eğitimin durumu, yön veren kurum ve kuruluşların tutumları, sektörel işbirliği, öğretmen ve öğrencilerin kaliteleri, staj uygulamaları ve finansmanı, yaygın ve informal öğrenme, öğrenci profili ve toplumsal algılar gibi pek çok konuda sorunlar belirlenerek çözüm önerilerinde bulunuldu. Çalıştayın sonuç raporunda sunulan başlıca sorunlar ve çözüm önerileri aşağıda sıralanmıştır (Çalıştay, 2012):

- Mesleki ve teknik eğitimin en önemli sorunlarının başında sektörle işbirliği yetersizliği, öğretmen ve öğrencilerin kalitelerinin geliştirilmesi ile mesleki eğitimin toplumsal algıları yer aldı.

- Bununla birlikte özel sektörün mesleki eğitime yeterince destek vermediği, sanayinin ihtiyacı olan nitelikte insanın yetişmediği gibi sorunlar tespit edildi.

- Sektörle işbirliğinin geliştirilmesine yönelik çalışmaların yapılmasının çok önemli olduğu çünkü yetiştirilen öğrencilerin sektörde istihdam olduğu, dolayısıyla sektörün düşüncelerinin ve önerilerinin eğitim ve öğretim süreçlerine yansımasının gerektiği vurgulandı.

- Eğitim programları ve mesleki yönlendirmede eksiklikler: Kurumsal yapıdan kaynaklı sorunlar, öğretmen yetiştirmeden kaynaklı sorunlar, iş piyasası ihtiyaç ve beceri analizinin yapılmaması, kalite güvencesinin eksikliği, eğitici, kariyer ve rehberlik konularında eksiklik, beceri ve staj eğitiminde yetersizlik, öğretim programlarında eksiklikler, işletmelere verilen teşvikler, eğitici kaynaklı sorunlar, mevzuat dağınıklığı ve bürokrasi çokluğu, tanıtım eksikliği, akademik başarı düzeyi düşük öğrenci profili, yetersiz rehberlik hizmetleri ile yaygın ve örgün eğitimde uygulanan programlarda yeterlilikte uyumsuzluk.

- Raporun çözüm önerilerinde ise açılacak eğitim programlarının belirlenmesi, stajların tasarımı ve uygulanması gibi süreçlere ilişkin karar verme konusunda paydaşların da yer alacağı bir mekanizmanın oluşturulmasının önemine değinildi.
- Eğitim kalitesinin artırılması, mesleki rehberlik ve yönlendirmenin ilgili bilgi ve donanıma sahip uzmanlarca yapılmasının gerekliliği bildirildi.

- Mesleki ve teknik eğitim veren kurumlara mali ve idari esneklik kazandırılması gerektiği belirtilen raporda, öğretmen ihtiyacının da ilgili yüksek öğretim programları mezunlarına lisansüstü eğitim verilerek karşılanmasının önemi kaydedildi.

- Mevcut öğretmenlerin yeni teknolojilere ayak uydurabilmeleri için Bakanlık tarafından belli aralıklarla hizmet içi eğitim verilmesinin önemi vurgulanan raporda, dört yıllık eğitimin 3. senesinde 2 gün okul 3 gün işletme sisteminin oluşturulması, 4. yılda öğrencilerin sene boyunca işletmelerde eğitim görmelerinin gerektiği belirtildi. Mesleki ve teknik eğitimde kalite güvencesinin sağlanması gerektiği kaydedilen raporda, staj imkanın sağlayan işletmelere aldığı öğrenci oranında teşvik verilmesi talep edildi.

- Her meslek için dil seviyesinin belirlenmesi ve yabancı dil eğitiminin geliştirilmesi de çözüm önerileri arasında yer aldı.

- Toplumun mesleki ve teknik eğitimle ilgili algısında zayıflığın olduğu tespit edildi. Mesleki ve teknik eğitim, genel eğitimin bir ikincil sınıf okulu olduğu yönünde bir toplumsal algının olduğu ve bu algıyı düzeltmek hepimizin ortak amacı olması gerektiği vurgulandı.

- Mesleki teknik eğitimle ilgili olarak toplumdaki bu zayıf algının düzeltilebilmesi için; Milli Eğitim, Çalışma ve Sosyal Güvenlik ve Maliye bakanlıklarıyla sanayi ve ticaret odalarınca mesleki ve teknik eğitime yönelik etkili tanıtım yapılmasının gerekliliği belirtilen raporda, ücret politikalarının mesleki ve teknik okul mezunlarının lehine düzenlenmesinin gerekliliği ifade edildi. Bu kişilerin asgari ücret dışında tutulması, asgari ücret uygulamasının nitelikli eleman için uygulanmaması gerektiği de kaydedildi.

- Ayrıca bu zayıf algının düzeltilebilmesi için mesleki ve teknik eğitime giden öğrencilere meslek seçiminden önce etkin rehberlik hizmetinin verilmesinin çok önemli bir faktör olduğu tespit edildi.

- Taraflar öğretmen ve öğrenci kalitesinin geliştirilmesi ile ilgili talepte bulundu. Mesleki ve teknik eğitimde kalite güvence sisteminin oluşturulmasını istediler. Öğrenciye kazandırılmaya çalışılan beceri, tutum ve davranışların belli bir kalite güvencesi altında olmasını ve öğrencilerin ölçme ve değerlendirmesini, öğretmenlerin yerine okuldaki bağımsız bir birimin yapmasını istediler.

- Taraflar mesleki ve teknik eğitimle ilgili özel sektörün teşvik edilmesi talebinde de bulundular.

Mesleki Eğitim Sistemi: Sorunlar, Çözüm Yolları ve Model Önerisi Çalıştayı (2015), İstanbul

İstanbul Ticaret Odası Mesleki Eğitim İhtisas Komisyonu üyelerinden, konuyla ilgili akademisyenlerden, işletme temsilcileri, meslek lisesi ve mesleki eğitim merkezi yönetici ve öğretmenlerinden oluşan geniş bir katılımcı grubuyla gerçekleştirilen bu çalıştayda öncelikle mesleki eğitim sisteminin sorunları belirlenerek katılımcılar tarafından oylanmıştır. Oylama sonucuna göre ön planda olan başlıca sorunlara çözüm önerilerinde bulunulmuştur (Çalıştay, 2015):

Belirlenen Sorunlar	Oylama
1- Mesleki eğitim kavramının içeriğinin anlaşılmamış/boş olması	13
2- Meslek lisesi ve MYO'larda öğrenci seviyesinin düşük olması/gittikçe düşmesi	8
3- Mesleki eğitimin akademik eğitimi başaramayacak öğrencilere yönelik olduğuna dair algı	4
4- Teknik öğretmenlerin nasıl yetiştirileceğinin belli olmaması	6
5- Eleman yetiştirme sürecinin ihtiyaçları karşılama hızının düşük olması (Bunu karşılamak amacı ile kurulan sertifika proramlarının istenen vasfı kazandırmaması)	2
6- Meslek liselerinden alınan eğitimin geçerli bir sertifika olarak kabul edilmemesi	5
7- Meslek eğitimi veren okullarla sanayi arasındaki işbirliğinin yeterli olmaması	12
8- Öğrencileri yönlendirecek rehber öğretmen sayısının azlığı	5
9- Meslek liselerinin yeterli düzeyde tanıtılmaması	3
10- Meslek lisesi idareci ve öğretmenlerinin hizmetiçi eğitimlerinin yeterli düzeyde olmaması	9
11- Meslek eğitimi için ihtiyaç planlaması eksikliği	4
12- Öğrencilerin ilgi ve yeteneklerine göre yönlendirilmemesi	5
13- Meslek eğitimi ile ilgili devlet politikasının net olmaması	3
14- Engellilere yönelik mesleki eğitimin yetersizliği/olmaması	2
15- Meslek liselerinin imajının yeterli düzeyde olmaması	12
16- Küçük yaştan itibaren çocukların kabiliyetlerine göre yönlendirilmemesi	5
17- Araç, gereç ve ekipman yetersizliği	2
18- Mesleki eğitim sistemindeki aktörlerin net olarak tanımlanmamış olması	4
19- Mesleki eğitimin aktörleri arasındaki iletişimin yetersizliği	8
20- Mesleki rehberlik, tanıtım ve kariyer planlama hizmetlerinin yetersizliği	7
21- Mesleki eğitimin itibarı için sivil toplum kuruluşlarının yeterli düzeyde destek olmaması	13
22- Meslek eğitimi ile ilgili ders sürelerinin yeterli olmaması	3
23- Eğiticilerin eğitiminin güncelleştirilememesi	12
24- Mesleki eğitimde kaynak israfı/ kaynak koordinasyonsuzluğu	2
25- Eğitim müfredatının merkezden belirlenmesi / öğretici yerleştirilmesi	3
26- Mesleki eğitim konusunun, meslek sivil toplum örgütleri tarafından belirlenmemesi, topun merkeze atılması	3
27- Mesleki eğitimden mezun olan öğrencilerin ulusal / uluslararası geçerli sertifikasyon problemlerinin olması	6
28- Mesleki eğitime yönelik yabancı dil eğitiminin yetersiz / yok olması	2
29- Mesleki eğitim kapasitesinin ülke çapında dengesiz dağılması	7
30- Devletin insan kaynakları planlama stratejisinin olmaması	11

31-	Cinsiyetçi önyargılar nedeniyle kadınların bazı meslek gruplarına dahil olamaması, Eğitimini alsalar bile mesleğe dahil olamamaları / kariyer yapamamaları	4
32-	Roman, LGBTİ, engelli bireylerin de benzer ayrımcılığa maruz kalıp, meslek eğitimlerine ulaşamaması	2
33-	Meslek okullarının müfredatının dinamik olmaması	11
34-	Eğitimcilerin eğitiminin kimler tarafından verileceği ve hangi eğitim programlarının uygulanacağının net olarak belli olmaması	5

Bu çalıştayda belirlenen sorunların hepsi önemli olmakla birlikte, yapılan oylamalara göre değerlendirdiğimizde, en başta gelen sorunlar aşağıdaki gibi sıralanmıştır (Çalıştay, 2015):

- Mesleki eğitim kavramının içeriğinin anlaşılmamış/boş olması
- Mesleki eğitimin itibarı için sivil toplum kuruluşlarının yeterli düzeyde destek olmaması
- Meslek eğitimi veren okullarla sanayi arasındaki işbirliğinin yeterli olmaması
- Eğiticilerin eğitiminin güncelleştirilememesi
- Meslek liselerinin imajının yeterli düzeyde olmaması
- Devletin insan kaynakları planlama stratejisinin olmaması
- Meslek okullarının müfredatının dinamik olmaması
- Meslek lisesi idareci ve öğretmenlerinin hizmetiçi eğitimlerinin yeterli düzeyde olmaması
- Meslek lisesi ve MYO'larda öğrenci seviyesinin düşük olması/gittikçe düşmesi
- Mesleki eğitimin aktörleri arasındaki iletişimin yetersizliği
- Mesleki rehberlik, tanıtım ve kariyer planlama hizmetlerinin yetersizliği
- Mesleki eğitim kapasitesinin ülke çapında dengesiz dağılması

SONUÇ VE ÖNERİLER

Bu bölümü yazmadan önce bu çalışmanın araştırmacısı olarak, uzun yıllar Teknik Eğitim Fakültesi'nde ve halen 2014 yılında açılan Uygulamalı Bilimler Yüksekokulu'nda akademisyen olarak çalıştığımı ve eskiden bazı yarıyıllarda Meslek Yüksek Okulları'nda da ders verdiğimi, ve lisans eğitimim süresince eğitim alanımla ilgili olarak çeşitli basım işletmelerinde belli dönemlerde çalıştığımı, öğretmenlik uygulamamı bir yarıyıl Sultanahmet Matbaa Meslek Lisesi'nde yaptığımı, uzun yıllar Teknik Eğitim Fakültesi, Matbaa Eğitimi Bölümü'de endüstri staj komisyonu başkanı ve üyesi olarak görev yaptığımı, 2011'de Mesleki Yeterlilik Çalışmaları kapsamında 'Baskı Sonrası Yöneticisi' meslek standardının oluşturulması çalıştayında görev aldığımı, ocak 2015'de İstanbul Ticaret Odası tarafından düzenlenen Mesleki Eğitim Sistemi: Sorunlar, Çözüm Yolları ve Model Önerisi isimli çalıştaya katıldığımı belirtmek isterim.

Bu çalışmanın sonuç ve öneriler bölümünü, ülkemizde var olan mesleki ve teknik eğitimin sorunları, konuyla ilgili yapılmış olan araştırmalar ve çalıştayların sonuçlarını öncelikle dikkate almakla beraber kendi mesleki tecrübe ve düşüncelerimi de paylaşarak, yazdım:

1- Ülkemizde mesleki ve teknik eğitim kavramının ne olduğu tam olarak anlaşılmalı ve buna bağlı olarak mesleki ve teknik eğitim, rasyonel bir şekilde planlanmalıdır. Lise düzeyinde ve üniversite (önlisans, lisans) düzeyinde meslek eğitimi veren okulların misyonunun ne olduğu ve mezunlarından hangi yeterliliklerin beklendiği net olarak bilinmelidir. Sektörlerin ihtiyaçlarına göre devletin insan kaynakları stratejisini ve hedeflerini oluşturması gerekir. Bu hedefler doğrultusunda ihtiyaç olan sektörler için meslek okulları belirlenmeli ayrıca var olan okullarda gerekiyorsa yeniden yapılanmaya gidilmelidir. Sektörlere ve ihtiyaçlara göre mevcut okulların sayısı yetersizse, yeni okul yatırımları yapılmalıdır. Okulların nitelik bakımından yetersizliği söz konusuysa, detaylı bir şekilde bu eksiklikler tespit edilip düzeltme yoluna gidilmelidir. Ama unutmamalıdır ki ihtiyaçlara uygun olmayan planlama ve yatırımlar kaynak israfına ve hayal kırıklıklarına neden olmaktadır. Mesleki eğitim kapasitesinin ülke çapında dengesiz dağılması buna bir örnektir. Ülke genelinde ihtiyaç olmayan yerlere meslek okullarının açılması kaynak israfıdır.

Bir diğer örnek 1980'li yıllarda kurulan Teknik Eğitim Fakülteleri'dir. Başlangıçta bunların sayılarına baktığımızda, tüm ülkede 2-3 fakülte vardı. Bu fakülteler, öğretim elemanlarının sayısı ve niteliği, atölye, öğretim programı, laboratuvar ve her türlü donanım bakımından zamanla eksikliklerini giderdi. Bu fakülteler başlangıçta az sayıda öğrenci alıyordu ve sadece örgün eğitim programları vardı. Öğrenciler 4 yıllık eğitim öğretim sürecinde hem temel kültürel dersleri hem yoğun meslek derslerini hem de öğretmenlik formasyon derslerini alıyorlardı. Mezunlar önemli bir oranda meslek liselerine teknik öğretmen olarak atanıyordu.

Öğretmenliği tercih etmeyenler ise kendi sektörlerinde kurumsallaşmış işletmelerde aranan eleman olarak istihdam ediliyordu. Bu fakülteler hem teknik öğretmen yetiştirme hem de nitelikli insan gücü yetiştirme açısından çok iyi bir modeldi. Teknik Eğitim Fakültelerinin bu önemi fark edilince ülke çapında çok fazla sayıda yeni Teknik Eğitim Fakülteleri açıldı. Bu yeni açılan fakültelerin kalitesi, ilk açılanlar kadar iyi değildi. Ayrıca teknik eğitim fakültelerine ikinci öğretim programları açıldı. Bu da yetmezmiş gibi bölümlerin öğrenci kontenjanları artırıldı. Bu fakültelerin yeterliliklerine ve kapasitelerine bakılmaksızın bütün bunlar yapıldı. Sonuçta teknik eğitim fakülteleri ihtiyaç fazlası mezun veren okullar haline dönüştü. Mezun olduktan sonra teknik öğretmen olarak atanma hedefiyle bu okullara gelen öğrencilerin çok büyük bir bölümü uzun yıllar öğretmen olarak atanamadı. Çünkü meslek liselerinin öğretmen ihtiyaçı birkaç yıl içinde karşılanmıştı. Bu durum öğretmen olmak isteyen öğrenciler için de hayal kırıklığı yarattı. Sonuçta Teknik Eğitim Fakülteleri'nin kapatılması gerektiği fikri gündeme geldi ve başlangıçta çok iyi bir model olan Teknik Eğitim Fakülteleri 2009 yılında kapatıldı. Teknik Eğitim Fakülteleri bölümlerinin geleceğinin ne olacağı ve nasıl bir yeniden yapılanmanın uygulanacağı çok iyi planlanmadan kapatıldı. Bazı bölümler yeni kurulan Teknoloji Fakültelerine aktarılırken çeşitli sorunlarla karşılaşıldı ve bazı bölümler birkaç yıl öğrenci alamadı. Sadece köklü geçmişi olan 3 Teknik Eğitim Fakültesi devam etseydi ve çok sayıda Teknik Eğitim Fakültesi açılmasaydı belki bugün bu üç fakülte varlığını devam ettirecekti. Maalesef hepsi kapatıldı!

2- Mesleki rehberlik, tanıtım ve kariyer planlama hizmetlerine önem verilerek öğrencilerin başarı, kabiliyet ve isteklerine göre doğru mesleğe yönlendirilmesi gerekir. Mesleğe yönlendirme amacıyla yapılan rehberlik hizmetleri için okullarda yeterli sayıda rehber öğretmen bulunmalıdır. Öğrencilere mesleğe yönlendirme rehberlik hizmeti liseye başlamadan önce yapılmalıdır. Bu hizmetin sağlıklı yapılabilmesi için öğrencinin küçük yaşlardan itibaren tüm eğitim öğretim hayatı boyunca rehber öğretmenleri tarafından izlenerek yeteneklerinin ve hangi meslekleri daha iyi yapabileceğinin ortaya çıkarılması gerekir.

3- Nitelikli insan gücünün yetiştirilebilmesi için nitelikli öğretmenlerin olması gerekir. Meslek öğretmeninin yeterlilikleri, çağımızın beklentilerini karşılayacak düzeyde olmalıdır. Teknik Eğitim Fakülteleri kapatıldığı için günümüzde meslek öğretmenlerinin/teknik öğretmenlerin nasıl yetiştirileceğine dair bir model yoktur. Öğretmen adaylarından lisans diplomalarının yanı sıra formasyon sertifikası, en az bir yıllık sektörde çalışma ya da yüksek lisans yapma gibi şartlar aranabilir ama bu gün için meslek öğretmeni olarak atanabilmek için geçerli olan bir model yoktur. Meslek öğretmenleri ve eğiticileri öğretmenlik formasyonlarının ve teorik mesleki bilgilerinin yanısıra sektörün onlardan beklediği becerilere de sahip olabilmeleri için profesyonel bir şekilde yetiştirilmelidirler. Meslek öğretmenlerine yeteri kadar iş yeri başında eğitim, staj, hizmetiçi eğitim gibi faaliyetlere katılma olanakları sağlanmalıdır. Böylece meslek öğretmenleri uygulama becerilerini geliştirip güncelleyebileceklerdir.

4- Mesleki ve teknik eğitimin yatırım finansmanının yüksek olması önemli bir sorundur. Bu sorunun aşılabilmesi için devletin bu alana mümkün olduğunca destek vermesinin yanı sıra mutlaka mesleki eğitim veren okullarla sanayi arasındaki işbirliğinin yeterli seviyeye getirilmesi gerekir. Mesela aynı sektöre hitap eden işletmelerin meslek okullarına hami olması, işbirliğinin geliştirilmesi açısından iyi bir örnek olabilir. Hami olan işletmelerle okulların eğitim programlarını birlikte geliştirmeleri, atölyelerini birlikte kurmaları, öğrencilere staj ve mezuniyet sonrası istihdam sağlamaları, öğretmenlere güncel uygulama eğitimleri sağlamaları gibi pek çok konuda işbirliği yapmaları mümkündür. Ayrıca sektörde kurumsallaşmış büyük işletmeler, özel meslek liseleri de kurabilmelidirler. Çağın gereklerine uygun olarak okul-sanayi işbirliğini geliştirmek için bahsedilen bu örneklerin dışında farklı işbirliği modelleri de araştırılmalıdır.

5- Toplumda yerleşmiş olan meslek lisesi algısının değiştirilmesi için bazı faaliyetler yapılmalıdır. Meslek liseleri başarısız öğrencilerin gittiği okullar olarak görülmemelidir. Meslek liselerinin eğitim programları oluşturulurken sadece meslek ve diğer dersler değil ayrıca iyi bir yabancı dil eğitimi, sanat müzik ve spor eğitimi gibi derslerle öğrencilerin kişisel gelişimini artırıcı yönde teşvikler yapılabilir. Böylece başarılı ve yetenekli öğrencilerin meslek liselerine gelmeleri sağlanabilir. Doğru olarak yapılmış mesleğe yönlendirme çalışmalarının sonucunda; öğrenci, veli, rehber öğretmen birlikte düşünerek ve öğrencinin yeteneğine ve isteğine bağlı olarak meslek lisesinin uygun bölümüne gelmesi sağlanmalıdır. Bunun dışında devletin ve sivil toplum kuruluşlarının bu yanlış algıyı düzeltmek için yapması gereken görevler vardır. Devlet başarılı öğrencilerin meslek okullarına gelmesi için onları teşvik edecek bazı düzenlemeler yapabilir. Mesela medyada ve basın organlarında her fırsatta çeşitli komu spotu, kampanya ve reklamlarla mesleklerin değerli olduğunu ve mesleki eğitimin önemini anlatabilir. Üniversite giriş sınavlarında meslek lisesi mezunlarına kendi alanıyla ilgili ya da yakın olan bölümlere girmelerinde yeterli ek puan verilmesi önemli bir teşvik olacaktır. Meslek lisesi öğrencilerinin yurtdışı staj ve yurtdışından anlaşma yapılan okullara gezi programlarına yönlendirilmeleri de önemli bir teşvik olabilir. Mesleki eğitim mezunlarına sınavsız verilen işyeri açma belgesi de önemli bir teşviktir ve devam etmelidir. Mesleki eğitim okullarından mezun olanların kısa sürede istihdamı ve iş hayatında emeklerinin karşılığını alabilmeleri için devletin, STK'ların ve işletmelerin üzerine düşen görevleri yapmaları gerekir. Ücret politikalarının mesleki ve teknik okul mezunlarının lehine düzenlenmesinin gerekir. Bu kişilerin asgari ücret dışında tutulması, asgari ücret uygulamasının nitelikli eleman için uygulanmaması gerekir. Bu konu toplumda meslek lisesi algısının pozitif yönde değişmesi için büyük önem taşımaktadır.

6- Öğrenci kalitesinin geliştirilmesi için mesleki ve teknik eğitimde kalite güvence sisteminin oluşturulması gerekir. Öğrenciye kazandırılmaya çalışılan beceri, tutum ve davranışların belli bir kalite güvencesi altında olması ve öğrencilerin ölçme ve değerlendirmesini, öğretmenlerin yerine okuldaki bağımsız bir birimin yapması, öğrenci kalitesinin geliştirilmesi açısından önemli bir katkı sağlayabilir. Böylece meslek okullarından alınan eğitim aynı zamanda işe girmek için geçerli olan bir sertifika olarak da görülür. Ayrıca toplumdaki meslek lisesi algısının pozitif yönde değişmesi, öğrenci kalitesinin gelişmesini sağlayacaktır. Meslek Yüksekokullarına, meslek liselerinden sınavsız öğrenci alınması yanlış bir uygulamadır. Hem Meslek Liselerindeki hem de MYO'lardaki öğrenci kalitesini düşürmektedir.

7- Meslek okullarının müfredatı dinamik bir yapıda olmalı, sektörün ve çağın ihtiyaçlarına göre zaman zaman güncellenebilmelidir. Böylece modası geçmiş ve kullanılmayan bilgi ve uygulamaların öğrencilere anlatılması engellenmiş olur.

8- Kız ve erkek öğrencilerin aynı okulda eğitim görmeleri her iki cinsin ileride sosyal hayata uyum sağlayabilmeleri açısından faydalıdır. Bu nedenle meslek eğitimi verilen okullarda karma eğitim sistemine devam edilmelidir. Cinsiyetçi önyargılar nedeniyle kadınların eğitimini alsalar bile bazı meslek gruplarına dahil olamaması haksızlıktır. İşe almalarda yetenek, başarı ve kişisel özelliklere bakılması makul ve kabul edilebilir kriterlerdir. Ancak bir kişinin sadece kadın olduğu için bazı iş kollarına alınmaması bir ayrımcılıktır ve insan haklarına aykırıdır.

9- Öğrencilerin mesleki eğitimde öğrendikleri bilgileri beceriye dönüştürebilmeleri için, haftanın belirli günlerinde işletmelerde uygulamalı eğitim ve iş başı eğitimi görmeleri gerekmektedir. Bu eğitimin haftada kaç gün ve kaç saat olacağı rasyonel bir şekilde planlanmalı ve meslek hocaları da bu eğitimi hem kontrol etmeli hem de eğitime katılmalıdır. Öğrencileri sadece okul eğitimiyle yetiştirmeye çalışırsak, uygulama becerileri ve işletmelerin beklentilerini karşılamaları bakımından yetersiz bir şekilde mezun ederiz. Mesleki eğitimi sadece işletmelerde, çıraklık ustalık ilişkisiyle yapmaya kalkarsak, öğrencileri sektörde pedogojik formasyonu olmayan ve sadece belirli işlerde uzmanlaşmış ustaların eline teslim etme riski vardır. Bu durumda öğrenci meslekten soğuyabilir ya da kendini yeterince geliştiremeyebilir. Mesleki eğitimin hem okullarda hem de işletmelerde birlikte verilmesi en ideal modeldir.

10- Mesleki eğitimin beklenen kaliteye ve yeterliğe ulaşabilmesi için tüm aktörlerin (toplum, devlet, okullar, işletmeler, STK'lar, öğrenciler, öğretmenler, aileler, sektör çalışanları, sendikalar, meslek odaları …) arasındaki iletişimin yeterli düzeyde olması ve hepsinin üzerine düşen sorumlulukları yerine getirmesi şarttır.

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HADOOP AND ITS COMPONENTS IN THE ANALYSIS OF THE BIG DATA

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ABSTRACT: Today, with the traditional methods, it is quite difficult to process, analyze and manage the "big data" that is formed with data from multi sources. In the current time period, which lacks relational databases, and models, the size of the data forced the businesses to find several solutions in terms of reducing the increasing costs, and saving of time. In that sense, the development of distributed, and parallel-processing technologies triggered the emergence of possibilities to benefit wisely from the "big data". In this work, while Hadoop, which is a distributed system software that enables the big data to be analyzed fast, scalable and accurately, and its components were investigated, components of 5V were also elaborated in order to understand the "big data".

Key words: big data, hadoop, distributed systems, mapreduce

BÜYÜK VERİ ANALİZİNDE HADOOP VE BİLEŞENLERİ

ÖZET:Günümüzde birçok kaynaktan üretilen veriler ile oluşan büyük veriyi geleneksel yöntemlerle işlemek, analiz etmek ve yönetmek oldukça zordur. İlişkisel veritabanlarının ve modellerinin yetersiz kaldığı bu zaman diliminde veri büyüklüğü işletmeleri artan maliyetin azaltılması ve zaman tasarrufunun sağlanması noktasında farklı çözüm yollarına zorlamıştır. Bu kapsamda dağıtık ve paralel işleme teknolojilerinin gelişmesi ile büyük veriden akıllıca yararlanma imkânları doğmuştur. Çalışmada büyük verilerin hızlı, tutarlı ve ölçeklenebilir şekilde analiz edilmesine imkân tanıyan ve bir dağıtık sistem yazılımı olan Hadoop ve bileşenlerinin incelemesi yapılmıştır. Ayrıca Büyük veriyi anlamak için 5V bileşenleri üzerinde durulmuştur.

Anahtar sözcükler: büyük veri, hadoop, dağıtık sistemler, mapreduce.

GİRİŞ

İnsanoğlunun var olduğu günden bugüne kadar geçen süreçte tarihi etkileyen iktisadi, siyasi, ekonomik ve teknolojik birçok hadise meydana gelmiştir. 1765 yılında James Watt'ın buharlı makineyi bulmasıyla başlayan sanayi devrimi insanoğlu tarihinde bir dönüm noktası olmuştur. İnsanlar artık tarım toplumundan çıkıp sanayi toplumuna doğru yol almaya başlamışlardır. Son yüzyılın en önemli gelişmesi ise internetin icadıdır. 1900'lerin sonları ve 2000'lerin başı ile hayatımıza giren ve giderek yaygınlaşan internet kullanımı artık hayatımızın vaz geçilmez bir parçası haline gelmiştir. Cep telefonu, tablet vb. elektronik cihazların geliştirilmesi ile internetin kullanımı akıl almaz boyutlara ulaşmıştır. 1993 yılında toplumun kullanımına sunulan internet 2005 yılında 1 milyar kullanıcıya ulaşmıştır. 2014 Ekim ayı verilerine göre ise yıllık %7,9'luk artış ile dünyada interneti kullanan kişi sayısı 2.985.488.855 kişidir. Dünya nüfusunun 7.243.784.121 olduğu düşünüldüğünde toplam nüfusun %40,4 'ünün interneti kullandığı görülmektedir (Internet Users, 2014).

İnternet kullanıcı sayısının artması, internette yer alan site sayısını da artırmıştır. Şuanda aktif olan site sayısı 1 milyarın biraz üzerindedir (1.080.157.860). Bu siteler vasıtası ile kişiler birbirleri ile haberleşebilmekte, duygularını resimlerini ve videolarını paylaşabilmektedir. İnternet Live Stats (2014) sitesinin verilerine göre günümüzde en popüler haberleşme sitelerinden birisi olan Twitter'da saniyede atılan tweet sayısı yaklaşık 7800 civarındadır, Instagram'da ise paylaşılan fotoğraf miktarı 1375'tir. Video paylaşım sitesi olan YouTube'da saniyede izlenen video sayısı 89,654'tür. Bu rakamlar her geçen gün artış göstermektedir. Bu inanılmaz trafik saniyelik 23,716 GB'lık bir veri iletişimine sebep olmaktadır.

Gelişen teknoloji ile birlikte verilerin üretilmesi ve depolanması da kolaylaşmıştır. Bu gelişmelerin neticesinde "büyük veri" olgusu ve "veri bilimi" ortaya çıkmıştır (Gürsakal, 2014). Çalışmada büyük veri olgusunun ne olduğu ve neleri vaat ettiği incelenmiş, günümüzde ve gelecekte insanoğlunu nasıl bir değişim beklediğinden bahsedilmiştir.

Büyük Veri ve Bileşenleri

İnternet ortamında dolaşan ve depolama ünitelerinde depolanan verilerin analizi klasik manada veri madenciliği denilen yöntemlerle halledilebilir mi? Bu sorunun cevabı veri formunu anlamaktan geçmektedir. Veri formu yapısal, yarı yapısal ve yapısal olmayan olmak üzere 3 farklı şekilde bulunmaktadır. (Prajapati, 2013, s.4) Bu formlardan sadece yapısal veriler üzerinde veri madenciliğinin sunmuş olduğu teknikler kullanılarak analizler gerçekleştirilebilmektedir. Peki, yapısal olmayan veya yarı yapısal olan veriler nasıl analiz edilecektir. Bu noktada büyük veri denilen kavram devreye girmektedir. Büyük veri, toplumun dijital ortamı kullanarak üretmiş olduğu veriyi bir araya toplayarak verilerin anlamlı, işlenebilir bir forma dönüştürülmesidir.

Büyük veri, "geleneksel veritabanı araçları ve algoritmaları ile işlenmesi zor olan verilerin oluşturulması, saklanması, akışı, analiz edilmesi gibi birçok konuyu içeren bir terim olarak karşımıza çıkmaktadır." (Özkan, 2013).

Büyük verinin anlaşılabilmesi için büyük veri platformunu oluşturan beş bileşenin anlaşılması gerekmektedir. 5V (Variety, Velocity, Volume, Verification, Value) olarak da ifade edilen beş bileşen şu şekildedir;

Variety (Çeşitlilik): Teknolojik ürünlerin ve yazılımların üretmiş oldukları veriler farklı formatlarda olmaktadır. Üretilen verinin yaklaşık %80'ni yapısal olmayan verilerden oluşmaktadır. Bu verilerin farklı formatta olmasının yanı sıra farklı dillerde de olması veri tiplerinin dönüşümlerinin yapılması ihtiyacını doğurmaktadır.

Volume (Veri Büyüklüğü): Büyük verinin kullanımı için önemli faktörlerden biri olan veri hacmi, 5V olarak ifade edilen bileşenlerden en önemlisidir. Çünkü günümüzde Google gibi tek bir firmanın üretmiş olduğu bir saatlik veri miktarı petabytelar seviyesini aşmaktadır (Gürsakal, 2014:75). 2012 yılında 2.7 zettabaytlık veri üretilirken bu rakamın 2016 yılında 7.9 zettabayta ulaşması öngörülmektedir (eticaretmag, 2013).

Velocity (Hız): Büyük verinin adreslemeye çalıştığı bir başka V bileşeni ise hız bileşenidir. Günümüzde hız vazgeçilmez bir öncelik haline gelmiştir. Dünyada saniyede üretilen veri miktarının 23,720 GB'a (internetlivestats, 2014) ulaşması verinin üretilme hızının ifade edilmesi açısından yeterlidir.

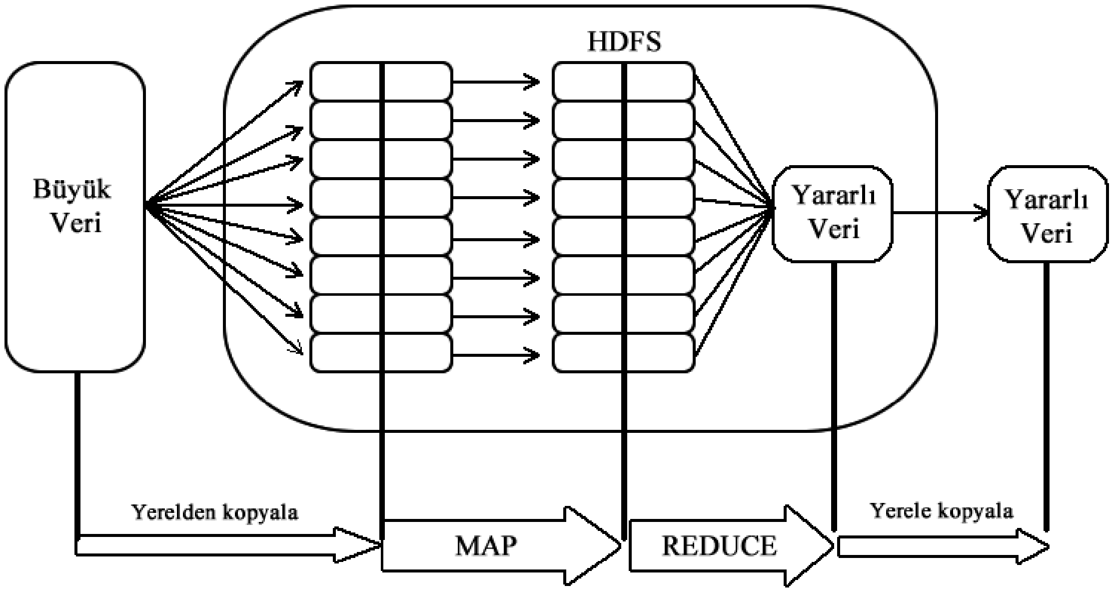
Verification (Doğrulama): Verinin gizliliği ve doğruluğu verinin akışında en önemli bileşenlerden biridir. Verinin akışı sırasında, güvenlik seviyesinin korunması ve verinin doğru kişilere ulaşması gerekmektedir. Akış sırasında başkaları tarafından görünebilirliğinin engellenmesi gerekmektedir.

Value (Değer): Değer katmayan veri hiçbir işe yaramayacaktır. 5V bileşenleri arasında birazda sonuç diyebileceğimiz değer ifadesi, verilerin üretimi ve işlenmesinden sonra elde edilen sonucun firma ya da kuruluşa sağladığı katkıyı ifade etmektedir.

Büyük veri kavramı ilk olarak 2000 yılında Diabold tarafından sunulan bir bildiride gündeme getirilmiştir (Diabold, 2012). 2004 yılında Google bu geliştirilen teknolojiyi kullanmaya başlamıştır. Büyük veri, gelişmiş veri tabanlarında yer alan transactions özelliklerini (Insert, Select, Update, vb.) bünyesinde barındırmaz, sadece yığın işleme(Batch) işlemlerini gerçekleştirir. Verilerin birden fazla yerde paralel işlenmesinden dolayı büyük veri defalarca okunup bir kere yazım yapılacak işlemlerde uygulanır (vikipedi, 2013).

Verilerin İşlenmesi

Günümüzde kullanılan ilişkisel veri tabanları gigabyte seviyelerinde veri saklayabilmektedir. Petabayt ve zettabayt seviyesine ulaşmış veri büyüklüğünü ise büyük veri sayesinde saklayabiliriz (vikipedi, 2013).Yüksek miktardaki verilerin analizi sayesinde birçok kritik alanda yeni olanakların oluşturulabileceği ve ciddi tasarrufların sağlanabileceği beklenmektedir (Goksen, 2013). Verilerin analizi sonucunda ilgi alanlarına yönelik ürünler geliştirilebilir, müşteri profili arttırılabilir. Bu çerçevede büyük verilerin analiz edilmesi için Hadoop gibi çeşitli araçlar geliştirilmiştir.



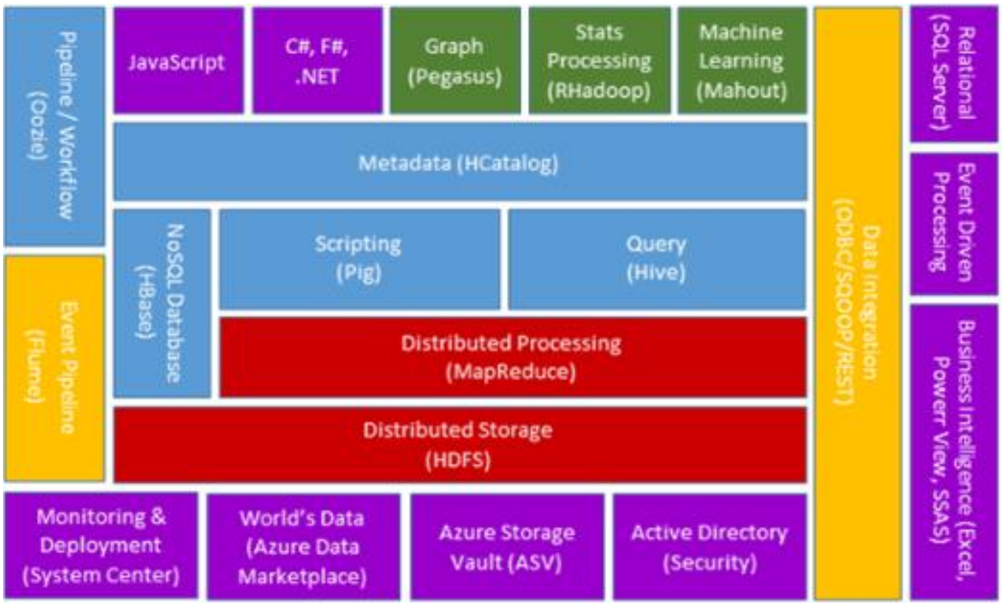
Şekil 1. HDFS Çalışma Diyagramı
Kaynak : http://www.glennklockwood.com/di/hadoop-overview.php, 2014

HADOOP ve BİLEŞENLERİ

Hadoop Java'da yazılmış açık kaynak kodlu bir kütüphane olup Hadoop Distributed File System (HDFS) ve MapReduce özelliklerini bir araya getiren, büyük verileri işlemek için geliştirilmiş bir platformdur (Ayberk, 2014). Hadoop 2005 yılında Apache Vakfı tarafından Google'ın MapReduce'ını ve dosya sistemlerini Apache 2.0 altında uygulamak amacıyla geliştirilen bir projedir (Gürsakal, 2014:218). Hadoop kullanılarak New York Times'ın 150 yılda oluşan 11 milyon makale arşivini dijital hale getirilerek aranabilir hale dönüştürmüştür. Facebook Hadoop kullanarak kullanıcıların davranışlarını analiz etmekte ve reklamların etkisini araştırmaktadır (Arikan, 2007).

Hadoop'u oluşturan MapReduce ve HDFS temel bileşenlerinden MapReduce, büyük boyutlarda yer alan veri kümesini alt kümelere bölerek bunları gerekli düğümlere gönderme işlemini ve onlardan gelen cevaplara göre indirgeme işlemini gerçekleştirmektedir. HDFS ise verilerin çoklu hesaplama düğümlerinde bulunmasını sağlamaktadır (Gürsakal, 2014:218).

Hadoop, sisteminin çalışma düzeninde ilk olarak veriler HDFS'ye yüklenmekte sonra eşleme ve indirgeme işlemleri gerçekleştirmekte ve son olarak da sonuçlar HDFS'den alınmaktadır. Hadoop yazılım platformunu kullanarak veri analizi gerçekleştirebilmek için Hadoop'un bileşenlerinin bilinmesi gerekmektedir. Bu bileşenler MapReduce, Hadoop Distributed File System (HDFS), Hive, Pig, HBase, ZooKeeper, Ambari ve HCatalog şeklinde sıralanabilir.



Kırmızı : Hadoop Çekirdeği Mor: Microsoft entegrasyonu ve Eklentileri

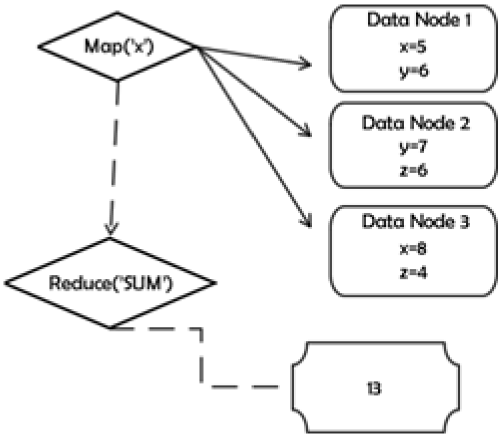
Mavi : Veri İşleme Turuncu: Veri Akışı Yeşil : Paketler

Resim 1: Hadoop Bileşenleri

Kaynak : Kasap (2014), https://blog.microsoft.com.tr/windows-azure-ve-hadoop-ile-buyuk-veri-analizi-1.html

MapReduce: Verileri depolama, arama ve indeksleme noktasında işlemlerin süratli bir şekilde yapılması iş süreçlerinin bölümlendirilmesiyle gerçekleştirilmektedir. İş süreçlerinin bölümlendirilmesi ise dağıtık programlama ile yapılabilmektedir. Bu alanda yapılan çalışmalar doğrultusunda ilk olarak Google firması 2004 yılında MapReduce adlı dağıtık hesaplama modelini geliştirilmiştir.

MapReduce C#, C++, Erlang, Java, Ocaml, Python, Ruby, F# ve R gibi programlama dilleri kullanılarak geliştirilen bir yazılım platformudur. MapReduce, Map(eşle) ve Reduce (İndirge) adımlarından oluşan birbirine bağlı bilgisayar grubunun büyük veri kümeleri üzerinde dağıtılmış programlamayı destekleyen bir yazılım kütüphanesidir. Map fonksiyonu istenilen verilerin filtrelenmesi için kullanılırken Reduce fonksiyonu ise verilerden sonuç elde etmek için kullanılmaktadır (Enacore, 2014). MapReduce işlemleri küçük parçalara ayırarak bunları sisteme bağlı olan bilgisayarlara dağıtmak ve oradan gelen verileri toplayarak sonucu verme mantığı ile çalışmaktadır (Işıklı,2009). MapReduce, Otomatik Paralellik ve Dağıtım, Hata Toleransı, I/O Zamanlama, Durum ve İzleme gibi özellikleri kullanıcılara sunmaktadır.



Şekil 2. MapReduce Çalışma Prensibi

Şekil 2'de görüldüğü gibi MapReduce'un Map adımında anadüğüm girişi alınır yani elemanlar bir anahtar ile eşleştirilerek çalışan düğümlere (Node) gönderir. Düğüm kendisine gönderilen işlemi cevaplandırarak ana düğüme bunu geri gönderir. Reduce adımında ise anadüğüme gelen cevaplar birleştirilerek cevabın elde edilmesi sağlanır.

***Hadoop Distributed File System (HDFS*)**: Hadoop'un yapısında yer alan HDFSdosya sistemi dağıtık sistemi kullanarak birçok bilgisayarın disklerini bir araya getirip büyük boyutlu tek bir sanal disk oluşturabilmektedir. Böylelikle büyük veriler üzerinde hızlı işlem yapabilme yeteneğine kavuşulmaktadır. Büyük verileri saklayabilmek için Hadoop sistemi verileri yatay bir şekilde bloklarda 64 ve 128 MB'lık bloklar halinde barındırmaktadır (Ayberk, 2014). Bu blokları RAID benzeri bir yapıyla birden fazla ve farklı sunucuya en az 3 kopya olacak şekilde kopyalamaktadır. Böylelikle veri güvenliği sağlanmaktadır (Temir, 2012). HDFS Veri düğümü (DataNode) ve Ad Düğümü (NameNode) denilen iki süreçten meydana gelmektedir. Ad Düğümü her türlü dosya işleminden sorumlu olup veri blokları hakkındaki bilgilerin saklandığı ve yönetildiği süreçtir. Her küme içerisinde bir tane Ad Düğümü yer almaktadır (Tozun, 2013). Veri düğümü HDFS'de çok sayıda bulunmakta olup sahip olduğu veri bloklarının bilgisini Ad Düğümüne rapor etmektedir (Gürsakal, 2014:223).

Pig: 2006 yılında Yahoo firması tarafından geliştirilen Hadoop üzerindeki büyük verilerin işlenmesini, analiz edilmesini ve ortak işlerin basitleştirilmesini sağlayan bir programlama dilidir (İlter, 2012). MapReduce ile yapılmak istenen analizler Pig ile daha kolay geliştirilebilmektedir (Tozun, 2014). Pig, Latin adında üst seviye bir programlama dili kullanarak geliştirdiği veri analiz programlarını MapReduce ile eşleşerek çalıştırmaktadır (Kasap, 2014)

Hive: Hive, MapReduce altyapısı üzerine kurulu bir veri ambarıdır. SQL benzeri bir arayüz kullanılarak java kullanmadan sorgulama, verilerin kolayca özetlenmesi ve analizinin yapması gibi olanaklar sağlamaktadır (Tozun, 2014).

HBase: Google'un büyük verisinden esinlenerek yenilenen Hbase, Hadoop için dağıtık büyük veri deposudur. HBase büyük veriye rastgele ve gerçek zamanlı okuma/yazma erişimi sağlamaktadır. XML ile RESTful web servislerini kullanma, lineer ve modüler ölçeklenebilirlik, tutarlı okuma ve yazma işlemleri, genişletilebilir kabuk HBase'in başlıca özellikleri arasındadır (Prajapati, 2013 s.200). Popüler ilişkisel veritabanı yönetim sistemleri gibi satır tabanlı olmayıp, veri ambarlarının ve Müşteri İlişkileri Yönetimi (CRM) tercih ettiği sütun tabanlı yapısıyla, sosyal medyada, arama motorlarında, istihbarat ve izleme servislerinde kullanılmaktadır.

Ambari: Hadoop Cluster'ının yönetim, tedarik ve görüntülenmesini sağlayan web tabanlı bir araç olup Hadoop HDFS, Hadoop MapReduce, Hive, HCatalog, HBase, ZooKeeper, Oozie, Pig, ve Sqoop için destek içermektedir.

Chukwa: Büyük dağıtık yapılardan veri toplamayı sağlayan bir sistemdir.

HCatalog: Veri işleme sistemlerine merkezi bir noktadan verinin yapısı ve saklanma noktası hakkında bilgi veren Tablo ve Metadata yönetim servisidir.

Zookeeper: Açık kaynak Apache projesi olup, veri işleme sistemlerindeki kümelerin senkronizasyonu ve sürekliliği için merkezi altyapı ve servis sağlar. Zookeeper, dağıtık yapıda yer alan bileşenlerin koordinasyonlu bir şekilde çalışmasını sağlamak için hiyerarşik isimlendirme, konfigürasyon bilgileri, tüm sistem durumunun kopyasını alan ve bu bilgileri lokal olarak saklayan sunucudur (Deroos, Deutsch, Eaton, Lapis ve Zikopoulos, 2012, s.76).

Sqoop: Organizasyonların değerli verilerini ilişkisel veri tabanlarında saklamaya devam etmelerinden ve verimli bir analiz yapılması ihtiyacından dolayı, ilişkisel veri tabanları ile HDFS arasında veri transferi yapılması gerekmektedir. İlişkisel veri tabanlarında yer alan tablolar, istenilen sütunlar veya tüm veri tabanı dosyalarını, dağıtık dosya sistemi veya veri ambarına aktarmaya yarayan komut satırı aracıdır (Sawant ve Shah, 2013, s.19).

Mahout: Ölçeklenebilir yapay öğrenme (machine learning) ve veri madenciliği kütüphanesidir. Hadoop'tan bağımsız olarak çalışabilir.

Flume: Source (Kaynak), Channel (kanal) ve Sink (hedef) olmak üzere birbirine bağlı üç yapıdan oluşmaktadır. Logların flume'da geldiği yere kaynak, Logların flume'de bulunduğu yere kanal ve Logların yazılacağı yere ise hedef denilmektedir. Sistem birden fazla kanal ve hedef çalıştırarak karmaşık modeller kurulabilmektedir (Ağaoğlu, 2014).

Cassandra: Genişleyebilir Multi-master bir veritabanıdır.

Avro: Veri serileştirme sistemidir (Avro, 2012).
Lucene: Apache yazılım lisansı kullanan, Java dilinde geliştirilen açık kaynak kodlu yanlızca listeleme ve arama işlemini gerçekleştiren bir bilgi toplama kütüphanesidir.

LİTERATÜR

Büyük veri kavramı yeni gelişmekte olan alanlardan bir tanesidir. Büyük veri üzerine yapılan yazın taramasında çeşitli çalışmalara rastlanmıştır.

Herodotou ve arkadaşlarının (2011) yapmış olduğu çalışmada, büyük verinin analizinde kullanılabilecek denizyıldızı sisteminden bahsedilmiştir. Denizyıldızı sistemi Hadoop üzerine inşa edilmiş büyük verinin analizini kullanıcı bazında kolaylaştıran bir sistemdir. Hadoop sisteminde kişi analiz yapabilmek için birçok ayarlamaya ihtiyaç duyuyordu, geliştirilen bu sistemle beraber kişi kendi başına rahatlıkla analizleri gerçekleştire bilmektedir.

Guardian Media Network'un 157 E-ticaret pazarlamacısı üzerinde yaptığı araştırmada E-ticaret pazarlamacılarına "bireysel tüketicileri hedefleyen ve genel hedef kitleye yönelik kampanyanlar da büyük veri kullanımının faydalı olup olmadığı" sorusu sorulmuştur. Katılımcıların %62'lik kısmı büyük veri kullanımının faydalı olacağı yanıtını vermiştir.

Demir ve Sayar (2012) MapReduce modeli ile görüntü dosyalarının işlenmesi için Hadoop eklentisi geliştirmişlerdir. Eklenti ile küçük boyutlu dosyalar birleştirilerek büyük boyutlu dosyalara çevrilmekte ve HDFS sisteminin daha verimli çalışması sağlanmaktadır. Eklenti yüz tanıma uygulamasında kullanılmış ve verimli sonuçlar elde edilmiştir.

SONUÇ

Bu çalışma büyük veri kavramının tanınırlığının artırılması ve farkındalık düzeyinin üst seviyelere doğru çekilerek ilgili kurum ve kuruluşların dikkatlerini bu yöne çekmeyi amaçlamıştır. Teknolojinin gelişmesi, veri çeşitliliğinin ve boyutlarının artması büyük veri kavramanı ortaya çıkarmıştır (Khalilov ve Gündebahar, 2014).

Büyük verilerin analizinde açık kaynak kodlu olarak kullanılan Hadoop altyapısında en genel ifade ile iki önemli araç kullanılmaktadır. Birincisi büyük verilerin kaydedildiği HDFS ve ikincisi bunların işlendiği MapReduce programlama yapısıdır. Büyük verilerin saklanması ve işlenmesinin beraberinde getirdiği en önemli sorun ise, bilişimdeki gelişmelerin çoğunda olduğu gibi, bireysel mahremiyetin korunmasıdır. (Goksen, 2013).

Büyük veri projeleri ile amaçlanan, şu ana kadar kayda almadığımız data' yı kullanarak, online raporlamalar ile müşteri memnuniyetini arttırarak işletmeye değer ve para kazandırmaktır. Büyük verinin analiz edilmesi ile birlikte yöneticilere ve karar vericilere yeni görüş açıları ile kurum ve kuruluşlara büyük tasarruflar sağlaması beklenmektedir. Büyük verinin uygulama alanlarında Sosyal Medya, Pazarlama, Müşteri memnuniyeti, dolandırıcılık tespiti, güvenlik vb. gibi alanlar bulunmaktadır. Büyük veri analizinin bize getirdiği yenilikleri ve olanakları ifade edecek olursak;

Büyük Veri analizi ile;

Yapılandırılmamış ve yarı yapılandırılmış verilerin önemi daha çok artmaktadır.

Keşifsel veri analizi bilimi doğmaktadır

Hadoop ve MapReduce kavramları daha çok duyulur hale gelecektir.

Kullanıcılara sunulan öneri sistemleri yaygınlaşarak devam edecektir.

Kişisel mahremiyet daha çok tartışılan bir konu haline gelecektir.

Kişisel bazda analizler ve mikro bazda çözümler öne çıkacaktır.

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STEM APPLICATION IN SCIENCE SCHOOL

Hülya Ertürk KOÇ
Milli Eğitim Bakanlığı Daire Başkanı

Halil İbrahim TOPÇU
Milli Eğitim Bakanlığı Daire Başkanı

Mustafa Hilmi ÇOLAKOĞLU
Milli Eğitim Bakanlığı Bakan Danışmanı

Aydın DEMİR
MEB Ankara Fen Lisesi Müdürü

ABSTRACT: The idea of establishing a Science High School, was discussed in a multilateral project at the beginning of 1963. In this project, Ministry of Education, Ford Foundation, METU and AID (International Development Agency) were participated. In Ankara, Science High School had been planned as a US funded project, carried out jointly by the Florida State University, METU and Ankara University. Science High School organizational goals were set as follows;

- The ability of children to improve their prowess in science found in Turkey, the intelligence to progress,
- In Turkey, the researchers needed to source the training of personnel for higher education and industry,
- Country-level science education should play a role for the development of laboratory science education needed, to be the center of research and development,

Ministry of Education created a "Science High School Project Advisory Board" with six members from Ankara University, Faculty of Science and four members from METU to contribute to the scientific aspects of the project. Advisory Board selected 30 teachers from Mathematics, Chemistry, Physics and Biology disciplines by written and oral exam. Selected science teachers were subjected to special education for the development of the branch tests and curriculum at USA Universities. After the success of Ankara Science High School, Ministry of Education started Istanbul and Izmir Science School Projects. Today, 238 Science High Schools are in education. In this the article, some statistical data about Science Schools, their development and innovation activities, STEM projects and vision for the future were discussed.

Key words: science school, STEM, MoNE

FEN LİSELERİNDE STEM UYGULAMALARI

ÖZET: 1963 yılı başlarında Fen Lisesi kurulması fikri çok taraflı bir proje olarak ele alınmıştır. Bu projeye Milli Eğitim Bakanlığı, Ford Vakfı, ODTÜ ve AID (Milletlerarası Kalkınma Teşkilatı) katılmışlardır. Fen Lisesi projesinin Ankara'daki Üniversiteler ve ABD'nde Florida State Üniversitesi tarafından ortaklaşa yürütülmesi öngörülmüştür. Fen Lisesi kuruluş amaçları da şöyle belirlenmiştir;

- Türkiye'deki fen alanında üstün yetenekleri saptanmış çocukların bu yeteneklerini geliştirmek, zekâlarını inkişaf etmek,
- Türkiye'de yükseköğrenim ve endüstri için gerekli olan araştırmacı elemanların yetiştirilmesine kaynaklık etmek,
- Ülke düzeyinde gereği duyulan fen eğitiminin geliştirilmesi için laboratuvar rolü oynayan fen eğitim, araştırma ve geliştirme merkezi olmak,

Türkiye'de Fen Lisesi kurulması fikri proje olarak ele alındıktan sonra, Milli Eğitim Bakanlığı'nda "Fen Lisesi Projesi Danışma Kurulu" oluşturulup 1963 yılında faaliyete başlamıştır. Bu kurul, önce 6'sı Ankara Üniversitesi Fen Fakültesi, 4'ü ODTÜ'nden olmak üzere 10 üniversite öğretim üyesi seçerek projeye bilimsel yönden katkılarını sağlamıştır. Danışma Kurulu Fen Lisesinde Matematik, Kimya, Fizik ve Biyoloji derslerini okutacak 30 öğretmen seçmiş, sonraları da sınavlarla diğer öğretmenler belirlenmiştir. Seçilen fen dersleri öğretmenleri özel eğitimlere tabi tutulmuş, Amerika'ya gönderilerek branşlarında ki gelişmeleri tetkik ve takip etmişler ve ders programları hazırlamışlardır. Ankara Fen Lisesi projesinin başarılı olması üzerine İstanbul ve İzmir'de yeni Fen Liseleri açılmış olup bugün 232 Fen Lisesinde eğitim sürmektedir. Makalede Fen Liselerinde verilen

eğitim, bazı istatistiki bilgiler, geliştirme ve yenilik çalışmaları ile STEM uygulamaları ve gelecek planları anlatılmaktadır.

Anahtar sözcükler: fen lisesi, STEM, MEB

GİRİŞ

4 Ekim 1957 tarihinde Sovyet Rusya'nın uzaya fırlattığı ilk uydunun Amerikan toplumunda yaptığı etkiyle birlikte Soğuk Savaş Dönemi başladı. Bu doğrultuda yapılan ilk iş Amerikan eğitim sistemindeki Fizik, Kimya, Matematik ve Biyoloji eğitimlerini gözden geçirmek oldu. Bu alanlarda MIT vb. üniversiteler, sivil toplum kuruluşları,, resmi kurum/kuruluşlar, öğretmenlerin katılımıyla oluşturulan çalışma grupları; tüm yayınları ve çalışmaları gözden geçirerek yeni kitaplar hazırladı. Ülkemize ise 1960'lı yıllarda intikal eden bu çalışmalar o günlerde Modern Fizik/Kimya/Matematik/Biyoloji eğitimi olarak adlandırılmaktadır. İlk olarak Ankara Bahçelievler'de adı Deneme Lisesi olarak değiştirilen lisede uygulanan yeni müfredat, uygulamalarını laboratuvar desteğiyle daha etkin olarak gerçekleştirebilmek için Ford Vakfı'nın da teknik ve mali yardımıyla bir lise kampüsü olarak ODTÜ'nün tahsis ettiği 120 dönümlük arazide kurulan ilk Fen Lisesi 1964 yılında eğitime başladı.

Uluslararası proje olarak başlatılan Fen Liselerinin kuruluş amaçları 7 Eylül 2013 tarih ve 28758 sayılı Resmi Gazetede yayınlanan Millî Eğitim Bakanlığı Ortaöğretim Kurumları Yönetmeliği'nde şöyle tanımlanmıştır;

- Öğrencileri bedenî, zihnî, ahlâkî, manevî, sosyal ve kültürel nitelikler yönünden geliştirmeyi, demokrasi ve insan haklarına saygılı olmayı, çağımızın gerektirdiği bilgi ve becerilerle donatarak geleceğe hazırlamak
- Öğrencileri ortaöğretim düzeyinde ortak bir genel kültür vererek yükseköğretime, mesleğe, hayata ve iş alanlarına hazırlamak,
- Eğitim ve istihdam ilişkilerinin Bakanlık ilke ve politikalarına uygun olarak sağlıklı, dengeli ve dinamik bir yapıya kavuşturmak,
- Öğrencilerin öz güven, öz denetim ve sorumluluk duygularının geliştirmek,
- Öğrencilere çalışma ve dayanışma alışkanlığı kazandırmak
- Öğrencilere yaratıcı ve eleştirel düşünme becerisi kazandırmak,
- Öğrencilerin dünyadaki gelişme ve değişmeleri izleyebilecek düzeyde yabancı dil öğretmek,
- Öğrencilerin bilgi ve becerilerini kullanarak proje geliştirerek bilgi üretmelerini sağlamak,
- Teknolojiden yararlanarak nitelikli eğitim vermek
- Hayat boyu öğrenmenin bireylere benimsetmek,,
- Eğitim, üretim ve hizmette uluslararası standartlara uyulmasını ve belgelendirilmesini özendirmek,
- Fen liseleri, fen ve matematik alanlarında; sosyal bilimler liseleri, edebiyat ve sosyal bilimler alanlarında öğrencilerin bilim insanı olarak yetiştirilmelerine kaynaklık etmek.

Yukarıda ifade edilen son madde Fen Liselerinin STEM- Bilim, Teknoloji ve Mühendislik Eğitim vermek amacıyla kurulduklarını ifade etmektedir.

Fen Liselerinde eğitim, öğretim ve yönetim etkinliklerinin verimliliğinin sağlanması, okul ve çevre işbirliğinin gerçekleştirilmesi, yerel yönetimlerin ve sivil toplum örgütlerinin desteğinin alınması, her tür ve seviyedeki eğitim kurumlarıyla işbirliğinin geliştirilmesi, çocuk haklarının korunması ve hayata geçirilmesi amacıyla aşağıdaki kurul, komisyon ve ekipler oluşturulur.

- Öğretmenler Kurulu,
- Sınıf/ Şube Öğretmenler Kurulu,
- Zümre Öğretmenler Kurulu,
- Okul Zümre Başkanları Kurulu,
- Okul Öğrenci Meclisi,
- Okul Öğrenci Ödül Ve Disiplin Kurulu,
- Onur Kurulu,
- Sosyal Etkinlikler Kurulu.
- Bilim, Danışma, Sanat, Proje vb. Kurullar

1964-2014 yılları arasındaki yarım asırlık dönemde çok sayıda yüksek nitelikli öğrenci yetiştiren ve başta ODTÜ ve Ankara Üniversitesi olmak üzere teknik üniversitelere ve tıp fakültelerine öğrenci gönderen Ankara Fen Lisesi MEB okullarında eğitim, öğrenci ve öğretmen kalitesini yukarı çekmiş, diğer okul türlerine de örnek olurken özellikle 2010'lu yıllarda artan sayıda yeni açılan yeni devlet ve özel fen liselerine model oluşturmuştur.

YÖNTEM

Monografi türündeki bu çalışmamızda Ankara Fen Lisesinin kuruluşuna ilişkin proje ve protokollerin incelenmesi ve MEB Fen Lisesi mevzuatının incelenmesiyle başlanmıştır. Bunu üniversitelerde Fen Liseleri ve STEM eğitimi konusunda yapılan yüksek lisans ve doktora tezlerinin incelenmesi takip edilmiştir. MEB E-okul veri tabanından ve ÖSYM raporlarından yararlanılarak istatistiksel tablolar incelenmiş, arşiv taraması yapılmıştır. Daha sonra 1964 yılında Ankara Fen Lisesi açılırken örnek alınan, ziyaret edilen ABD'deki Liselerin bugünkü seviyeleriyle Fen Liselerimizin genel düzeyi karşılaştırılmıştır. Fen Lisesi mezunları, öğretmenleri ve yöneticileriyle yapılan mülakatlarda önemli bilgi ve tecrübeler ile tavsiye ve öneriler edinilmiştir.

BULGULAR

Fen Lisesi'nin kuruluşundan itibaren yıllara göre farklı programlar uygulanmıştır. Bu programlardan ilki okulun henüz yönetmeliğinin hazırlanmadığı, proje dokümanına istinaden eğitim ve öğretimin yapıldığı döneme ait 1964-1965 yılı programıdır.

Tablo 1: Fen Lisesi Ders Çizelgesi (1964-1965 Eğitim ve Öğretim Yılı)

			3. SINIF		
DERSLER	1. SINIF	2. SINIF	FİZİK ŞUBESİ	KİMYA ŞUBESİ	BİYOLOJİ ŞUBESİ
Temel Matematik	4	4	4	4	4
Geometri	3	2	2	2	2
Fen Bilgisi	6 (l. Sömestr)	-	-	-	-
Fizik	3 (2. Sömestr)	4	6	-	-
Kimya	3 (2. Sömestr)	4	-	6	-
Biyoloji	4	4	-	-	4
Edebiyat	4	4	4	4	4
Tarih	-	3	-	-	-
Coğrafya	3	-	-	-	-
Sosyal Bilim	-	-	3	3	3
Yabancı Dil	5	5	5	5	5
Beden Eğitimi	1	1	1	1	1
Milli Güvenlik Bilgisi	1	1	1	1	1
Seçmeli Dersler	5	4	7	7	7
TOPLAM	**36**	**36**	**36**	**36**	**36**

Kaynak: Ankara Fen Lisesi Projesi, 1964

Programların hazırlanmasında esas olan belirleyici nokta Fen derslerinin ağırlığı olmuştur. Fen Liselerinde her sınıftaki fen derslerinin ağırlığı yabancı dil ve beden eğitimi dersleri dışındaki haftalık ders saatleri çizelgesindeki ders saatleri toplamının % 65'inden az olamaz. 1993 yılındaki düzenlemede; Fen Liselerinde fen derslerinin ağırlığı yabancı dil ve beden eğitimi dışındaki derslerin kredi toplamının %60'ından az olamaz şekilde belirlenmiştir. Fen Lisesinin amacına uygun olarak matematik ve fen bilimleri derslerinin programda daha fazla yer alması beklenirken yeni düzenleme ile kültür ve sosyal bilimler derslerinin programa konulduğu görülmektedir. 1999 tarihli düzenlemede ise fen derslerinin ağırlığı korunurken, laboratuvar derslerine ve uygulamalara ağırlık verilmiştir. Tablo 2'de halihazırda Fen Liselerinde uygulanmakta olan program, Anadolu Liseleri ve Sosyal Bilimler Liseleriyle karşılaştırmalı olarak verilmektedir.

Tablo 2: Okul Türlerinin Programları

Sıra Nu.	Ortak Dersler	Anadolu Lisesi					Fen Lisesi					Sosyal Bilimler Lisesi					
		Sınıflar				Toplam	Sınıflar				Toplam	Sınıflar					Toplam
		9	10	11	12		9	10	11	12		Hz.	9	10	11	12	
1	Türkçe	-	-	-	-	0	-	-	-	-	0	4	-	-	-	-	4
2	Dil ve Anlatım	2	2	2	2	8	2	2	2	2	8	-	2	4	4	4	14
3	Türk Edebiyatı	3	3	3	3	12	3	3	3	3	12	-	3	4	4	4	15
4	Din Kültürü ve Ahlak Bilgisi	1	1	1	1	4	1	1	1	1	4	-	1	1	1	1	4
5	Tarih	2	2	-	-	4	2	2	-	-	4	-	2	4	3	-	9
6	T.C. İnkılâp Tarihi ve Atatürkçülük	-	-	2	-	2	-	-	2	-	2	-	-	-	2	-	2
7	Çağdaş Türk ve Dünya Tarihi	-	-	-	-	0	-	-	-	-	-	-	-	-	-	4	4
8	Coğrafya	2	2	-	-	4	2	2	-	-	4	-	3	2	4	4	13
9	Matematik	6	6	-	-	12	6	6	6	6	24	3	6	6	6	6	27
10	Fizik	2	2	-	-	4	2	2	4	4	12	-	2	2	-	-	4
11	Kimya	2	2	-	-	4	2	2	4	4	12	-	2	2	-	-	4
12	Biyoloji	3	3	-	-	6	3	3	3	3	12	-	3	3	-	-	6
13	Sağlık Bilgisi	1	-	-	-	1	1	-	-	-	1	-	1	-	-	-	1
14	Felsefe	-	-	2	-	2	-	-	2	-	2	-	-	-	2	-	2
15	Birinci Yabancı Dil	6	4	4	4	18	7	3	3	3	16	20	6	3	3	3	35
16	İkinci Yabancı Dil	2	2	2	2	8	2	2	2	2	8	4	2	2	2	2	12
17	Beden Eğitimi	2	2	2	2	8	2	2	2	2	8	2	-	-	-	-	2
18	Bed. Eğt. / Görsel Sanatlar/Müzik	1	1	1	1	4						-	2	2	-	-	4
19	Trafik ve İlk Yardım	-	-	-	1	1	-	-	-	1	1	-	-	-	-	1	1
20	Rehberlik ve Yönlendirme	1	1	1	1	4	1	1	1	1	-	1	1	1	1	1	5
21	Sosyal Bilim Çalışmaları	-	-	-	-	0	-	-	-	-	-	-	-	2	2	2	6
22	Psikoloji	-	-	-	-	0	-	-	-	-	-	-	-	-	2	-	2
23	Sosyoloji	-	-	-	-	0	-	-	-	-	-	-	-	-	2	2	4
24	Mantık	-	-	-	-	0	-	-	-	-	-	-	-	-	-	2	2
25	Osmanlı Türkçesi	-	-	-	-	0	-	-	-	-	-	-	-	2	2	2	6
26	Matematik Uygulamaları (S)	-	-	-	-	0	-	2	2	2	-	-	-	-	-	-	0
27	Bilim Uygulamaları (S)	-	-	-	-	0	-	3	3	3	-	-	-	-	-	-	0
Ortak Ders Saati Toplamı		**36**	**33**	**20**	**17**	**106**	**36**	**36**	**40**	**37**	**130**	**34**	**36**	**40**	**40**	**38**	**188**
Haftalık Ders Saati Toplamı		**40**	**40**	**40**	**40**	**160**	**40**	**40**	**40**	**40**	**160**	**34**	**40**	**40**	**40**	**40**	**194**

Anadolu Liselerinde Fen Liselerine göre Fen ve Matematik haftalık ders süreleri toplamı 2 katıdır. İlk Fen Lisesi 1964-1965 yılında eğitim ve öğretime başladıktan 18 yıl gibi uzun bir süre sonra 1982 yılında ikinci Fen Lisesi açılmıştır. Takip eden yıllarda bir Fen Lisesi açılırken 1995 yılından itibaren sayı artmıştır. 2009 yılında ise sayıda daha fazla artış meydana gelmiştir. 2014-2015 yılında kapanan Öğretmen Liselerinin önemli bir bölümünün Fen Lisesine dönüştürülmesiyle 81 yeni Fen Lisesi eğitime hazırlık çalışmalarına başlamıştır.

Tablo 3: Açılış Yıllarına Göre Devlet Fen Lisesi Sayıları

Açılış Yılı	Kurum Sayısı
1964-1965	1
1982-1983	1
1983-1984	1
1984-1985	1
Açılış Yılı	**Kurum Sayısı**
1985-1986	1
1986-1987	1
1987-1988	1
1988-1989	1
1989-1990	5
1991-1992	1
1992-1993	3
1993-1994	3
1994-1995	6
1996-1997	8
1997-1998	3
1998-1999	3
1999-2000	5
2000-2001	2
2001-2002	6
2002-2003	4
2003-2004	3
2004-2005	7
2005-2006	2
2006-2007	7
2007-2008	4
2008-2009	3
2009-2010	12
2010-2011	20
2011-2012	26
2012-2013	4
2013-2014	6
2014-2015	81
GENEL TOPLAM	**232**

Kaynak: MEB E-Okul 2015

2014 yılında Fen Lisesine dönüştürülen okulların bir kısmı henüz fiilen eğitime başlamamış olup eğitime açık 159 Fen Lisesinde 3.957 öğretmen norm kadrosunun 3.735'i doludur (% 94,3). Okul başına öğrenci sayısı 350 olup, kız öğrencilerin oranı %67,5, erkek öğrencilerin ise %32,5'dir.

2015 yılında Milli Eğitim Bakanlığı yeni ve yenilikçi eğitim programlarını geliştirmek amacıyla muhtelif illerdeki okul türlerinden 45 okulu Proje Okulu olarak belirlemiş olup bunları 15'i Fen Lisesidir.

Tablo 4: Proje Okulu Seçilen MEB Fen Liseleri

İL	İLÇE	FEN LİSESİ
Adana	Seyhan	Adana Fen Lisesi
Ankara	Çankaya	Ankara Fen Lisesi
Antalya	Döşemealtı	Yusuf Ziya Öner Fen Lisesi
Bursa	Nilüfer	Tofaş Fen Lisesi
Diyarbakır	Yenişehir	Rekabet Kurumu Cumhuriyet Fen Lisesi
Erzurum	Palandöken	Erzurum İbrahim Hakkı Fen Lisesi
Gaziantep	Şehitkamil	Vehbi Dinçerler Fen Lisesi
İstanbul	Kadıköy	İstanbul Atatürk Fen Lisesi
İstanbul	Fatih	Çapa Fen Lisesi
İzmir	Bornova	İzmir Fen Lisesi
Kayseri	Melikgazi	Kayseri Fen Lisesi
Malatya	Yeşilyurt	Malatya Fen Lisesi
Mersin	Yenişehir	Eyüp Aygar Fen Lisesi
Şanlıurfa	Karaköprü	Şanlıurfa Fen Lisesi
Van	Edremit	Türk Telekom Fen Lisesi

Kaynak: MEB E-Okul, 2015

Devlet Fen Liselerine kayıt olan öğrencilerin mezun olduğu okullara baktığımızda ise özel ortaokulların payının sürekli olarak artarak günümüzde %70 seviyesine ulaştığını görmekteyiz.

Tablo 5: Devlet Fen Liselerine Gelen Ortaokul Mezunları Kaynağı

EĞİTİM ÖĞRETİM YILI	ÖZEL ORTAOKUL	DEVLET ORTA OKULU	TOPLAM
2006-2007	2.463	5.087	7.550
2007-2008	2.644	5.129	7.773
2008-2009	2.918	5.961	8.879
2009-2010	3.570	7.723	11.293
2010-2011	4.128	9.249	13.377
2011-2012	5.390	10.422	15.812
2012-2013	6.148	14.399	20.547
2013-2014	9.003	22.735	31.738
TOPLAM	36.264	80.705	116.969
YÜZDE ORAN	31	69	100

Kaynak: MEB E-Okul, 2015

Özel Fen Liseleri

İstanbul'da 58, Ankara'da 30, İzmir'de 18 olmak üzere Türkiye'de toplam 231 Özel Fen Lisesi bulunmaktadır. 231 Özel Fen Lisesinin 35.593 öğrenci kontenjanı bulunmasına karşılık 19.251 öğrenci kayıtlıdır. Buna göre doluluk oranı 6 Nisan 2015 tarihi itibariyle % 54'dür. 2014-2015 yılında 6528 sayılı kanunun12. maddesine istinaden sağlanan öğrenci başına yıllık 3.500 TL özel eğitim desteğinden Türkiye genelinde 168.310 öğrenci yaralanırken bunların 33.749'u Özel Lise öğrencisidir. Özel Lise öğrencilerinin ise 2.069'u Özel Fen Lisesi öğrencisidir. Buna göre Özel Fen Liselerinin öğrenci kontenjanı kullanımında kanunla sağlanan destekle birlikte %6 oranında artış sağlanmıştır. Özel ve devlet Fen Lisesi sayısı hemen hemen aynı olmasına karşılık devlet liselerinde öğrenci kontenjanı ve sayısı ile kapasite kullanımı daha yüksektir. Özel Fen Liselerinde ise öğretmen ve derslik başına düşen öğrenci sayısı daha düşüktür.

İllere göre devlet Fen Liselerinin dağılımına bakıldığında sekizer Fen Lisesi ile Ankara ve Antalya ilk sırada yer alırken yedi Fen Lisesi ile Şanlıurfa ikinci sırada gelmektedir. 1990-2011 arası döneme bakıldığında fen liselerinde erkek öğrenci oranı yüksek iken günümüzde bu oran kız öğrenci sayısının hızla artmasıyla %50'lilere gerilemiştir. MEB fen lisesi mezunlarının yerleştikleri fakültelere göre dağılımları Tablo 1'de verilmiş olup %45,5 oranıyla ilk sırada yer alan Mühendislik ve Mimarlık Fakültelerini %25,3 oranıyla Tıp Fakülteleri izlemektedir. MEB fen liselerinde toplam 5.881 öğretmen norm kadrosu bulunmaktadır. Bu, her okul için yaklaşık 26 öğretmen normuna karşılık gelmektedir. Fen Liselerinde öğrenci sayısı 30 ile sınırlandırılmış olup yeni yapılacak okul binaları ile bu sayının daha aşağıya çekilmesi amaçlanmaktadır. 1989 yılında açılan Seoul Science High School örneğinde ortaokul mezunlarından başarı sıralamasında %0,01 diliminden alındığı, derslik başına öğrenci sayısının 20 olduğu ve bunun 15'e indirilmesinin hedeflendiği belirtilmektedir.

Tablo 6: MEB Fen Lisesi Mezunlarının Fakülte ve Yüksekokullara Dağılımları

FAKÜLTE	KIZ (%)	ERKEK (%)	TOPLAM (%)
Tıp Fakültesi	10,5	14,8	25,3
Mühendislik- Mimarlık Fakültesi	10,1	33,5	45,5
Diş Hekimliği Fakültesi	1,7	1,5	3,2
Hukuk Fakültesi	0,2	0,3	0,5
İktisadi ve İdari Bilimler Fakültesi	1,7	6,3	8,1
Fen-Edebiyat Fakültesi	3,4	3,6	7,0
Eğitim Fakültesi	1,7	1,6	3,3
Eczacılık Fakültesi	1,3	1,2	2,5
Ziraat Fakültesi	0,3	0,4	0,7

Veteriner Fakültesi	0,4	1,0	1,4
Açık Öğretim Fakültesi	0,4	0,7	1,1
Meslek Yüksekokulları	0,1	0,2	0,3
Sağlık Meslek Yüksekokulları	0,5	0,3	0,7
Diğer	1,5	1,0	2,5
TOPLAM	33,7	66,3	100,0

Kaynak: MEB E-OKUL (1990-2011)

Özel Fen Liselerinden mezun öğrenci sayısı 2008 yılından itibaren düzenli olarak artarken, devlet Fen Liselerinde daha hızlı bir artış gözlenmektedir.

Tablo 7: Yıllar İtibariyle Fen Liselerinden Mezun Sayısı

EĞİTİM ÖĞRETİM YILI	ÖZEL FEN LİSESİ	DEVLET FEN LİSESİ	TOPLAM
2008-2009	2.393	4.490	6.883
2009-2010	2.097	4.735	6.832
2010-2011	2.295	5.276	7.571
2011-2012	2.327	5.442	7.769
2012-2013	2.639	6.252	8.891
2013-2014	2.919	8.380	11.299
TOPLAM	14.670	34.575	49.245
YÜZDE ORAN	30	70	100

Aşağıda Tablo 8'de Ankara Fen Lisesi'nin kuruluşundan bugüne kadar 4.300 mezun vermiş olup 3 öğrenci hariç tamamı tercih ettiği üniversiteye yerleşmiştir. AFL yılda ortalama 85 mezun vermektedir. Mezunların %43,3'ü Tıp Fakültesine, %49'u Mühendislik ve Mimarlık Fakültesine, %0,7'si ise diğer Fakültelere yerleşmiştir.

Tablo 8: Ankara Fen Lisesi Mezunlarının Yerleştiği Fakülteler

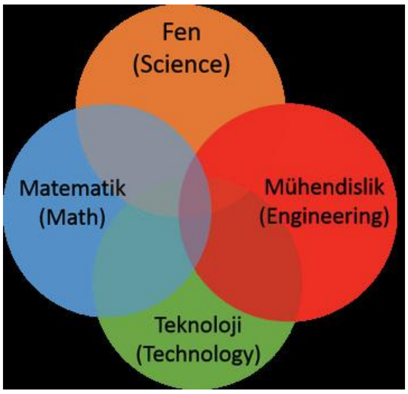
Yıl	Mezun Sayısı	Tıp F.	Mühendislik Mimarlık F.	Diğer Fakülteler	Yerleşen Sayısı
1967	96	24	60	12	96
1968	96	19	60	17	96
1969	96	7	75	14	96
1970	96	14	71	11	96
1971	95	23	67	3	95
1972	95	26	69	-	95
1973	96	28	66	2	96
1974	96	45	48	3	96
1975	96	65	31	-	96
1976	96	75	18	3	96
1977	89	60	26	3	96
1978	85	51	30	4	96
1979	84	58	20	6	96
1980	73	70	13	-	96
1981	96	87	8	1	96
1982	90	70	20	-	90
1983	85	70	15	-	85
1984	88	62	20	6	88

Yıl	Mezun Sayısı	Tıp	Mühendislik Mimarlık	Diğer Fakülteler	Yerleşen Sayısı
1985	96	30	57	9	96
1986	89	25	60	4	89
1987	94	17	72	5	94
1988	92	49	39	4	92
1989	94	29	64	1	94
1990	95	13	45	37	95
1991	94	26	52	13	94
1992	88	35	44	4	88
1993	95	33	45	17	95
1994	23	9	10	4	23
1995	58	25	25	8	58
1996	24	9	10	5	24
1997	93	18	72	5	93
1998	94	27	66	1	94
1999	90	26	60	4	90
2000	89	25	60	4	89
2001	94	30	50	4	94
2002	92	49	39	4	92

2003	90	30	56	4	90
2004	91	27	52	12	91
2005	89	35	44	10	89
2006	94	38	46	10	94
2007	93	48	36	9	93
2008	92	52	30	10	92
2009	92	39	48	7	92
2010	90	44	35	9	90
2011	94	48	37	9	94
2012	92	52	30	10	92
2013	90	46	38	6	90
2014	98	52	40	6	98
Toplam	4247	1.840	2.079	339	4.300

ABD'de STEM Uygulamaları[4]

SSCB'nin 4 Ekim 1957 tarihinde Kazakistan'daki Baykonur Uzay Üssünde gönderdiği Sputnik 1 uydusunun 250 km. çapında bir yörüngeye yerleşmesi ABD yönetimini ve halkında çok önemli bir etki yaptı. Sputnik'ten kısa bir süre sonra ABD'nin gönderdiği uydunun başarılı olamaması endişeleri artırdı. Soğuk Savaş döneminin ve Uzay Yarışının başlamasını tetikleyen bu olay ile birlikte eğitim müfredatının ve sisteminin gözden geçirilmesine, roket bilimine ve fen bilimlerine ilgi uyanmasına ve uzay projelerine ayrılan mali kaynaklar artırılmış. 1980'li yıllarda Japonya'nın sağladığı başarı ABD için ikinci önemli etkiyi oluşturmuştur. Benzer bir başarı/tehdit Çin ve Hindistan'dan gelebileceği görülerek, ABD çeşitli reform girişimleri başlatmıştır. Bunlardan en tanınanları 1996'da yayınlanan National Science Education Standards kapsamında fen bilimlerinde nelerin ve nasıl öğretileceğine dair eyaletlere ve okullara yön veren bir müfredat programıdır. Bu program hem ABD'de hem de dünyanın gelişmiş ve gelişmekte olan STEM- Bilim-Teknoloji-Mühendislik-Matematik programlarının temelini oluşturmuştur. 2012 yılında ise Gelecek Nesil Bilim Standartları kapsamında 1996 yılında oluşturulan temel standartlara uygun olarak kurulacak 15 disiplindeki STEM laboratuvarlarının standardı yayınlanmıştır.



Şekil 1: STEM Eğitimi

- Astronomi ve Astrofizik
- Otomasyon ve Robotik
- Biyoteknoloji ve Yaşam Bilimleri
- Kimyasal Analiz ve Nanokimya
- Haberleşme Sistemleri
- Bilgisayar Destekli Tasarım
- Bilgisayar Sistemleri
- Enerji Sistemleri
- Çokdisiplinli Araştırma
- Mikroelektronik
- Mobil ve Web Uygulama Geliştirme
- Nörobilim
- Oşinografi ve Jeofizik Sistemleri
- Kuantum Fiziği ve Optik
- Prototip ve Mühendislik Malzemeleri

Optik ve Modern Fizik Laboratuvarı deneysel, teorik, bilgisayarlı araştırma takip ve uygulamalı fizik için heyecan verici fırsatlar sunmaktadır. Uygulamalı araştırma, öğrenciler sık sık yeni cihazlar veya optik, elektromanyetik, akustik, fotonik ve nanoteknoloji sistemleri ile ilgili mevcut cihazların mühendis iyileştirmeler geliştirmek. Optik projeler genellikle görüntüleme sistemleri, vizyon, sensörler, renk, insan algı, görüntü işleme, holografi, enterferometre ve diğer lazer uygulamaları yer var. Modern Fizik, öğrenciler atom, kuantum, nükleer, katı hal, ve temel parçacık fiziği Metamalzemeler ve holografik veri depolama alanlarında araştırma peşinde. Laboratuvar öncelikli hedefleri çağdaş araştırma sorunlarını takip ve alanında profesyoneller ile işbirliği içinde öğrencilerin ilgisini çekmek için vardır.

- Optik ve Modern Fizik Laboratuvarında gerçekleştirilen bazı projeler şunlardır;
- 3D Görselleştirme için "Artırılmış Gerçeklik" Camların Tasarım
- Birbirine benzemeyen Metaller Arasında Kuantum Tünel

[4] https://www.tjhsst.edu/research-academics/research-labs/index.html

- Bilgi Depolama Bilgisayar Oluşturulan holografi kullanarak
- Mikrodalga Metamalzemeler Q-Faktör İyileştirme
- Pentasen Transistörlerle Gürültü Analizi

Bu laboratuvarda şu cihazlar bulunmaktadır;
- Newport Optik Breadboards Titreşim-İzole
- Helyum-Neon, Argon-İyon ve Katı Hal Lazerler
- Sintilasyon Dedektör Çok kanallı Skaler / Analiz
- Bilgisayar Kontrollü X-ray Sistemi
- EasyScan Taramalı Tünel Mikroskobu
- Mikrodalga Üretimi ve Ölçüm Aparatı

CAD Lab kalp pompalama simülasyon karmaşık bir mekanizmanın montaj teknolojik tasarım yönlerini çeşitli keşfetmek için bilim adamı / mühendis hayal yürütmektedir. Laboratuvar Tasarım Sanayi için ticari yazılım hat akımı bültenleri üst vardır; öncelikle mühendislik ve mimarlık. kullanılan baskın yazılım Autodesk paketidir.

- Bilgisayar Destekli Tasarım Laboratuvarında gerçekleştirilen projeler
- Sualtı yaşam tasarımı (okyanus yaşamının malzemelerin basınç ve toksisite araştırmalar).
- Çok Amaçlı tasarım ve montaj atölyesi
- Güneş enerjili araçlar
- DNA Modelleme
- Uçuş simülasyonu testi
- "Yeşil" TJ yenileme
- Yapay vücut parçaları ve organları Tasarım ve Simülasyon
- Buluşçu montaj ekran ile otomatik araba asansörü robotu

Laboratuvarda aşağıdaki cihaz ve yazılımlar kullanılmaktadır;

- HP Compaq dc5100 Mikro-Kule
- Intel Pentium 4 HT / 2.8 GHz, 1 GB RAM
- NVIDIA Quadro NVS 280 Grafik Adaptörü
- Blaster Audigy X-Fi Midi Arabirimi Ses
- Tasarım Jet 500 çizici
- Z 310 3-D çizici prototipleme makinesi
- Inventor, AutoCAD, Mekanik, İnşaat, Land, Revit, VIZ, ve 3ds Max Solid Works CAD Yazılımları

TUBİTAK STEM DESTEKLERİ

TUBİTAK Bilim ve Toplum Programları kapsamında desteklenen projeler, STEM yaklaşımına uygun olarak üretilecek projelerle bilginin topluma anlaşılır bir biçimde aktarılmasını, bunu yaparken de bilginin mümkün olduğunca görselleştirilerek, etkileşimli uygulamalarla desteklenmesini amaçlar. Bu projelerde, klasik eğitim metotlarının kullanılarak, katılımcılara olabildiğince fazla bilgi aktarılması değil, katılımcıların basit bilimsel olguları fark etmeleri sağlanarak, merak duygularının, araştırma ve öğrenme isteklerinin tetiklenmesi önem arz etmektedir.

TUBİTAK 4003 Programı Bilim ve Teknoloji Merkezleri

Her yaştan farklı birikime sahip insanları bilimle buluşturmak, bilgiyi kaynağından öğrenmelerini sağlamak ve bilime olan merakı tetiklemek üzere tasarlanmış deneysel ve uygulamalı merkezlerdir. Bilim merkezleri, kişilerin tüm duyularına hitap eder ve isteyene okuyarak, isteyene dinleyerek, isteyene uygulayarak yani dokunarak öğrenme fırsatı sunar. Bilim merkezlerinin amacı tüm bilgileri tam anlamıyla vermek değil, kişilerin bilime karsı olan ilgilerini artırmak ve dikkatlerini çekebilmektedir. Kısaca bu merkezler duyular yoluyla sezgiyi harekete geçirir ve yaratıcılığı kışkırtır. Bilime katkısının yanı sıra, bu merkezler bulundukları coğrafyanın tarih ve kültürünü de sergiler. Bilim ve sanatın birlikteliğidir. Çünkü bilimsel bilginin sunulması yaratıcılık ve sanatsal bir bakış açısı gerektirir.

Bilim merkezleri, günlük olaylara bilimsel bir bakış açısıyla yaklaşabilme yönünde bir ufuk açmaktadır. Herkesin yaratıcı düşünebileceğini ve yaratıcı düşünme becerilerini geliştirebileceğini göstermektedir. Özellikle küçük yaştaki ziyaretçilerin kendi başlarına karar verebilen ve sorumluluk sahibi bireyler olmalarına katkı sağlamaktadır. Bilim merkezleri, sadece içerikleriyle değil, mimarileriyle, yeşil alanları ve kullanım amaçlarının çeşitliliğiyle de cazibe merkezi olma özelliği taşımaktadırlar. Geniş giriş ve bekleme salonları, yüksek tavanlarıyla, ziyaretçilere rahat bir ortam sunmaktadırlar. Henüz bilim merkezinin içerisine girmeden ziyaretçileri karşılayan etkileşimli açık hava sergileri, onları bilimin gizemli dünyasına davet eder.

TÜBİTAK, Türkiye'de bilim merkezlerini yaygınlaştırarak bilimsel düşüncenin gelişmesini ve bilim kültürünün yaygınlaşmasını, topluma düşünen ve sorgulayan öncü bireyler kazandırmayı, topluma yeni bir vizyon kazandırarak, Türkiye'deki bilimsel birikime ihtiyaç duyduğu sıçramayı yaptırmayı amaçlar. Bilim ve Teknoloji Yüksek Kurulu'nun 23. toplantısında özellikle çocukların ve gençlerin bilime olan ilgi ve meraklarını artıracak, teknolojiyi daha doğru kullanmalarını sağlayacak bilim merkezlerinin 2016 yılı itibarıyla tüm büyükşehirlerde, 2023 yılı itibarıyla tüm illerde kurulmasına yönelik çalışmaların yerel yönetimlerle işbirliği halinde gerçekleştirilmesine karar verilmiştir[5].

TUBİTAK 4004 Doğa Eğitimi ve Bilim Okulları Programı, bilginin topluma anlaşılır bir biçimde aktarılmasını, bunu yaparken de bilginin mümkün olduğunca görselleştirilerek, etkileşimli uygulamalarla desteklenmesini amaçlar. Projelerde katılımcılara, olabildiğince fazla bilgi aktarılması değil, basit bilimsel olguları fark etmeleri sağlanarak, merak duygularının, araştırma, sorgulama ve öğrenme isteklerinin tetiklenmesi önem arz etmektedir. 2007-2012 arasında 289 proje gerçekleştirilmiştir[6].

TUBİTAK 4005 Bilim ve Toplum Yenilikçi Eğitim Uygulamaları programı, öğretmenlere eğitim verilmesi ve çağrı kapsamındaki konularla ilgili faaliyet ve uygulamaları içeren projelerin desteklenmesi hedeflenmektedir. 2014 yılında 11 proje desteklenmiştir.

Öğretmenlere, kendi branşlarına yönelik olarak öğrencilerinde ilgi ve merak uyandırmak, olumlu tutum geliştirmek ve öğrencilerinin motivasyonlarını artırmak için gerekli bilgi ve becerileri yenilikçi yaklaşımlar, stratejiler, yöntem ve teknikler aracılığıyla etkileşimli olarak kazandırmak, bilimsel konularda sadece alan bilgisi ve farkındalık kazandırmaya yönelik faaliyetlerin ötesinde, öğretmenlerin, geleneksel öğretim yöntemleri dışında kalan yenilikçi yaklaşım, strateji, yöntem ve teknikleri öğrenerek kendi öğretim ortamlarında uygulamalarına yönelik projelerin desteklenmesi amaçlanmaktadır. Bu program kapsamında öğretmenlerle yürütülecek etkinlikler yoluyla aşağıdaki amaçlara ulaşılması hedeflenmektedir;

- Bilimi ve bilim insanını sevdirmek,
- Bilimin eğlenceli boyutuna vurgu yapmak,
- Toplumda ve öğrencilerde bilime ve bilim insanına yönelik olumsuz endişe, kaygı ve önyargıları ortadan kaldırmak,
- Bilimsel araştırma yapan kurum/kuruluşlarla okul arasında köprü kurmak,
- Bilimsel süreç becerilerini geliştirmek,
- Bilimin doğasının anlaşılmasını sağlamak,
- Bilim, teknoloji, toplum, çevre ve birey arasındaki etkileşimi kavratmak,
- Okul dışı kaynakların, çağrı amaçlarına uygun olarak kullanılmasını sağlamak,
- Özgün yöntem, teknik ve materyallerin etkili kullanımını yaygınlaştırmak,
- Bilimsel tecrübelerin paylaşılması ve yeni içeriklerin geliştirilmesine yönelik etkinlikleri yaygınlaştırmak,
- Üst düzey düşünme becerilerini geliştirmek,
- Bilimin günlük hayatla ilişkilendirilmesi ve öğrencilerde/toplumda karşılaşılan "Bu benim işime nerede, nasıl yarayacak?" vb. sorulara anlamlı cevapların verilebilmesini sağlamak,
- Refah toplumu ve bilimsel/teknolojik faaliyetler arasındaki ilişkinin kavranmasını sağlamak,
- Bilimsel bir bakış açısıyla çevre farkındalığını ve duyarlılığını geliştirmek,
- Bilim okuryazarlığını yaygınlaştırmak,
- Çağrı konusuyla ilgili iyi örnekleri transfer etmek ve uyarlamak,
- "Yurttaş bilim insanı" kavramı çerçevesine giren faaliyetleri teşvik etmek,
- Web 3.0 (Semantik Web) teknolojilerinin çağrı kapsamında kullanımına yönelik faaliyet ve oluşumları geliştirmek/yaygınlaştırmak[7].

4006 TÜBİTAK Bilim Fuarları Destekleme Programı

Milli Eğitim Bakanlığı ile TÜBİTAK arasında imzalanan ve TÜBİTAK Bilim ve Toplum Dairesi tarafından yürütülen "Eğitimde İşbirliği Protokolü" kapsamında ülkemizde bilim kültürünün geliştirilmesine yönelik olarak açılmıştır. **"**TÜBİTAK Bilim Fuarları"**,** 5-12. sınıfta okumakta olan öğrencilerin öğretim programı çerçevesinde

[5] http://www.tubitak.gov.tr/tr/destekler/bilim-ve-toplum/ulusal-destek-programlari/4003/icerik-bilim-merkezleri
[6] http://www.tubitak.gov.tr/sites/default/files/projeler_2007-2012_0.pdf
[7] http://www.tubitak.gov.tr/sites/default/files/4005_2015_desteklenmesine_karar_verilen_projeler.pdf

ve kendi ilgi alanları doğrultusunda belirledikleri konular üzerine araştırma yaparak, araştırmalarının sonuçlarını sergileyebilecekleri, öğrenciler ve izleyiciler için eğlenerek öğrenebilecekleri bir ortam oluşturmayı amaçlamaktadır;
• Bilimin ve bilimsel çalışmaların yeni nesiller tarafından benimsenmesinin teşvik edilmesi,
• Bilimin günlük hayatla ilişkilendirilmesi,

• Araştırma tekniklerinin, bilimsel raporlamanın ve bilimsel sunum becerilerinin tabana yayılarak genç bireylere kazandırılması,

• Farklı gelişimsel ve bilişsel seviyedeki her çocuğa bilimsel proje yapma fırsatının sunulması,
• Öğrencilere bilimsel proje yapma ve paylaşma konusunda yeni ortam ve olanakların yaratılması,
• Öğrenciler üzerindeki yarışma baskısının ortadan kaldırılarak bilimin eğlenceli taraflarının ön plana çıkarılması,
• Farklı sosyo-ekonomik seviyedeki bölge okullarının bilimsel projelere eşit katılımının sağlanması,
• Gerçek hayattaki soru ve sorunlara çözüm bulunmasında bilimin ve bilimsel çalışmaların öneminin öğrenciler tarafından uygulayarak/yaşayarak öğrenilmesinin sağlanmasıdır. 2015 yılında 3.300 Bilim Fuarı düzenlenecektir[8].

TUBİTAK 4007 Bilim Şenliği Destekleme Programı

Bilim iletişiminin sağlanması, bilimsel bilginin geniş toplum kitlelerine ulaştırılması ve bilim-teknoloji arasındaki etkileşimin kavratılması için sergi, sahne şovları, gösteri, atölye/laboratuvar çalışmaları, tematik bilim oyunları, yarışmalar, söyleşiler vb. etkinlikler yoluyla katılımcıların temel bilimsel olguları fark etmelerinin sağlanması, merak duygularının, araştırma, sorgulama ve öğrenme isteklerinin tetiklenmesini amaçlar. 2014 Bilim ve Toplum Projeleri destek üst limiti 100.000 TL olup 25 projenin desteklenmesine karar verilmiştir[9].

TUBİTAK 5000 Dijital İçerikli Açık Ders Kaynaklarını Destekleme Programı

Programın genel amacı, ilk ve ortaöğretim ile yükseköğretim kurumlarında okutulan dersler için Türkçe telif kaynakları artırarak ders materyali havuzunu genişletmek ve ilköğretim, ortaöğretim, ön lisans, lisans ve lisansüstü öğrencilerine fırsat eşitliği sağlayacak ulaşılabilir kaynaklar üretmektir. Akademik e-Kitap ve Akademik e-Ders çağrıları bireysel ve kurumsal başvurulara yönelik olarak yayımlanmıştır[10].

SONUÇ ve ÖNERİLER

Ülkemizde devlet ve özel sektörün Fen Liseleri Bilim, Teknoloji ve Matematik eğitiminde önemli bir aşama kaydetmiş olmasına karşılık 2023 hedeflerine katkıda bulunabilmek için aşağıdaki tedbirlerin alınması önerilebilir.

1. Müfredat sanayi toplumundan bilişim toplumuna geçişi hızlandıracak biçimde değiştirilmeli, geleceğin teknolojileri ve mesleklerine yönelik bilim adamı yetiştirilmesi hedeflenmelidir.
2. Fen Liselerinin STEM laboratuvarları tamamen yenilenmelidir.
3. Fen liselerinin fiziki şartları en üst seviyeye yükseltilmeli ve yardımcı araç gereç eksiklikleri giderilmelidir.
4. Mezun- Öğrenci – Aile - Okul işbirliği güçlendirilmelidir.
5. Üniversitelerle işbirliği artırılmalı, üniversitelerle k12 okulları çok yakın çalışmalıdır.
6. Fen liselerine karar alma ve uygulama serbestliği sağlanmalıdır.
7. Fen liselerine öğretmen seçimi objektif esaslara göre yeniden düzenlenmelidir. Öğretmen atamada yüksek lisans mezuniyeti ve yabancı dil bilgisi ön şart olarak belirlenmelidir.
8. Öğretmenlere yönelik hizmet içi eğitimleri sürekli hale getirilmeli; ayrıca öğretmenlerin bilgi ve görgülerini arttırmak, ve yeni gelişmeleri takip edebilmeleri için yurt dışında gönderilmeleri sağlanmalıdır.
9. Fen Liselerinden üniversitelere gelen öğrencilerin, bu okulların amacına uygunluklarının ve akademik yeterliklerinin incelendiği araştırmalar yapılmalıdır.

[8] http://www.tubitak.gov.tr/tr/destekler/bilim-ve-toplum/ulusal-destek-programlari/icerik-4006-tubitak-bilim-fuarlari-destekleme-programi
[9] http://www.tubitak.gov.tr/sites/default/files/4007_2015_desteklenmesine_karar_verilen_projeler.pdf
[10] http://www.tubitak.gov.tr/tr/destekler/bilim-ve-toplum/ulusal-destek-programlari/icerik-5000-dijital-icerikli-acik-ders-kaynaklari-destekleme-programi

10. TUBİTAK Programlarından daha fazla okulumuz yararlanmalı, proje çıktıları daha geniş bir kitlenin istifadesine sunulmalıdır.
11. TUBİTAK, Fen Liselerinde STEM laboratuvarlarının kurulmasını destekleyen programlar geliştirilmelidir.
12. Mezunlarla ilgili araştırmalar yapılarak uygulamaya yansıtılmalıdır.

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AN ACTIVE LEARNING MODEL OF BIOMEDICAL CALIBRATION COURSE: HOSPITAL CALIBRATOR APPLICATIONS

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Başkent Üniversitesi, Mühendislik Fakültesi, Biyomedikal Mühendisliği Bölümü

ABSTRACT: Calibration refers to comparing a reference measuring device which is sure to be accurate (traceability ensured) with a device which is not sure to be accurate and reporting measurement results. The Biomedical Calibration Training and Applications course is one of the important courses for technical sciences students. 75% of the medical devices used in hospitals have to be subjected to periodic calibration and preventive maintenance. Thus, technical staff to be employed in hospitals has to have deep theoretical and practical knowledge on this subject. The Biomedical Calibration course is taught 4 hours (2 hours in theory + 2 hours in practice) a week for 14 weeks in the 3rd semester of Başkent University Vocational School of Technical Sciences Biomedical Device Technology Program.

The Biomedical Calibration course involves both theoretical and practical difficulties for students and academics. The main problems are as follows: medical devices have a wide variety of types and models; new devices are introduced continually; and standardization has not been achieved yet. The educational model adopted by considering these problems involves teaching medical devices to students through classifying them by working parameter and grouping them by clinical department. To this end, relational database management systems are used (SQL). In this database, risk levels of medical devices and parameters of calibration (e.g. flow, humidity, pressure, temperature, vacuum, leakage current, electrophysiological signals) are determined in the first place. Then devices are grouped by department through relational methods. In this way, theoretical knowledge, database management applications, and planning about calibration workflow are taught to students (5 weeks in theorical). After that, students apply calibration procedures to medical devices in the hospital environment via traceable calibrators (7 weeks in practice).

This study deals with the practice-based education model developed for the Biomedical Calibration course, the software used, and the planning of the calibrators used. The study also presents the planning of the new in-hospital practical training that has been carried out recently. This renewed model was evaluated by students via questionnaires, and results were interpreted statistically. The practical training was found to be successful in that it was carried out in the hospital and prepared the students for the sector.

Key words: active learning, biomedical calibration, database management, field based practice

BİYOMEDİKAL KALİBRASYON DERSİ AKTİF ÖĞRENME MODELİ: HASTANE KALİBRATÖR UYGULAMALARI

ÖZET: Kalibrasyon doğruluğundan emin olunan (izlenebilirliği sağlanmış) referans ölçüm cihazı ile doğruluğundan emin olunamayan bir tıbbi cihazı mukayese ederek ölçüm sonuçlarını raporlama işlemidir. Biyomedikal kalibrasyon eğitimi ve uygulamaları teknik bilimler öğrencileri için oldukça önemli dersler arasında yer almaktadır. Hastanelerde kullanılan tıbbi cihazların %75'i periyodik kalibrasyon ve önleyici bakıma tabi tutulmak zorundadır. Bu nedenle hastane içerisinde istihdam edilecek teknik personelin bu konu ile derinlemesine teorik ve pratik bilgi birikimine sahip olması gerekmektedir. Biyomedikal Kalibrasyon dersi, Başkent Üniversitesi Teknik Bilimler Meslek Yüksekokulu Biyomedikal Cihaz Teknoloji Programı içerisinde, 3.dönem eğitim sürecinde 4 saat (2 saat teorik + 2 saat pratik) toplam 14 hafta olarak verilmektedir.

Biyomedikal kalibrasyon dersinin teorik eğitim ile birlikte pratik uygulamalarını gerçekleştirmek öğrenciler ve akademisyenler için çeşitli güçlükler içermektedir. Tıbbi cihazların oldukça fazla çeşit ve modelden oluşması, sürekli yenilenmesi ve standart birliğinin tam oturmaması kalibrasyon eğitimi konusunda sorunların başında gelmektedir. Bu problemlerden yola çıkarak uygulanan eğitim modelinin amacı, tıbbi cihazları çalışma parametrelerine göre sınıflandırmak ve kullanıldıkları klinik departmanların önceliklerine göre gruplayarak öğrencilere aktarmaktır. Bu çalışmalar için ilişkisel veri tabanı yönetim sistemleri kullanılmaktadır (SQL). Bu veri tabanında öncelikle tıbbi cihazların risk seviyeleri, kalibrasyona tabi tutulacağı parametreleri (akış, nem, basınç, sıcaklık, vakum, kaçak akım, elektrofizyolojik sinyaller, vb.) belirlenmektedir. Daha sonra ilişkisel

yöntemlerle cihazlar departmanlarına göre gruplandırılmaktadır. Böylelikle öğrencilere kalibrasyon iş akışı hakkında teorik ve veri tabanı yönetimi uygulamaları ile planlama öğretilmektedir (5 Hafta teorik). Daha sonra öğrenciler hastane ortamında izlenebilir kalibratörler yardımıyla tıbbi cihazlara kalibrasyon prosedürlerini uygulamaktadır (7 Hafta pratik).

Bu çalışma biyomedikal kalibrayon dersi için geliştirilen uygulama temelli eğitim modelini, kullanılan yazılımları ve kullanılan kalibratörlerin planlamasını içermektedir. Bu temele göre yeni gerçekleştirilen hastane içi pratik eğitimin planlaması anlatılmaktadır. Sonuç olarak yenilenen bu model öğrenciler tarafından anketler aracılığıyla değerlendirilmiş, istatistiksel olarak yorumlanmıştır. Bu pratik uygulama modeli hastane içerisinde olması ve öğrenciyi sektöre hazırlaması açısından başarılı bulunmuştur.

Anahtar sözcükler: aktif öğrenme, biyomedikal kalibrasyon, veri tabanı yönetimi, saha uygulamaları

GİRİŞ

Kalibrasyon, önceden belirlenmiş şartlar altında, bir ölçü aletinin veya ölçme donanımının gösterdiği değerler ya da bir ölçüm sonucu bulunan değerler ile ölçülerin bunlara karşı gelen ve bilinen değerleri arasındaki ilişkiyi belirleyen işlemlerdir (Megep,2012).

Kalibrasyon bir ayarlama işlemi, bakım veya tamir değildir. Özetle kalibrasyon bir ölçümler dizisidir (Howarth & Redgrave, 2008).Uzunluk, ağırlık, fiziksel parametre (sıcaklık, basınç, nem ve akış), elektrik direnç vb. gibi farklı büyüklüklerin ölçümlerini gerçekleştirerek referans ve izlenebilir bir ölçüte göre raporlanması, hata sınırlarının belirlenmesi biçiminde de ifade edilebilir (Karaböce, Gülmez, Akgöz, Kaykısızlı, Dorosinskiy ve Yalçınkaya, 2013). Gerçekleştirilen tüm ölçüm işlemleri bir üst basamak izlenebilirlik zincirine dahil olmalıdır ve periyodik olarak izlenebilirliği sağlanmalıdır (Megep,2007).

Günümüzde sağlık kurumlarında yoğun olarak tıbbi cihaz kaza ve aksaklıklarının başlıca nedenleri, cihazların bilinçsiz kullanımı, hatalı uygulamalar, kullanıcı eğitimlerinin yetersiz olması, tıbbi cihazların periyodik bakımlarının gerçekleştirilmemesi ve kalibrasyon sürecinin uygulanmaması olarak sayılabilir (Koçoğlu ve Koçak, 2009). Ayrıca yeni teknolojilerin verimli bir biçimde kullanımında tecrübe ve bilgi eksikliği de aksaklıklar arasında yer almaktadır. Bu nedenlerden bazılarının hastane veya personel tarafından ihmali birçok aksaklığa yol açmaktadır.

Tıbbi cihazlar sadece konumlandırıldıkları sağlık kuruluşlarının değil, bu cihazları kullananlarında sorumluluğu bulunmaktadır. Bir tıbbi cihaz, satın alınması ile birlikte şartnameye uygun olarak sağlık kurumuna konumlandırılır. Test, muayene ve kabul işlemlerinden sonra tıbbi cihaz artık hastane tarafından işletilmektedir. Bunun anlamı, cihazın işletilmesi ve uygun olarak kullanılması ile ilgili tüm sorumluluk hastanenin yani biyomedikal mühendislik merkezlerinindir. Bu merkezlerde çalışan biyomedikal mühendis ve biyomedikal teknikerleri tıbbi cihazlara uygulanacak koruyucu ve önleyici bakım faaliyetlerinden, onarım süreçlerinden ve de kalibrasyon prosedürlerinden sorumludur (Koçoğlu ve Koçak, 2009).

Tıbbi cihaz kalibrasyonu için kalibrasyon prosedürünün gerçekleştirilmesi ile sağlık kurumlarında verilen hizmetlerde; kullanılan tıbbi cihaz ve sistemlerin kalite zinciri içerisinde izlenebilir olması sağlanmaktadır. Böylelikle bu cihazlarla gerçekleştirilecek her türlü işlemin güvenilirliğinde, tıbbi cihazların teknolojik ömrü içerisinde sağlayacağı maliyet/etkililik analizlerinin yapılmasında hastanelere önemli yararlar sağlanacak ayrıca ihmallerden doğabilecek risklerin minimize edilmesi sağlanacaktır (Fank, 2013).

05.05.2005 tarihli ve 25806 sayılı Resmi Gazete'de yayınlanan Yataklı Tedavi Kurumları İşletme Yönetmeliği'ne göre, madde 106/A- Sağlık kurumları envanterinde görünen tüm tıbbi cihaz, araç-gereç ve ekipmanların periyodik bakımlarını, amaca uygun olarak kullanıp kullanılmadıklarını, garanti sürelerinin takibini, envanterin güncelleştirilmesini, tıbbi cihazların ulusal ve uluslararası düzeyde belirlenmiş referans değerlere uygun olarak çalışıp çalışmadığının takibini, gerekiyorsa kalibrasyonlarının yapılmasını ve sonucun takibi hizmetlerini yürütmek üzere, bünyesinde biyomedikal hizmetler ve kalibrasyon birimi kurar. Sağlık kurumları, bu hizmetleri kendi kurduğu birim aracılığıyla yürütebileceği gibi dışarıdan hizmet alımı yoluyla da gördürülebilir tavsiyeleri bulunmaktadır.

Tıbbi cihazların sağlık kurumlarında işletilmesinde hayati öneme sahip biyomedikal kalibrasyon prosedürlerinin verimli bir şekilde gerçekleştirilmesi oldukça kritiktir. Hastanelerin klinik mühendislik birimlerinde istihdam edilen mühendis ve teknikerlerin kalibrasyon prosedürleri konusunda eğitim ve tecrübeye sahip olmaları gerekmektedir. Bu ihtiyaçlara göre üniversitelerin biyomedikal mühendisliği ve biyomedikal cihaz teknoloji programlarında “Biyomedikal Kalibrasyon” dersleri açılmaktadır. Tıbbi cihazların oldukça fazla çeşit ve modelden oluşması, sürekli yenilenmesi ve standart birliğinin tam oturmaması ülkemizde biyomedikal kalibrasyon eğitiminin nitelikli bir biçimde gerçekleştirilmesi sorunlarının başında gelmektedir. Buna yönelik üniversitelerin farklı müfredat ve öğrenme modelleri kullandıkları görülmektedir.

Bu çalışmada Başkent Üniversitesi Teknik Bilimler Meslek Yüksek Okulu, Biyomedikal Cihaz Teknolojisi Programı öğretim programı içerisinde yer alan BMET 207 Kalibrasyon dersinde uygulanan aktif öğrenme yöntemi ve bu öğrenme yönteminden elde edilen bulgular yer almaktadır. Öncelikle öğrencilere temel kalibrasyon ve metroloji alanında teorik bilgiler aktarılmaktadır. Geliştirilen bu modelde öğrencilerin çalışacakları sağlık tesislerinin kapasitelerine göre tıbbi cihazları tespit etme yöntemleri ve envanter yönetimi hakkında yazılımsal bilgi verilmektedir. Ardından geliştirilen envanter takip sistemi ile tıbbi cihazlara uygulanacak kalibrasyon prosedürlerinin belirlenmesi ve takip edilmesi sağlanmaktadır. Bunun için Başkent Üniversitesi Hastanesi biyomedikal servisi ve kalibrasyon birimi ile eş güdümlü çalışılmaktadır. Böylelikle öğrencilere hem teorik hem de pratik uygulama becerisi kazandırılmış olmaktadır.

MATERYAL ve YÖNTEM

Bu bölümde aktif öğrenme modeli ile desteklenen Başkent Üniversitesi Teknik Bilimler Meslek Yüksek Okulu, Biyomedikal Cihaz Teknolojisi Programı öğretim programı BMET 207 Kalibrasyon dersinin içeriği hakkında bilgi verilmektedir. Ders başlangıcında kalibrasyon ve ilgili parametreleri hakkında teorik bilgi aktarımı gerçekleştirilmektedir. Daha sonra ders kapsamında öğrencilerin tıbbi cihazları çalışma parametrelerine göre sınıflandırmak ve kullanıldıkları klinik departmanların önceliklerine göre gruplamaları hakkında bilgi verilmektedir. Bu çalışmalar için ilişkisel veri tabanı yönetim sistemleri (SQL –MS Access) kullanmaları teşvik edilmektedir. Öğrenciler tarafından oluşturulan basit veri tabanı modellerinde tıbbi cihazların risk seviyeleri, kalibrasyona tabi tutulacağı parametreleri (akış, nem, basınç, sıcaklık, vakum, kaçak akım, elektrofizyolojik sinyaller, vb.) belirlenmektedir. Daha sonra ilişkisel yöntemlerle cihazlar departmanlarına göre gruplandırılmaktadır. Böylelikle öğrencilere kalibrasyon iş akışı hakkında teorik ve veri tabanı yönetimi uygulamaları ile planlama öğretilmektedir. Daha sonra öğrenciler hastane ortamında izlenebilir kalibratörler yardımıyla tıbbi cihazlara tasarladıkları kalibrasyon prosedürlerini uygulamaktadır.

Biyomedikal Kalibrasyon Süreci

Öğrencilere teorik olarak aktarılan Biyomedikal kalibrasyon kavramından sonra kalibrasyon sürecinin kurgulanması hakkında bilgi aktarımı sağlanmaktadır. Mutlaka bulunacağınız sağlık kurumunda mevcut aletler tanımlanmalı ve bir envanteri yapılmalıdır. Bu envanter belirleme sürecinde ilişkisel veri tabanı yapısı oluşturma işlemleri gerçekleştirilmelidir. Kalibrasyonda kullanılacak kalite yönetim sistemi çevriminde olan ve izlenebilir kalibratörler tercih edilmelidir. Temin edilen kalibratörlerin saklama koşulları ilgili standartlara göre sağlanmalıdır. Kalibrasyonu gerçekleştirilecek olan kapalı alanda çevre koşullarının uygunluğu sağlanmalıdır. Kalibrasyon işlemini gerçekleştirecek teknikerin gerekli ve güncel eğitimleri almış olmaları ve bunları belgelendirmeleri beklenmektedir. Tıbbi cihazın kullanım sıklığına göre kalibrasyon periyodu belirlenmelidir. Kalibrasyon süreci sonucunda hesaplanan ölçüm belirsizliği değerlerine göre tıbbi cihazın tolerans değerleri dışında kalması durumunda, cihaz mutlaka hizmete alınmadan bakım onarıma tabi tutulmalıdır. Sağlık kurumuna yeni satın alınan tıbbi cihaz veya sistemlerin mutlaka üretici onaylı ilk kalibrasyon sertifikalarına sahip olması gerekmektedir. Eğer bu belge edinilemediyse cihaz hizmete alınmadan önce kalibrasyona tabi tutulmalıdır. Biyomedikal kalibrasyon faaliyetleri ile ilgili tüm belgeler, eğer elektronik kayıt alınmışsa bu belgelerde dahil, dokümante edilerek arşivlenmelidir (Karagöz, 2013).

Biyomedikal kalibrasyon sürecinin izlenebilir şekilde gerçekleştirilebilmesi için gerekli asgari şartların yerine getirilmesi gerekmektedir. Öncelikle kalibrasyon laboratuarı iklimlendirme şartları istenilen sıcaklık ve nem değerlerini sağlamalıdır. Kullanılacak kalibratörlerin ulusal ve uluslararası primer seviye etalonlara izlenebilirliği sağlanmalıdır. Kalibrasyon cihazı kalibre edilen cihaza göre daha yüksek ölçüm doğruluğuna sahip olmalıdır. Kalibrasyon sürecinde tüm tıbbi cihazlara ait teknik özellikler belirlenmiş olmalıdır.

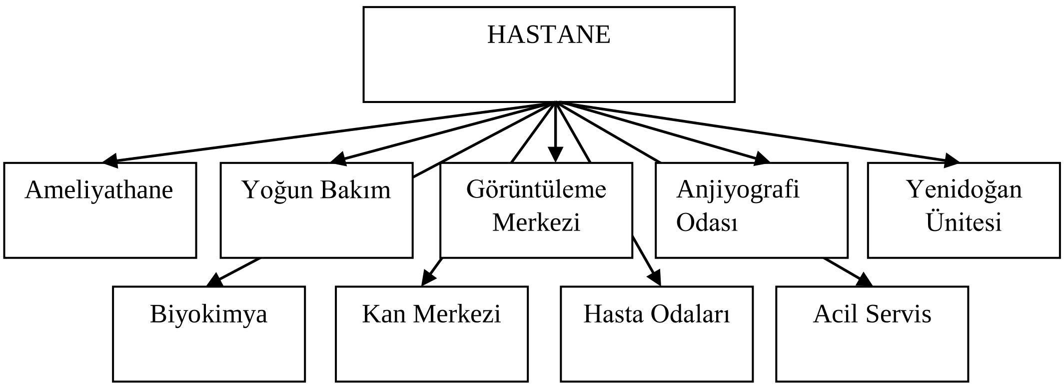
Biyomedikal Kalibrasyon Prosedürü Hazırlanması

Biyomedikal Cihaz Teknolojisi programı öğrencilerine tıbbi cihazlara uygulayacakları kalibrasyon prosedürü hakkında bilgi aktarımı yapılmaktadır. Prosedür hazırlama sürecine rehberlik edecek teorik bilgiler öğrencilere aktarılmaktadır. Böylece daha sonra ilişkisel veri yönetimi konusunda öğrencilerin kalibrasyon prosedürü oluşmuş olacaktır. Belirlenen şartlara uygunluğun gösterilmesi amacıyla kullanılan tüm kalibratörler Kalibrasyon Teçhizat Listesi' ne kaydedilerek listelenmelidir. Kalibrasyon Teçhizat Listesi'nde belirlenen cihazların kalibrasyonu, amaç ve kullanıma bağlı olarak yıllık kalibrasyon planı hazırlanmalıdır. Plan dahilinde gerekli çalışma standartlarının sağlanması veya sağlanmadığı taktirde geçici ölçüm standartlarının geliştirilmesi, dış kalibrasyon merkezlerinin seçiminden ve bunlara yaptırılan işlemler için, kalibrasyon belgelerinin tedarik edilmesi süreçleri tamamlanmalıdır (Eroğul, 2010). Sağlık kurumu bünyesinde gerçekleştirilen tüm kalibrasyon işlemleri için kalite çemberi içerisinde referans gösterilecek bir kalibrasyon sertifikası düzenlenmelidir ve cihaz kalibrasyon etiketi ile etiketlendirilmelidir. Gerek dahili gerekse harici yapılan kalibrasyonlara ilişkin kayıtlar mutlaka tutulmalı, güncel ve ulaşılabilir olmalıdır.

Bu çalışmalar ile birlikte teorik kalibrasyon eğitiminin yanında pratiğe yönelik bilgiler de aktarılmaktadır. Böylelikle öğrenci pratik uygulama sürecinde kendi hazırladığı süreç ve prosedürlere göre kalibrasyon işlemlerini gerçekleştirebilmektedir.

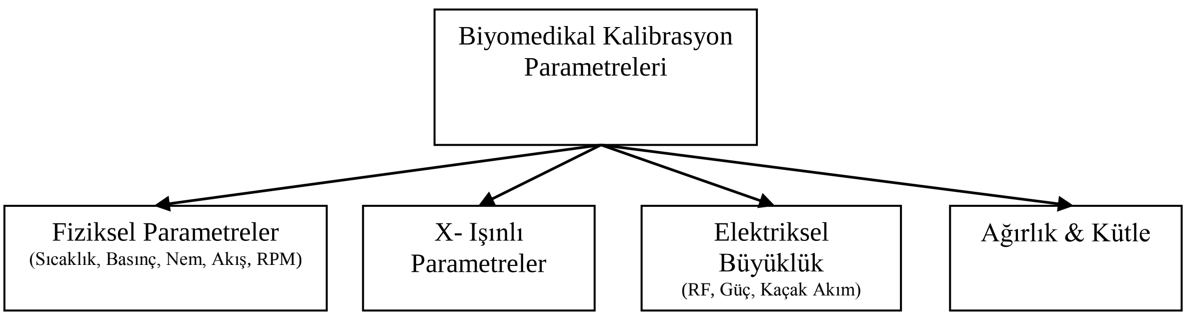
İlişkisel Envanter Belirleme Süreci

Bu aşamada öğrencilere çalışacakları hastanelerde mevcut envanterin belirlenmesi ve kalibrasyona tabi tutulması gereken cihazların listelenmesi çalışmaları aktarılmaktadır. Özellikle evanter yönetiminin hastanede tıbbi cihazların yoğun olarak kullanıldığı birimlere göre gerçekleştirmesi istenir. Şekil 1'de standart bir hastanenin tıbbi cihaz yoğunluğu fazla olan birimleri verilmiştir. Birimlere göre tıbbi cihazlar mutlaka kalibrasyona tabi tutulacakları fiziksel veya elektriksel büyüklüklere göre gruplandırılmalıdır. Her birimdeki biyomedikal kalibrasyona tabi tutulacak tıbbi cihazların sayısı mutlaka belirlenmeli ve cihazlar künyeleri ile birlikte veri tabanına kaydedilmelidir. Bir tıbbi cihazın, adı, markası, modeli, ne amaçla kullanıldığı, birim içerisindeki konumu, üretim yılı, garanti süresi, cihazdan sorumlu teknik personelin bilgileri, kalibrasyon periyot süresi, cihazın bakım onarım künyesi tespit edilerek her cihaz için bir bilgilendirme formu açılmalıdır. Bu prosedür kalibrasyon dersinin envanter belirleme sürecinde Başkent Üniversitesi Hastanelerinde kullanılan cihazlar üzerinden gerçekleştirilmektedir.



Şekil 1. Standart Donanımlı Bir Hastanede Birimleri

Şekil 2'de hastane birimlerinde kullanılan tıbbi cihazların kalibrasyona tabi tutulacağı parametrelerine göre gruplandırılması görülmektedir.



Şekil 2. Biyomedikal Kalibrasyon Parametreleri

Bu parametreler öğrenciler tarafından belirlenerek ilişkisel veri tabanına kaydedilir. Böylelikle tıbbi cihaz künyeleri ve biyomedikal kalibrasyon prosedürleri ile ilgili oluşturulan çeşitli tablolar arasında organize edilmiş verilerden oluşan bir veri tabanı elde edilmiş olur. İlişkisel veri tabanlarında bilgi bağımsız dosyalar şeklinde depolanmaktadır. Bilgi öğeleri satırlar ve sütunlar şeklinde depo edilmektedir. Her bir satır tek bir bilgi kaydı içerirken her sütun ise bir bilgi parçası içermektedir (Demirgüneş, Ertaş ve Eroğul, 2011). Böylelikle öğrenciler pratik uygulamalarda ve sektörde görecekleri veri tabanı yönetimi temelli yazılımlar hakkında da bilgi sahibi olmakta ve pratik edinmektedir.

BULGULAR

Başkent Üniversitesi Teknik Bilimler Meslek Yüksek Okulu, Biyomedikal Cihaz Teknolojisi Programı öğretim programı BMET 207 Kalibrasyon dersi her güz döneminde açılmaktadır. Bu çalışmada son 4 yılda bu dersi alan öğrenciler üzerinde ders değerlendirme anketi ile ders verimi ve memnuniyeti ölçülmektedir. Tablo 1'de anket uygulanan öğrencilere ait demografik veriler görülmektedir. Ankete katılan 87 öğrencinin 29'u bayan, 58'i baydır.

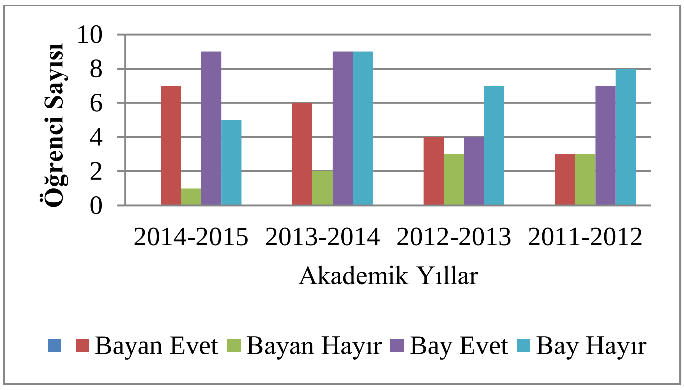
Tablo 1. BMET 207 Kalibrasyon Dersini Alan Öğrencilerin Demografik Özellikleri

Der Dönemi	Yarıyıl	Mevcut	Bayan	Bay	Yaş
2014-2015	Güz	22	8	14	18-22
2013-2014	Güz	26	8	18	18-22
2012-2013	Güz	18	7	11	18-22
2011-2012	Güz	21	6	15	18-22
TOPLAM		***87***	***29***	***58***	

İlişkisel veri tabanı kullanarak kalibrasyon süreci ve prosedürlerini belirleme ile öğrenciler tarafından belirlenen bu sistemin pratik uygulamalarının hastane içerisinde gerçekleştirilmesi 2013-2014 yılı itibariyle uygulanmaya başlanmıştır. Bundan önceki dönemlerde sadece teorik uygulama ile ders yürütülmüştür. Aktif öğrenme modeli ve pratik uygulama ise son 2 dönemdir gerçekleştirilmiştir.

Öğrencilere uygulanan anketlerde *"Biyomedikal Test ve Kalibrasyon Hizmetlerinde Çalışmak İster misiniz?"* başlıklı soruya dönemlere bağlı olarak elde edilen bulgular tablo 2'de görülmektedir. Buna göre aktif öğrenme modeli ve pratik uygulamaların gerçekleştirilmediği yıllarda bayan öğrencilerin kalibrasyon hizmetlerinde çalışma sorusuna verdikleri cevap 2011-2012 yılında 3 evet ve 3 hayır, 2012-2013 yılında 4 evet ve 3 hayır, 2013-2014 yılında 6 evet ve 2 hayır, 2014-2015 yılında 7 evet ve 1 hayır şeklindedir. Bay öğrencilerin bu soruya yanıtları 2011-2012 yılında 7 evet ve 8 hayır, 2012-2013 yılında 4 evet ve 7 hayır, 2013-2014 yılında 9 evet ve 9 hayır, 2014-2015 yılında ise 9 evet ve 5 hayır şeklinde olmuştur.

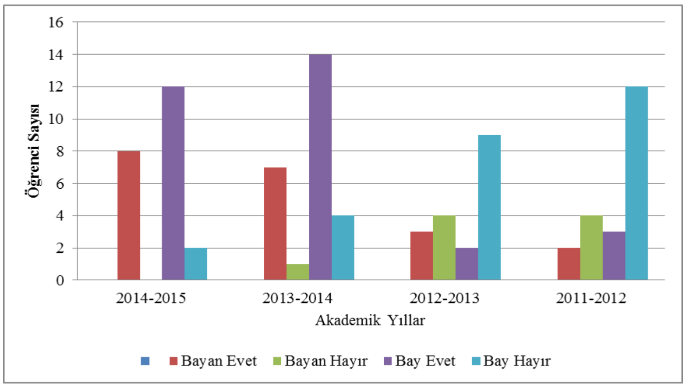
Tablo 2. Kalibrasyon Dersini Alan Bay ve Bayan Öğrencilerin Kalibrasyon Alanında Çalıma İstekleri



Ders değerlendirmesi anketinde öğrencilere sorulan bir diğer kritik soruda *"Bu Derste Öğrendiğiniz Teorik ve/veya Pratik Bilgileri Mesleki Hayatınızda Kullanabileceğinizi & Uygulayabileceğinizi Düşünüyor musunuz?"* şeklindedir. Tablo 3'de anketteki bu sorudan elde edilen bulgular görülmektedir. Bayanlardan elde edilen buluglar incelendiğinde 2011-2012 yılında 2 evet ve 4 hayır, 2012-2013 yılında 3 evet ve 4 hayır cevabı verilmiştir. Aktif öğrenme ve pratik uygulamanın başladığı 2013-2014 yılında bayanlar 7 evet ve 1 hayır, 2014-2015 yılında ise 8 evet cevabı verilirken hayır cevabı verilmemiştir. Bay öğrencilerden elde edilen bulgularda aktif öğrenme ve pratik uygulamadan yana memnuiyeti göstermektedir.

Buna göre 2011-2012 yılında 3 evet ve 12 hayır, 2012-2013 yılında 2 evet ve 9 hayır, 2013-2014 yılında 14 evet ve 4 hayır, 2014 – 2015 yılında ise 12 evet ve 2 hayır elde edilmiştir.

Tablo 3. Kalibrasyon Dersini Alan Bay ve Bayan Öğrencilerin Bu Dersten Elde Ettikleri Bilgileri Mesleki Hayatta Kullanıma Geçirme Beklentileri



SONUÇ

Biyomedikal kalibrasyon tıbbi cihazların verimli kullanılması için oldukça önemli bir prosedür ve süreçler dizisidir. İzlenebilirlik zinciri ve kalite çemberleri içerisinde gerçekleştirilmesi gereklidir ve süreklilik arz eder. Bundan dolayı her zaman dinamik ve güncel yetişmiş insan gücüne ihtiyaç duymaktadır. Hastanelerde kullanılan tıbbi cihazların neredeyse %75'i periyodik kalibrasyon ve önleyici bakıma tabi tutulmak zorundadır. Birçok farklı amaca hizmet eden oldukça fazla çeşide sahip tıbbi cihazlarda biyomedikal kalibrasyon konusunda yetişmiş insan kaynağına ihtiyaç her geçen gün artmaktadır. Bu farkındalık ile Başkent Üniversitesi Teknik Bilimler Meslek Yüksek Okulu, Biyomedikal Cihaz Teknolojisi Programı, BMET 207 Kalibrasyon dersinin içeriğini aktif öğrenme modeli ve pratik uygulamaları ile zenginleştirmiştir. Pratik uygulama ders ağırlığının yaklaşık %60'ını oluşturmaktadır. Ayrıca teorik öğretiler ile öğrencilerin tarafından kurgulanacak süreç ve prosedürler her öğrencinin pratik uygulamalarında kullanılmaktadır. Bu sayede öğrencilerin teorik derslerde daha ilgili olmaları sağlanmıştır. Öğrencilerin süreç ve prosedürleri basit ilişkisel veri tabalarına kaydetmeleri ve pratik uygulamada kullanmaları istenmektedir. Böylelikle öğrencilerin tüm bilgi ve uygulamaları kurgulaması sağlanmaktadır. Pratik uygulama sürecinde öğrenci teorik olarak kurguladığı süreçlerde hata tespit ettiğinde bunu canlı olarak düzeltme imkanı bulmaktadır.

Bu çalışmada aktif öğrenme ve pratik uygulamalar ile bay ve bayan öğrencilerin biyomedikal kalibrasyon konusuna yaklaşımlarında önemli değişiklikler tespit edilmiştir. Bay öğrenciler tarafından mesleklerinin bir parçası görülmekten uzak olan biyomedikal kalibrasyon, yeni uygulama ve öğrenme yöntemleriyle bay öğrenciler arasında da tercih edilebilir duruma gelmiştir. Bayan öğrencilerin kariyer hedeflerinde daha yüksek oranda tercih ettikleri biyomedikal kalibrasyon aktif öğrenme ile daha da tercih edilebilir konuma gelmiştir. Dersten alınan verim bay ve bayan öğrenciler tarafından uygulanabilir düzeyde tespit edilmiştir.

Biyomedikal teknikeri yetiştirme sürecinde biyomedikal kalibrasyon dersinin mutlaka uygulamalı ve öğrenciler tarafından kurgu yapılabilir gerçeğe en yakın pratik uygulamaları içeren bir biçime dönüştürülmesi ile kalibrasyon konusuna verimlilik kazandırılmıştır.

ÖNERİLER

Bu çalışmanın gelecek yıllarda da öğrencilere uygulanacak anketlerle geliştirilmesi ve desteklenmesi düşünülmektedir.

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A STUDY TO IMPROVE EFFICIENCY IN THE PROCESS OF INTERDISCIPLINARY UNDERGRADUATE EDUCATION: NEW APPROACHES IN INTRODUCTION TO BIOMEDICAL ENGINEERING COURSE

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ABSTRACT: Biomedical engineering is an engineering discipline that is responsible for effectually designing, producing, and operating diagnostic, treatment, medical research, and laboratory instruments and devices. Undergraduate education in this field, which is a mix of many disciplines, involves many difficulties for students and academics. In the first grade, Basic Physics, Mathematics, Chemistry, and Computer Software courses are intensely provided at Başkent University Department of Biochemical Engineering, as at many universities. In this process, students have to take interdisciplinary courses whose acquisitions are a must for them, and they have to be provided with capabilities such as learning effectively, study techniques, and having a technical perspective on the profession.

Within the scope of the course , the history of science and the history of engineering are taught visually. In this way, an attempt is made to increase students' motivation in engineering. In addition, main disciplines, study areas, and scientific research topics of biomedical engineering are presented with up-to-date examples. In this sense, sector representatives and engineers having a successful career in biomedical calibration, R&D and production of medical devices, clinical engineering, technical service, and sales & marketing of medical devices are invited to ensure information exchange with students for 5 weeks. Moreover, students are divided into working groups to prepare interactive projects about current biomedical engineering practices. These projects are supported with actual data obtained from hospitals. By this means, it is made sure that even the first grade biomedical engineering students take a step in hospitals – the places they are going to perform their profession.

This study deals with the planning of biomedical engineering educational process which students are to go through within the scope of the Introduction to Biomedical Engineering course as well as the new approaches followed in the interaction of students, academics, and the sector. This course is taught in the 1st semester. It is taught 2 hours a week for 14 weeks. Improvements made in the course were evaluated by students via questionnaires administered at the beginning and at the end of the semester. Innovations such as interactive project, field applications, and mutual information exchange with graduates and sector representatives were found to be effective. It was determined that this course, which was developed based on active learning method, makes positive contributions to students in the biomedical interdisciplinary educational process.

Key words: interdisciplinary education, business-student interaction, clinical engineering

DİSİPLİNLERARASI LİSANS EĞİTİMİ SÜRECİNDE VERİMLİLİĞİ ARTTIMA ÇALIŞMALARI: BİYOMEDİKAL MÜHENDİSLİĞİNE GİRİŞ DERSİNDE YENİ YAKLAŞIMLAR

ÖZET: Biyomedikal Mühendisliği; teşhis, tedavi, tıbbi araştırma ve laboratuvar cihazlarının istenilene uygun bir şekilde tasarlanması, üretimi ve işletilmesinden sorumlu bir mühendislik dalıdır. Birçok disiplinin bir araya gelmesi ile oluşan bu bilim dalında lisans eğitimi süreci öğrenciler ve akademisyenler için oldukça güçlükler içermektedir. Birinci sınıf eğitimi ile birlikte, birçok üniversitede olduğu gibi Başkent Üniversitesi Biyomedikal Mühendisliği Bölümünde de, temel fizik, matematik, kimya ve bilgisayar yazılım dersleri yoğun olarak verilmektedir. Bu süreçte öğrencilere disiplinlerarası dersler verilmesi ve öğrenme süreci, çalışma tekniği, mesleğe teknik olarak bir bakış açısı katabilme gibi kabiliyetlerin öğrencilere kazandırılması gerekmektedir.

Ders kapsamında görsel olarak bilim tarihi ve mühendislik tarihi anlatılarak öğrencilerin mühendisliğe olan motivasyonlarının arttırılması hedeflenmektedir. Ayrıca Biyomedikal Mühendisliği, ana disiplinleri, çalışma alanları, bilimsel çalışma konuları güncel örnekler ile anlatılmaktadır. Bu kapsamda 5 haftalık bir sürece yayılan mesleğin farklı disiplinlerinden olan biyomedikal kalibrasyon, tıbbi cihaz ar&ge ve üretim, klinik mühendislik, teknik servis hizmetleri, tıbbi cihaz satış pazarlama konularında kariyer başarısı elde etmiş mühendisler ve sektör temsilcileri davet edilerek öğrenciler ile etkileşimli bilgi alışverişi gerçekleştirilmektedir. Ayrıca öğrencilerin, çalışma gruplarına ayrılarak güncel biyomedikal mühendislik uygulamaları hakkında etkileşimli

projeler hazırlamaları sağlanmaktadır. Gerçekleştirilen projeler hastanelerden alınan gerçek veriler ile desteklenmektedir. Böylelikle henüz birinci sınıf biyomedikal mühendisliği öğrencilerinin çalışma sahası olan hastanelere adım atması sağlanmaktadır.

Bu çalışma; Biyomedikal Mühendisliğine Giriş dersi kapsamında öğrencilere kazandırılacak biyomedikal mühendisliği eğitim sürecinin planlamasını, öğrenci, akademisyen, sektör etkileşiminde izlenen yeni yaklaşımları içermektedir. Ders, 1. Sömestr dersi olup 2 saat / hafta süresinde 14 haftadır. Ders kapsamında gerçekleştirilen iyileştirmelerin, dönem başında ve sonunda gerçekleştirilen anketler ile öğrenciler tarafından değerlendirilmesi sağlanmıştır. Etkileşimli proje, saha uygulama örnekleri, mezun ve sektör temsilcileri ile karşılıklı bilgi paylaşımı gibi yenilikler başarılı bulunmuştur. Aktif öğrenme yöntemi ile geliştirilen bu dersin biyomedikal disiplinlerarası eğitim sürecinde öğrencilere olumlu katkılar yaptığı tespit edilmiştir.

Anahtar sözcükler: disiplinlerarası eğitim, sektör-öğrenci etkileşimi, klinik mühendisliği

GİRİŞ

Disiplinlerarası mühendislik lisans eğitimlerinde kritik süreçlerin başında öğrencileri, 1. Sınıftan itibaren mesleğe ve meslek alanlarına yönlendirmek ve bu alanlardan biri veya birkaçında uzmanlaşmalarını sağlamak gelmektedir. Temel bilimler ve temel mühendislik eğitiminde (elektrik, elektrik – elektronik, makine, inşaat, kimya, fizik mühendislikleri, vb.) mesleğe giriş dersleri öğrenciler için daha anlaşılır ve açıklayıcı olabilmektedir (Rugarcia, Felder, Woods, & Stice, J.E. (2000). Fakat biyomedikal mühendisliği eğitiminde bu ders takip edilmesi ve her yıl revize edilmesi gereken bir süreçtir. Başkent Üniversitesi Mühendislik Fakültesi Biyomedikal Mühendisliği Bölümünde 1. Sınıf öğrencilerine ilk dönem verilen dersler Tablo 1'de görülmektedir (Başkent Üniversitesi Mühendislik Fakültesi Biyomedikal Mühendisliği Bölümü Ders Kataloğu, Erişim tarihi Mart 2015).

Tablo 1. Başkent Üniversitesi Mühendislik Fakültesi Biyomedikal Mühendisliği Bölümü Birinci Dönem Dersleri Kataloğu

Ders Kodu	Ders Adı	Teorik Ders Saati	Uygulama Saati	Kredi	AKTS
BİL 101	Bilgisayar Yazılımı I	3	1	3	5
BİL 105	Programlama Laboratuarı I	-	2	1	2
BME 110	Biyomedikal Mühendisliğine Giriş	2	-	2	3
FİZ 103	Mekanik Laboratuarı	-	2	1	2
FİZ 105	Genel Fizik I	3	1	3	5
KİM 113	Kimya I	3	-	3	3
KİM 115	Kimya Laboratuarı	-	2	1	2
MAT 151	Matematiksel Analiz I	4	1	4	6
TÜRK 101	Türk Dili I	2	-	2	2
	TOPLAM	***17***	***9***	***20***	***30***

1.Dönemlerine (Güz Dönemi) oldukça yoğun bir kredi ve AKTS (Avrupa Kredi Transfer Sistemi) yükü ile eğitime başlayan Başkent Üniversitesi Biyomedikal Mühendisliği Bölümü adaylarının mesleki eğitimleri ile ilgili tek ders Biyomedikal Mühendisliğine Giriş Dersidir. Diğer üniversitelerde bulunan 19 biyomedikal mühendisliği lisans programlarında ise benzer içerik görülmektedir. Bunun yanında ulusal ve uluslararası mühendislik eğitiminin ilk yıl en önemli parçası temel mühendislik eğitimidir. İlerleyen yıllarda adaylar meslekleri ile ilgili teknik derslerden daha ağırlıklı olarak sorumlu olmaktadır (Koçak, Koçoğlu, Telatar ve Eroğul (2009).

Biyomedikal mühendisliği gibi disiplinlerarası eğitimlerde adayların meslek ile tanışıklığını sağlayabilmek temel mühendislik bölümlerine göre daha zordur. Adaylar yaklaşık 40000 çeşit olan ve tıbbın her alanında yaygın olarak kullanılan tıbbi cihaz ve sistemlerin herhangi bir bölümüne ilgili olabilirler (Koçak ve Koçoğlu, (2009). Ayrıca elektrik, elektronik, mekanik, mekatronik, yazılım, gömülü yazılım, medikal enformatik, biyomalzeme, biyomekanik, nanoteknoloji, biyokimya ve biyoteknoloji gibi alanların sadece biri veya birkaçı hakkında bilgi sahibidirler. Bu bakımdan biyomedikal mühendislik öğrencilerinin henüz eğitimlerinin başlangıcında biyomedikal mühendisliğinin kapsadığı tüm disiplinler hakkında bilgi sahibi olmaları istenmektedir.

Sonuç olarak mesleki teknik eğitim sürecini başlatan ders "Biyomedikal Mühendisliğine Giriş" dersi olduğundan bu dersin çok iyi kurgulanarak verimli bir şekilde öğrencilere aktarılması gerekmektedir.

Bu çalışmada Başkent Üniversitesi Biyomedikal Mühendisliği Bölümü 1. Dönem (güz dönemi) dersi olan Biyomedikal Mühendisliğine Giriş kapsamında uygulanan verimliliği arttırma çalışmaları ve bunlar için gerçekleştirilen yeni yaklaşımlar hakkında bilgi verilmektedir. Ayrıca uygulanan yeni yöntemler sonucunda öğrencilere uygulanan anket yöntemi ile ders verimliliği hakkında geribildirimlerin alınması sağlanmıştır. Sonuçta; ders kapsamında uygulanan teorik ders anlatımı ve süresi öğrenciler tarafından olumlu değerlendirilmiştir. Bölüm mezunlarından sektörde önemli konumlara ulaşmış biyomedikal mühendislerinin, uygulamalar üzerine verdikleri seminerler ve içerikleri öğrencilerin sektör hakkında ilk elden bilgi edinmelerini sağlamıştır. Bunun yanında öğrencilere ders kapsamında verilen araştırma projeleri ve bu projelerin topluluk önünde mühendislik kurallarına göre sunulması çalışmaları, disiplinlerarası eğitimin önemli örneklerinden olan biyomedikal mühendisliği ve kapsadığı disiplinler hakkında detaylı bilgi sunmaktadır.

MATERYAL ve YÖNTEM

BME 110 – Biyomedikal Mühendisliğine Giriş dersi öğrencilere kazandırılacak biyomedikal mühendisliği eğitim sürecinin planlamasını, öğrenci, akademisyen, sektör etkileşiminde izlenen yeni yaklaşımları içermektedir. Bu Ders, 1. Sömestr dersi olup 2 saat / hafta süresinde 14 haftadır. Bu bölümde ders müfredatı kurgulanması ve verimliliği arttırma çalışmalarındaki yeni yaklaşımlar anlatılmaktadır.

Dersin Teorik Bilgi İçeriği

Bu ders kapsamında uygulanan öğrenim içeriği ile öğrenciler ilk 2 hafta sonunda Başkent Üniversitesi, Mühendislik Fakültesi ve Biyomedikal Mühendisliği Bölümü, kampüs olanakları, web sayfası kullanımı ve duyuru takibinin izlenmesinin öğrenilmesi, kütüphane ve sosyal tesislerin kullanımı gibi bilgilere sahip olurlar. 3 ila 6. hafta arasındaki dersler ile birlikte bilim ve mühendislik tanımları ile gelişim süreçleri, bu süreçlerle etkileşimle biyomedikal mühendisliğinin doğuşu; tıp, mühendislik ve temel bilimlerle ilişkileri, biyomedikal mühendisliğini oluşturan disiplinler ve çalışma alanları ile ülkemizdeki durumu hakkında bilgi sahibi olurlar. 7. Hafta teorik bilgi aktarımının en son olduğu haftadır. Bu süreçte öğrencilere tıbbi bakım onarım ve biyomedikal kalibrasyon hakkında temel bilgiler aktarılmaktadır (Koçoğlu, Koçak ve Eroğul, (2009). Ayrıca kalibrasyonun nasıl gerçekleştirildiğine dair bir uygulama örneği Başkent Üniversitesi Ankara Hastanesi Biyomedikal Kalibrasyon Biriminden temin edilen kalibratör ile öğrencilere aktarılmaktadır. Ders içeriği Tablo 2' de görülmektedir.

Tablo 2. Biyomedikal Mühendisliğine Giriş Dersi İçeriği

Hafta	Konu Başlıkları
1	Tanışma ve Bölüm Oryantasyonu
2	Fakülte ve Üniversite Tanıtımı
3	Bilim ve Mühendislik Tarihi
4	Biyomedikal Mühendisliği Tarihi
5	Biyomedikal Mühendisliği Çalışma Alanları
6	Biyomedikal Mühendisliğinin Ülkemiz Koşullarında Durumu
7	Biyomedikal Kalibrasyon
8	Ara Sınav Haftası
9	Biyomedikal Mühendislik, Ar&Ge ve Üretim (Çağrılı Konuşmacı)
10	Biyomedikal Mühendislikte Teknik Servis (Çağrılı Konuşmacı)
11	Biyomedikal Mühendislikte Satış – Pazarlama (Çağrılı Konuşmacı)
12	Klinik Mühendisliği (Çağrılı Konuşmacı)
13	Öğrenci Sunumlar
14	Öğrenci Sunumları

Ders Kapsamında Verilen Seminerler

Ara sınav haftasından sonra biyomedikal mühendisliğinin ana çalışma konuları arasında yer alan biyomedikal kalibrasyon, tıbbi cihaz ar&ge ve üretim süreci, biyomedikal mühendislikte teknik servis ve tıbbi cihaz satış pazarlama ve aplikasyon alanlarında uzmanlığını kazanmış biyomedikal mühendisleri veya sektör temsilcileri ile biraraya gelerek etkileşimli bilgi aktarımı ile güncel teknik ve gelişmelerden bilgi sahibi olurlar. Klinik Mühendisliği tanım ve çalışma disiplinini öğrenirler. Böylelikle biyomedikal mühendisliğine yeni başlayan öğrencilerin ileride meslektaşları olacak kişilerle şimdiden etkileşime girmeleri ve bilgi alışverişinde bulunmaları sağlanmış olur.

Proje Gerçekleştirme Süreci

Son haftalarda Ülkemizde ve Dünya'da kullanılan modern tıbbi cihaz ve sistemleri grup projesi ile araştırarak bulgularını sunum biçiminde diğer öğrenciler ile paylaşarak sunum ve araştırma becerilerini geliştirirler. Kaynaklara erişmede kütüphane ve akademik bilgi veri tabanlarını kullanmayı öğrenir. Akademik sunum tekniklerini öğrenir ve becerilerini geliştirir.

Öğrenme Çıktıları

Ders kapsamında tanımlanan toplam 8 öğrenim çıktısı (Ö.Ç.) bulunmaktadır. Öğrencilerin ders sonunda bu öğrenim çıktılarına ulaşma dereceleri ölçülmektedir. Bu öğrenim çıktıları,

ÖÇ.1: Bilim ve Mühendislik kavramlarını, Biyomedikal mühendisliği, çalışma ve meslek alanları ile ilgili tanımları yapabilir.

ÖÇ.2: Biyomedikal mühendisinin görev alacağı süreçleri şematik olarak tasarlayarak gösterebilir.

ÖÇ.3: Akademik araştırma yapma, rapor hazırlama, raporunu sunma kurallarını tanımlayabilir. Bilimsel makale içeriği hakkında bilgi sahibi olur.

ÖÇ.4: Biyomedikal Kalibrasyon (Tıbbi Metroloji) kavramlarını tanımlayabilir. Biyomedikal kalibrasyona tabi tutulması zorunlu olan tıbbi cihazları bilir.

ÖÇ.5: Klinik Mühendisliği hakkında bilgi sahibi olur.

ÖÇ.6: Biyomedikal Mühendisliğinin ar&ge, üretim, satış&pazarlama ve klinik aplikasyon alanları ile tıbbi projelendirme hakkında bilgi sahibi olur.

ÖÇ.7: Tıbbi cihaz türleri, mühendislik gelişimleri ve çalışma prensipleri hakkında temel bilgi sahibi olur.

ÖÇ.8: Araştırdığı ve öğrendiği konular ile ilgili yorum yapabilir.

Öğrenme ve Öğrenme Yöntemleri

Tamamen Powerpoint uzantılı slaytlarla ve diğer görseller ile anlatım sağlanmaktadır. Konularda yer alan hesaplama ve adım adım anlatımlarda ise akıllı tahta kullanılmaktadır (Foulds, Bergen, & Mantilla (2003). Ayrıca bölüm mezunlarından veya sektörde uzman kişilerden sunumlar talep edilmektedir. Böylelikle 9 ila 12. Haftalar arası, üretim, teknik servis yönetimi, satış – pazarlama ve aplikasyon ile klinik mühendisliği alanlarında sektör bilgi ve deneyimi öğrencilere aktarılmaktadır. Bunun yanında öğrencilerin hazırlamış oldukları projeleri grup olarak 13. ve 14. haftalarda multimedya öğeleri destekli sunmaları istenmektedir.

Değerlendirme

Ders değerlendirmesi katılım ve devam, arasınav, proje, final sınavı olarak değerlendirilmiştir. Tüm derslerde görülen teorik bilgiler, seminerler ve proje ödevleri kapsamında final sınavı olmaktadır. Final sınavının ağırlığı % 45'dir. İlk 7 haftanın olduğu tamamen teorik ve kalibrasyon uygulamasını içeren arasınavın ağırlığı %30'dur. Proje ödevi, grup çalışması, sunumu ve mühendislik raporlama kurallarına göre raporlanması ise değerlendirmenin %20'sini oluşturmaktadır. Katılım ve devam ise %5'dir. Buna göre dönem değerlendirme ve ağırlıklandırma tablosu Tablo 3'de yer almaktadır.

Tablo 3. Biyomedikal Mühendisliğine Giriş Dersi Değerlendirmesi

Katılık ve Devam	Arasınav	Proje	Final Sınavı	Toplam
%5	%30	%20	%45	%100

BULGULAR

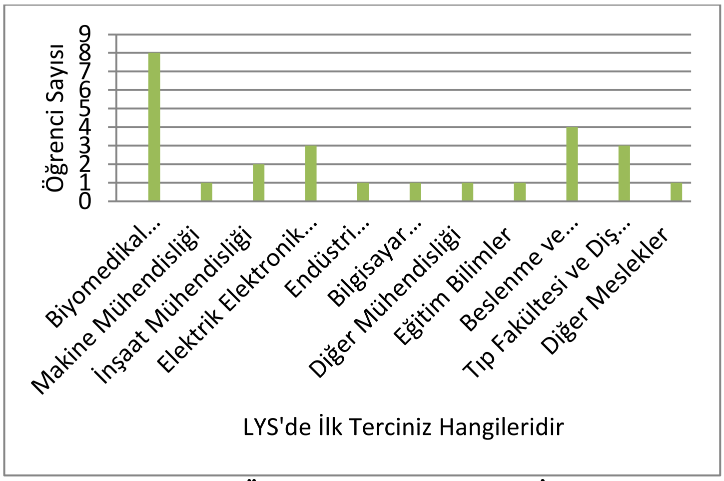
Anket Bulguları

Başkent Üniversitesi, Mühendislik Fakültesi ve Biyomedikal Mühendisliği Bölümünde güz dönemi derslerinden BME 110 Biyomedikal Mühendisliğine Giriş dersi ile adaylara meslek hakkında bilgiler aktarılmıştır.

Ders kapsamında öncelikle öğrencilerin bölüme gelmeden önceki beklentileri, mezuniyet durumları araştırılmıştır. Şekil 1'de BME 110 dersini alan birinci sınıf öğrencilerine uygulanan anketin ilk bulguları görülmektedir. Burada öğrencilerin biyomedikal mühendislik ile ilgili yatkınlıklarını ve mühendislik altyapılarını tespit edebilmek için "Hangi Tür Lise Mezunusunuz?" sorusu sorulmuştur. Ankete katılan 26 öğrenciden 5 kişi fen liselerinden, 15 kişi anadolu liselerinden, 5 kişi genel liselerden ve 1 kişi de teknik meslek liselerinden mezun olmuştur. Aday öğrenciler biyomedikal mühendislik eğitimine yatkın oldukları anlaşılmıştır.

Şekil 1. BME 110 Öğrencilerinin Mezun Oldukları Lise Türleri

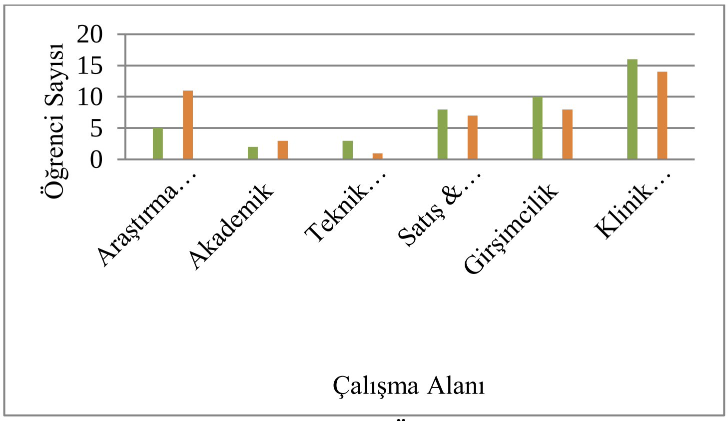
Şekil 2'de BME 110 öğrencilerine uygulanan diğer ankette ise öğrencilere "Üniversite Yerleştime Sınavında İlk Tercihiniz Hangi Mesleklerdir?" olmuştur. Bu ankete katılan 26 öğrenciden 8 tanesi ilk tercihinde biyomedikal mühendisliği, 3 kişi elektrik – elektronik mühendisliği tercihinde bulunmuşlardır. 6 öğrenci makine, inşaat, bilgisayar, endüstri ve diğer mühendislik branşlarından birini tercih etmişlerdir. Toplamda 17 kişi, bir başka ifade ile ankete katılanların %65,38'i mühendislik alanından bir tercih yapmıştır. Ayrıca 4 kişi beslenme ve diyetetik, 3 kişi tıp veya diş hekimliği, 1kişi de diğer mesleklerden tercih yapmıştır. Bulgulardan tespit edildiği üzere biyomedikal mühendisliği bölümüne kayıt yaptıran öğrencilerin önemli bir kısmının ilk tercihi biyomedikal mühendisliğidir. Biyomedikal mühendisliğinin yakın disiplinlerinden elektrik – elektronik mühendisliği ve sağlık eğitimi ise yine en çok tercih edilenler arasındadır.



Şekil 2. BME 110 Öğrencilerinin LYS'de ki İlk Tercihleri

Ders kapsamında uygulanan aktif öğrenme, etkileşimli öğrenme ve verimliliği artırma işlemleri biyomedikal mühendislik öğrencileri tarafından anket ile değerlendirilmiştir. "BME 110 Dersinin Mesleği Tanımasına Yardımcı Olacağını Düşünüyor musunuz?" sorusuna dersi almadan önce %45 evet verilmiştir. Dersten sonra gerçekleştirilen tekrar anketinde ise bu soru %90 evet ile cevaplandırılmıştır. BME 110 dersinin öncesinde ve sonrasında gerçekleştirilen anketlerde ise "Biyomedikal Mühendisi Olduğunuzda Hangi Alanda Çalışmak İstiyorsunuz?" sorusu sorulmuştur. Şekil 3'de BME 110 dersini almadan önce ve aldıktan sonra hangi alanda çalışacaksınız sorusuna verilen cevaplar görülmektedir. Dersi almadan önce biyomedikal mühendisliği araştırma – geliştirme konusunda çalışabileceğini belirten 5 kişi varken, dersten sonra 11 kişi bu alanı tercih edebileceğini söylemiştir. Akademik alanda çalışmak isteyenlerin sayısı dersten önce 2, dersten sonra 3 kişi olarak belirlenmiştir. Ayrıca teknik servis alanında dersten önce 3 kişi, dersten sonra 1 kişi, satış pazarlama alanında dersten önce 8, dersten sonra 7, girişimcilik alanında ise dersten önce 10, dersten sonra 8 kişi tercih edebileceğini belirtmiştir. Klinik mühendisliği çalışmalarına yönelmek isteyenlerin sayısı dersi almadan önce 16, dersi aldıktan sonra 14 kişi tarafından işaretlenmiştir. Ankete toplam 44 öğrenci katılmıştır.

Görülmektedir ki BME 110 dersinde gerçekleştirilen aktif öğrenme modeli ile öğrenciler teorik derslerin yanında saha tecrübesi edinmiş biyomedikal mühendislerinden aldıkları seminerler ile sahaya karşı net bir bakışı açısı kazanmışlardır. Ayrıca derste gerçekleştirdikleri projeler ile araştırma ve geliştirme süreçlerine olan yatkınları ortaya çıkarılmıştır.



Şekil 3. BME Çalışma Alanları BME 110 Dersinden Önce ve Sonra Gerçekleştirilen Anket Bulguları

Ders Değerlendirme Bulguları

BME 110 dersinde ders tanımı kısmında verilen konuların tamamı, sunum destekli olarak öğrencilere aktarılmış, detaylı inceleme için tahtada anlatılıp, tekrarlanıp öğrencilerin konuyu kavraması sağlanmıştır. Ayrıca öğrencilerin soru sormaları ve derse katılımları sağlanmaya çalışılmıştır. Derse toplam 44 öğrenci kayıt yaptırmıştır.

BME 110 dersinde öğrenim çıktılarının sağlama düzeyi ise (ÖÇ'leri Sağlama Düzeyi) %55 ile %72 arasında dağılım göstermiştir. ÖÇ sağlama düzeyi en az olan 2 No'lu ÖÇ "biyomedikal mühendisinin görev alacağı süreçleri şematik olarak tasarlayarak gösterebilir" dir. Burada öğrencilerin meslekleri ile ilgili mesleki dağılım, disiplinlerarası mesleki eğitimin tanım ve tarifleri, görev ve sorumlulukları gibi kavramları ilk defa öğrendikleri için meslek yaşantısında görev alacakları süreçleri şekillendirmede %55 düzeylerinde başarılı oldukları görülmüştür. Öğrencileri meslek çalışmaları ile gerçekleştirecekleri kurumlara özgü değişkenlik gösteren görev sorumluluk süreçleri ve bu süreçleri tasarlamaları konuları ile yüksek öğretim hayatlarında ilk tanışıklıklarından dolayı %55 düzeylerinde ölçülmüştür. Meslek yaşantısı içerisinde çalışacakları kurumlara özgü mühendislik süreçleri ve tıbbi cihaz hizmetleri ile ilgili görev ve teknik sorumluluk tasarımlarını lisans eğitim sürecinde farklı derslerde göreceklerinden yeni kavradıkları bu bilgilerin mezuniyet sürecinde artacağı düşünülmektedir.

ÖÇ. 3 öğrenme çıktısı "Akademik araştırma yapma, rapor hazırlama, raporunu sunma kurallarını tanımlayabilir. Bilimsel makale içeriği hakkında bilgi sahibi olur" dir. Bu öğrenme çıktısı derste slayt ve sonrasında tahtada gerekli kuralları ile anlatılmıştır. Sınavlar ve proje sürecinde ölçülmüştür. Öğrencilerin özellikle kaynak kullanma ve kullandıkları kaynakları hazırladıkları rapor ve sunumlarda konu içerisinde gösterme konusunda ciddi sıkıntılar yaşadıkları görülmektedir. Lisans eğitimi öncesinde bilimsel kullara uygun rapor, teknik rapor, bilimsel makale ve mesleki değerlendirme gerçekleştirmedikleri için bu öğrenme çıktısının %58 seviyelerinde ölçülmesi olağan karşılanmaktadır. Ayrıca makale okuma (kaynak tarama), bilimsel veya teknik rapor yazma konuları için ilerleyen dönemlerde ders saati payının arttırılması düşünülmektedir. Ayrıca proje sürecinden önce bu durumu destekleyecek ödev / ödevlerin verilmesi hedeflenmektedir.

ÖÇ.6 "Biyomedikal Mühendisliğinin ar&ge, üretim, satış&pazarlama ve klinik aplikasyon alanları ile tıbbi projelendirme hakkında bilgi sahibi olur" %60.77 ölçülmüştür. Öğrencilerin sektörün farklı alanlarında uzmanlıklarını kazanmış biyomedikal mühendisi veya sektör temsilcileri tarafından verilen seminerleri takip etmeleri ve meslekleri ile ilgili çalışma koşulları ve tıbbi projelendirme süreçlerini daha yakından takip etmelerinin sağlanması gerekmektedir. ÖÇ.6 ile ilişkilendirilen diğer çıktılar ile sağlanma düzeyinin %66.81, %66.85, %68.12 sevilerinde ölçülmüştür. Seminer biçiminde görsel destekli bu sunumların ve sonrasında gerçekleştirilen proje ve sınavların öncesinde öğrencilere konu ile ilgili daha detaylı bilgi verilmesi ve katılımlarının mümkün olduğunda eksiksiz sağlanması hedeflenmektedir.

SONUÇ

Biyomedikal mühendisliği lisans eğitim disiplinlerarası bir süreç olup sektörel beklentilere göre esnek olarak kurgulanmalıdır. Biyomedikal mühendisliği eğitiminin mesleki eğitim anlamındaki ilk kritik dönemeci Biyomedikal Mühendisliğine Giriş Dersi'dir. Giriş dersinde, öğrencilerin mesleğe olan bakış açılarının ilk bilgileri aktarılacağından derste kullanılacak öğrenme modeli son derece önemlidir.

Bu çalışmada Başkent Üniversitesi Biyomedikal Mühendisliği Bölümünde verilen BME 110 dersi için geliştirilen aktif öğrenme modeli ve verimlilik arttırma çalışmaları anlatılmış, elde edilen bulgular yorumlanmıştır. Ders kapsamında tamamen teorik bilgi aktarımı yerine öğrencilere biyomedikal mühendisliği alanında kariyerini geliştirmiş olan mühendisler aracılığıyla seminerler düzenlenmiştir. Böylelikle öğrenciler saha uygulamaları hakkında ilk elden bilgi alabilmekte, soru cevap bölümü ile paylaşımlar gerçekleştirebilmektedir. Vize sınavından sonra aldıkları grup çalışması projelerinde, bilgisayarlı tomografi, manyetik rezonans (MR), radyografi cihazları, biyokimya cihazları, elektrofizyolojik sistem cihazları (EKG, EMG, EOG, ENG, vb.), elektrocerrahi üniteleri, ultrasonik görüntüleme sistemleri ve kalp akciğer makinası ile ilgili çalışma prensiplerinin araştırılması, tarihçeleri, mühendislik gelişim süreçleri, kullanım alanları, ölçme işleminde kullandıkları bilimsel teknikler hakkında sektörel ve akademik araştırma yapmaları istenmiştir. Öğrenciler bu cihazların ülkemizdeki üreticilerine yönlendirilerek ilk elden bilgi toplamaları sağlanmıştır. Dersin son iki haftasında ise araştırmaları hakkında sunum yapmaları istenmiştir. Öğrencilerin tamamı projelerinde başarılı olmuşlardır.

Ders kapsamında uygulanan verimlilik arttırma çalışmalarının ve geliştirilen aktif öğrenme sürecinin, öğrencilerin başarısını arttırdığı sonucuna varılmıştır. Ders kapsamında gerçekleştirilen ölçme ve değerlendirme sonuçlarında, öğrenim çıktıların sağlanma düzeyi %67,72'dir. Ayrıca öğrencilere gerçekleştirilen anketlerde öğrencilerin ders öncesi ve sonrasında biyomedikal mühendisliğine ve çalışmalarına olan bakışları dramatik biçimde değişiklik göstermiştir. Ders sonunda araştırma – geliştirme ve sonrasında gerçekleştirilecek üretim süreçlerine öğrencilerin ilgisi oldukça artmıştır.

Ülkemizde kullanılan tıbbi cihaz ve sistemlerin yaklaşık %85'inin ithal olduğu düşünüldüğünde ar&ge ve üretime yönlenmek isteyen biyomedikal mühendislerinin sayısının arttırılmasının sağlanması gelecek açısından kritiktir. Biyomedikal Mühendisliğine Giriş dersi kapsamında uygulanan verim arttırma çalışmaları ve yeni yaklaşımlar ile ülkemizin esas anlamda ihtiyacı olan, yerli tıbbi cihaz üretimi süreçlerine katkı koyacak biyomedikal mühendislerinin yetiştirilmesinin başlangıç aşaması başarı ile gerçekleştirilmiştir.

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ASSESSMENT OF INTERDISCIPLINARY PARTS IN UNDERGRADUATE EDUCATION OF BIOMEDICAL ENGINEERING

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ABSTRACT: Biomedical Engineering undergraduate education program at Baskent University is a interdisciplinary model which consist of 240 ECTS (European Credit Transfer System) and 150 credits. Courses of the department are composed several areas, such as basic engineering , engineering laboratory applications, electrical and electronics engineering , fundamental and technical English, basic medicine and medical engineering, engineering science, business management and analysis, field application and research and technical project courses.

In this study, the courses of Baskent University Biomedical Engineering undergraduate program were analyzed with questionnaire that applied to senior students. Students assessed course requirements, course contents, duration of courses, ECTS weight, range of applications in industry, course goals, and laboratory conditions issues gradually. Specifying adjustments and innovations that they propose have also been requested from the students in the questionnaire. The survey was realized with 25 last year students and the results were interpreted as statistically.

According to results, courses that are mainly practical and applicable are founded more necessary than courses that have theoretical training model.
In addition, contents of electrical- electronic based courses have to be enriched with interdisciplinary courses. Moreover we determined that the increasing course hours of laboratory practices would be useful. Finally rather than technical elective courses based on a single branch, they have to content of at least one from each branches.
This study will be a reference for improvements of the course catalog at Baskent University Department of Biomedical Engineering which is in MUDEK (Association for evaluation and Accreditation of Engineering Programs) application process. It will also be a reference for lecturers in terms of revising the course contents and the improvement of laboratory facilities with feedback of the senior students.

Key words: biomedical engineering, interdisciplinary education, course assessment, catalog, last year students

BİYOMEDİKAL MÜHENDİSLİĞİ LİSANS EĞİTİMİNDE DİSİPLİNLERİN DEĞERLENDİRİLMESİ

ÖZET: Başkent Üniversitesi Biyomedikal Mühendisliği bölümü lisans eğitim programı 240 AKTS (Avrupa Kredi Transfer Sistemi) ve 150 krediden oluşan disiplinlerarası bir modeldir. Bölüm dersleri; temel mühendislik dersleri, mühendislik laboratuar uygulamaları, elektrik-elektronik mühendisliği dersleri, temel ve teknik İngilizce, temel tıp ve tıp mühendisliği, mühendislik bilimi, işletme yönetimi ve analiz, saha uygulama, seçili araştırma ve teknik proje derslerinden oluşmaktadır.

Bu çalışmada Başkent Üniversitesi Biyomedikal Mühendisliği Bölümü lisans eğitim programı kapsamındaki dersler, son sınıf öğrencilerine uygulanan anket değerlendirmeleri ile analiz edilmiştir. Öğrenciler, dersin gerekliliği, içeriği, ders saati süresi, AKTS ağırlığı, sektördeki uygulama alanları, öğrencilere katkıları ve laboratuar şartları konularını kademeli olarak değerlendirmiştir. Ayrıca anketim son bölümünde öğrencilerden, önerdikleri düzeltme ve yenilikleri de belirtmeleri istenmiştir. Anket 25 son sınıf öğrencisi ile gerçekleştirilmiş olup sonuçlar istatistiksel olarak yorumlanmıştır.

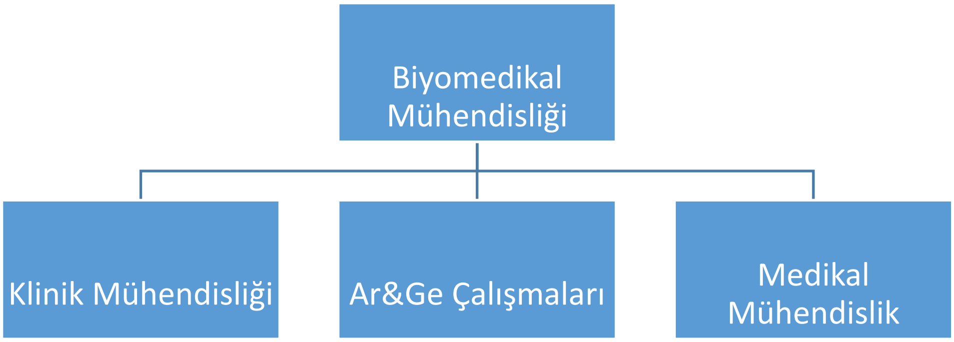
Sonuçlara göre uygulama ve pratik ağırlığı olan dersler teorik eğitim modeline sahip derslere göre daha gerekli görülmektedir. Ayrıca elektrik-elektronik temelli derslerin içeriklerinin disiplinlerarası dersler ile zenginleştirilmesi önerilmiştir. Bunlara ilave olarak, laboratuar uygulamalarının ders saatinin arttırılmasının faydalı olacağı tespit edilmiştir. Bunun yanında teknik seçimlik derslerin tek disipline göre değil, her disiplinden en az bir adet olmak üzere açılması önerisi ulaşılan sonuçlar arasındadır.

Bu çalışma MÜDEK (Mühendislik Eğitim Programları Değerlendirme ve Akreditasyonu) başvuru sürecinde bulunan Başkent Üniversitesi Biyomedikal Mühendisliği Bölümüne gerçekleştireceği ders kataloğu iyileştirmelerinde bir referans olacaktır. Ayrıca son sınıf öğrencilerinden alınan geribildirimlerle ders içeriklerinin revize edilmesi ve laboratuar imkânlarının iyileştirilmesi açısından öğretim üyelerine de referans oluşturacaktır.

Anahtar sözcükler: biyomedikal mühendisliği, disiplinlerarası eğitim, ders değerlendirme, katalog, son sınıf öğrenciler

GİRİŞ

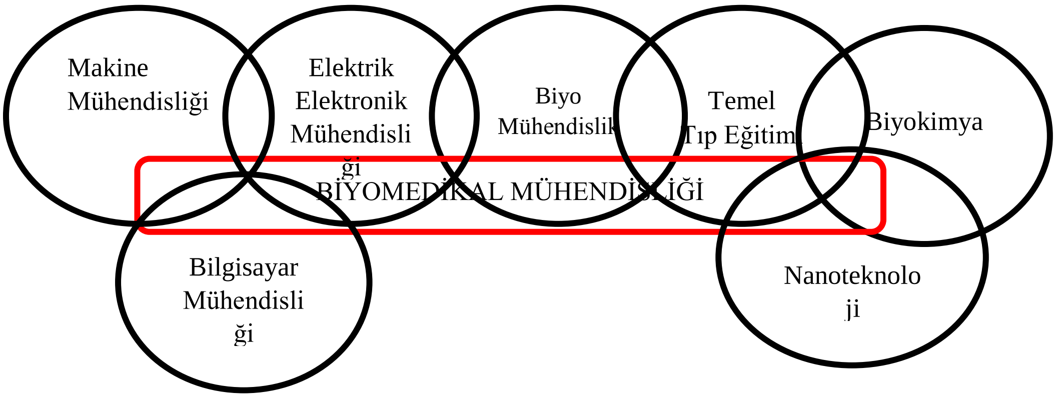
Biyomedikal Mühendisliği; teşhis, tedavi, tıbbi araştırma ve laboratuar cihazlarının istenilene uygun bir şekilde tasarlanması, üretimi ve işletilmesinden sorumlu bir mühendislik dalıdır (Enderle & Bronzino, 2012). İsminden de anlaşılacağı üzere eğitim süreci birçok farklı disiplini kapsamaktadır. Biyomedikal mühendisliği lisans eğitimi sürecini tamamlayan adaylar tıbbi cihazların sağlık kurumlarında mühendislik esaslı işletiminde, bakım & onarım ve kalibrasyon süreçlerinde, tıbbi sterilizasyon konusunda, tıbbi gazların işletilmesinde, tıbbi cihazların teknik yenileme çalışmalarında, satın alma birimlerinde, teknik şartname hazırlama, muayene ve kabul işlemlerinde, sağlık personelinin teknik eğitiminde, tıbbi cihaz üreten firmalarda, fabrikalarda, ar & ge merkezlerinde, üniversitelerde ve özel sektörde görev almaktadırlar (Chu & Bronzino, 1995). Sağlık teknolojilerinin birçok farklı alanında teknik çalışma imkanı bulan biyomedikal mühendislerinin amaçlarından biri de tıbbi ihtiyaçlar doğrultusunda analitik mühendislik çözümleri üretmektir. Şekil 1'de biyomedikal mühendisliğinin çalışma alanları görülmektedir (Bronzino, 1995). Bronzino'ya göre Biyomedikal mühendisliği 3 temel çalışma alanına sahiptir.



Şekil 1. Biyomedikal Mühendisliğinin Çalışma Alanları

Klinik Mühendisliği; biyomedikal mühendisliğinin sağlık kurumlarında istihdam edilen şeklidir (Kline, 2012). Sağlık kurumu içerisinde tıbbi cihazların teknolojilerine göre temin edilmesi ve verimli bir şekilde teknik işletilmesinden sorumludur. Medikal Mühendislik; biyomedikal mühendislerinin özel sektör veya kamuda istihdam edilerek gerçekleştirdiği üretim, satış, pazarlama, teknik servis, kalibrasyon, şartname uzmanı, kalite yöneticisi vb. görevlerde çalışmalardır (Kutz, 2003). Ar&Ge ve akademik çalışmalar ise üniversite merkezli gerçekleştirilen tıbbi cihaz geliştirme, araştırma, prototip tasarım ve bilimsel literatüre katkı yapılan diğer akademik çalışmalardır. Genel anlamda disiplinlerarası gruplar ile birlikte çalışılması gerektiğinden biyomedikal mühendislik eğitimi disiplinlerarası eğitim modeline göre oluşturulmuştur (Koçak, Arifoğlu, Telatar ve Eroğul, 2009). Biyomedikal mühendisliğinin temel alanları biyomedikal sinyal işleme, tıbbi görüntü işleme, tıbbi görüntüleme sistemleri, biyomedikal enstrümantasyon, biyomekanik, biyoteknoloji, biyomühendislik, medikal informatik şeklinde sıralanabilir.

Birçok disiplin ile ilgili çalışma alanı bulunan biyomedikal mühendisliğinin diğer bilim dalları ile kesişimleri şekil 2'de görülmektedir. Biyomedikal mühendisliği lisans eğitiminde; makine mühendisliği temelli dersler, elektrik & elektronik mühendisliği dersleri, bilgisayar mühendisliği, biyomühendislik, mühendisler için temel tıp eğitimi, temel eczacılık ile biyokimya dersleri, nanoteknoloji gibi temel ve disiplinlerarası arası eğitimler ön plana çıkmaktadır.



Şekil 2. Biyomedikal Mühendisliği Disiplinler Kesişimi

Birçok disiplinin biraraya gelerek oluşturduğu biyomedikal mühendisliği lisans eğitimi ülkemizde 15 yıldır uygulanmaktadır. 2014 – 2015 akademik yılı itibariyle ülkemizde toplam 20 bölümde biyomedikal mühendisliği lisans eğitim programı yürütülmektedir. Üniversitelerin, yetişmiş insan gücüne katkı verecekleri alanlara göre biyomedikal mühendisliği lisans eğitim müfredatları farklılıklar göstermektedir. Bu çalışmada Başkent Üniversitesi Biyomedikal Mühendisliği Bölümü lisans eğitim süreci incelenmiş olup, eğitimi oluşturan disiplinlerin değerlendirilmesi gerçekleştirilmiştir. Ayrıca bölüm son sınıf öğrencileri arasında gerçekleştirilen anket çalışmaları ile derslerin niteliği hakkında geri bildirimler alınmıştır. Ayrıca bu çalışmanın sonuçları MÜDEK (Mühendislik Eğitim Programları Değerlendirme ve Akreditasyonu) başvuru sürecinde bulunan Başkent Üniversitesi Biyomedikal Mühendisliği Bölümüne gerçekleştireceği ders kataloğu iyileştirmelerinde bir referans olacaktır.

MATERYAL ve YÖNTEM

Başkent Üniversitesi Biyomedikal Mühendisliği Bölümü eğitim içeriği farklı disiplinlerden oluşmaktadır. Tüm dersler 240 AKTS ve 150 krediden oluşmaktadır. Dersler tüm disiplinlerden 52 adet olup ayrıca 2 Bitirme Projesi dersi ve 2 Staj olmak üzere toplam 56 adettir. Bunlar elektrik – elektronik mühendisliği, temel mühendislik dersleri, mühendislik bilimi, tıp ve tıp mühendisliği, temel mühendislik laboratuarları, temel ve teknik İngilizce dersleri, işletme yönetimi ve analiz, saha araştırma derslerini kapsayan disiplinlerdir. Bu bölümde verilen dersler ve disiplinlerin içerikleri analiz edilmiştir.

Temel Mühendislik Dersleri

Temel Mühendislik dersleri 14 adet dersten oluşmakta olup Başkent Üniversitesi Mühendislik Fakültesinde ilk yıl tüm bölümlere ortak müfredat olarak uygulanmaktadır. Sadece her bölümde kendi disiplinine ait giriş dersi bulunmaktadır. Biyomedikal Mühendisliğine Giriş dersi biyomedikal mühendisliği eğitimine özgüdür. Temel mühendislik dersleri C ve C++ programlama dillerinin öğrenimini içeren bilgisayar mühendisliği disiplinine dayanan Bilgisayar Yazılım I ve II, matematiksel analiz bilgilerinin aktarıldığı calculus dersleri olan Matematiksel Analiz I ve II, Genel Fizik I ve II, Kimya I ve II (organik kimya), Türk Dili I ve II, Atatürk İlkeleri ve İnkılap I ve II dersleridir (Başkent Üniversitesi Mühendislik Fakültesi Ders Kataloğu, 2015). Ayrıca biyomedikal mühendisliği kavramını öğrencilere aktaran, mesleğin içeriğini, çalışma alanlarını, gelecek dönemlerde alacakları derslerin işlendiği Biyomedikal Mühendisliğine Giriş dersi bulunmaktadır. Seçmeli Güzel Sanatlar dersi ise mühendislik eğitimi alan öğrencilerin yeteneklerine veya ilgi duydukları alanlara göre öğrencilere hobi amaçlı öğretim sunmaktadır. Toplam 37 kredi ve 51 AKTS ile biyomedikal mühendisliği eğitiminin en önemli parçalarındandır.

Temel Mühendislik Laboratuar Uygulamaları

İlk yıl alınan temek mühendislik derslerinin laboratuar uygulamalarından oluşmaktadır. Bu dersler C ve C++ uygulamalarının gerçekleştirildiği Programlama Laboratuarı I ve II, Mekanik Laboratuarı, Kimya Laboratuarı ve temel elektrik devreleri analizin başladığı Elektrik Laboratuarıdır. 5 dersten oluşan bu grup 5 kredi, 10 AKTS'dir.

Elektrik – Elektronik Mühendisliği Ders Grupları

Elektrik – Elektronik Mühendisliği temeline dayanan dersler biyomedikal mühendisliği eğitiminin en kritik aşamalarındandır. Tablo 1'de elektrik – elektronik ders grubu kredi ve AKTS dağılımı ile ders grupları görülmektedir. Elektrik - elektronik disiplini biyomedikal mühendisliği eğitiminde 5 gruptan oluşmaktadır. Elektronik – Tıp Elektroniği dersleri; Devre Teorisi, Elektronik, Doğrusal Cebir ve Diferansiyel Denklemler ile Medikal Elektroniktir. Kredi sayısı 14, AKTS 19'dur. Manyetik dersleri 2 adet olup Radyasyon Fiziği ve Elektromanyetik Teoriden oluşmaktadır. Sayısal tasarım dersleri, Sayısal Mantık Tasarımı ve Mikrodenetleyicilerdir. Sinyal analiz dersleri Sinyaller ve Sistemler, Biyomedikal İşaret İşleme I ve II, Biyomedikalde Bilgisayar Uygulamalarıdır. 14 kredi ve 22 AKTS'den oluşmaktadır. Enstrümantaston ve görüntüleme dersleri ise en çok AKTS'ye sahiptir. Biyomedikal Enstrümantasyon I ve II, Tıbbi Görüntüleme Sistemleri ve Tıbbi Teknoloji Yönetimi derslerinden oluşmaktadır. Elektrik – elektronik ders grubu ile öğrencilere, sayısal analiz, devre elemanları bilgisi, devre tasarımı, sayısal tasarım, mikroişlemci programlama, biyoelektrik sinyallerin canlı vücudundan toplanması, toplanan sinyallerin sayısal hale getirilerek işlenmesi, elektronik sistem tasarımı, tıbbi görüntüleme cihazlarının çalışma prensipleri, matematiksel temelleri ve analizleri hakkında bilgi verilmektedir (Başkent Üniversitesi Mühendislik Fakültesi Ders İçerikleri, 2015).

Tablo 1. Elektrik – Elektronik Ders Grubu Kredi ve AKTS Dağılımı

Ders Grubu	Ders Sayısı	K	AKTS
Elektronik – Tıp Elektroniği	4	14	19
Manyetik	2	5	8
Sayısal Tasarım	2	7	10
Sinyal Analiz	4	12	22
Enstrümantasyon ve Görüntüleme	4	14	23
TOPLAM	***16***	***52***	***82***

Mühendislik Bilimi Ders Grupları

Mühendislik bilimi ders grubu, makine mühendisliği disiplinine ait derslerden oluşmaktadır. Toplam 6 kredi ve 10 AKTS değerindedir. Dersler Biyomekanik ve Biyomalzemedir. Bu derslerde malzeme bilgisi, biyomedikal teknolojilerden kullanılan malzemelerin yapısı, biyouyumluluğu, protez ve ortez tasarımlarında kullanılan malzemelerin dayanımları, kuvvet analizleri, vücuda etkileri gibi detaylar işlenmektedir (Poitout, 2004).

İşletme Yönetimi ve Analiz Dersleri

İşletme Yönetimi ve Analiz ders grubu 4 dersten, 11 krediden ve 16 AKTS'den oluşmaktadır. Biyomedikal mühendisliği lisans eğitimi sürecinde verilen tıbbi cihaz tasarlama ve üretme süreçlerine katkı sunacak satış, pazarlama, finansman yapılandırma, yatırımcı bulma, girişimcilik, melek yatırımcılık gibi güncel bilgilerin aktarıldığı Ekonomi ve İşletme dersleri verilmektedir. Ayrıca biyomedikal mühendislerinin sıklıkla istihdam edildiği hastanelerde teknik işletme bilgilerinin aktarıldığı Sağlık Kurumları İşletmeciliği dersi verilmektedir (Shohet & Lavy, 2004). Biyoistatistik dersi ile de sayısal analiz çalışmaları için adaylara teorik bilgi aktarımı gerçekleştirilmektedir.

Temel ve Teknik İngilizce

İngilizcenin çok fazla gerekli olduğu biyomedikal mühendisliğinde adaylara 1. Sınıftan son sınıfa kadar İngilizce verilmektedir. Temel İngilizce içeriğinin verildiği 1. ve 2. Sınıfı kapsayan Advanced English I ve II, TOEFL içeriğinin hakim olduğu ve öğrencilere uluslararası dolaşımda büyük kolaylık sağlayan Developing English Language Skills – TOEFL dersi ve öğrencilerin küresel şirketlerde gerçekleştirecekleri İngilizce sunum yeteneklerini geliştiren Presentation Skills dersleri verilmektedir. İngilizce ders grubu toplam 14 kredi, 16 AKTS'dir.

Tıp ve Tıp Mühendisliği Dersleri

Biyomedikal mühendisliği eğitiminde mühendislik disiplinlerinin yanında tıp eğitimi disiplininden gelen derslerden oluşan gruptur. Biyomedikal mühendislerini diğer mühendisliklerden ayıran, farkındalık yaratan bir içeriğe sahiptir. Toplam 5 ders, 15 kredi ve 27 AKTS'den oluşmaktadır. Biyokimya dersi temel tıp eğitiminin de bir parçası olup aynı içerik ile biyomedikal mühendis adaylarına da aktarılmaktadır. Tıbbi Biyoloji ile vücudun yapı taşı olan aminoasitler ve proteinler başta olmak üzere insan biyolojisi üzerine durulmaktadır. İnsan Anatomisi ve Fizyoloji dersi ile insan kemik yapısı, iskelet sistemi detaylı olarak verilmektedir.

Ayrıca vücutta bulunan tüm fizyolojik sistemler tıbbi neden – sonuçları ile incelenmektedir (Iaizzo, 2009). Mühendisler İçin Fizyoloji I ve II dersleri ise temel tıp derslerinden elde edilen bilginin tıbbi cihaz tasarımında kullanılması hakkında sayısal bilgiler içermektedir. Bir başka anlamda tıp ile mühendisliğin ara kesitini oluşturmaktadır. Tablo 2'de Tıp ve Tıp Mühendisliği Derslerinin kredi ve AKTS dağılımları görülmektedir.

Tablo 2. Tıp ve Tıp Mühendisliği Dersleri

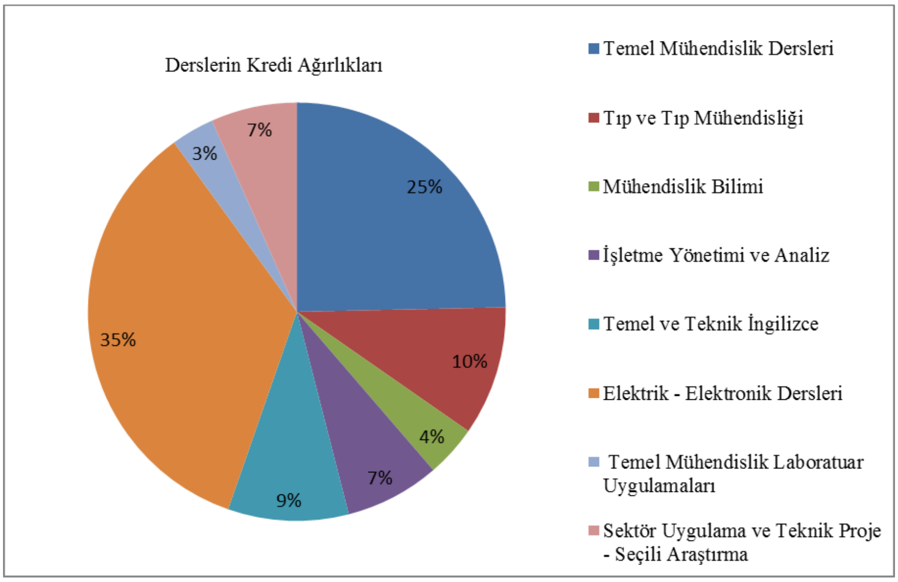
Tıp ve Tıp Mühendisliği Dersleri	**K**	**AKTS**
Biyokimya	3	5
Tıbbi Biyoloji	3	5
İnsan Anatomisi ve Fizyolojisi	3	5
Mühendisler İçin Fizyoloji I	3	5
Mühendisler İçin Fizyoloji II	3	7
TOPLAM	***15***	***27***

Sektör Uygulama ve Teknik Proje - Seçili Araştırma Dersleri

Toplam 6 dersten 10 Krediden ve 26 AKTS'den oluşan bu ders grubu biyomedikal mühendis adaylarını sektöre, pratik uygulamalara ve istedikleri alanda detaylı uzmanlaşmaya yöneltmektedir. Bu dersler, bir tıbbi cihaz veya sistemin modellenerek prototip olarak tasarlanmasını içeren Bitirme Projesi I ve II derslerinden, 2. Sınıf bitiminde hastanelerde, 3. Sınıf bitiminde ise mutlaka üretim yapan bir tıbbi cihaz firmasında gerçekleştirecekleri Staj I ve II derslerinden, ayrıca uzmanlaşmak istedikleri alanlarda tercih edecekleri Teknik Seçimlik I ve II derslerinden oluşmaktadır.

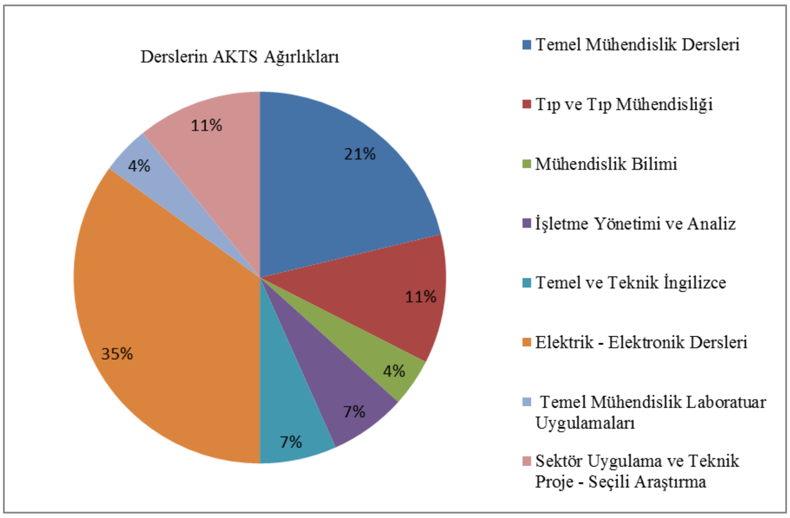
BULGULAR

Başkent Üniversitesi Biyomedikal Mühendisliği bölümü toplamda 56 ders olmak üzere, 52 ders, 2 proje dersi ve 2 stajdan oluşmaktadır. Bu dersler 240 AKTS ve 150 kredi ağırlığındadır. Ders katalogları incelendiğinde, derslerin kredi ağırlıklarının Şekil 3'deki gibi olduğu, derslerin AKTS ağırlıklarının ise Şekil 4'deki gibi olduğu elde edilmiştir. Bu bulgular ışığında Başkent Üniversitesi Biyomedikal Mühendisliğinin elektrik - elektronik ağırlıklı olarak eğitim verdiği görülmektedir.



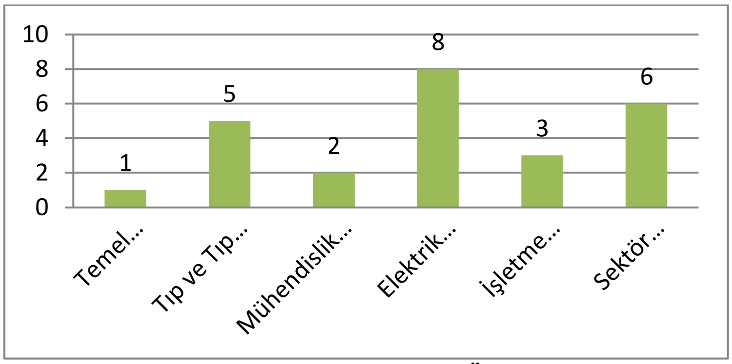
Şekil 3. Biyomedikal Mühendisliği Derslerinin Kredi Ağırlıkları Dağılımı

Başkent Üniversitesi Biyomedikal Mühendisliği bölümü 25 son sınıf öğrencisine uygulanan anket sonucunda elde edilen veriler, sorulara göre grafik bulguları üzerinden yorumlanmıştır. Ankette toplamda 11 soru yöneltilmiştir. Anketin ilk 4 sorusu katılımcının demografik özelliklerini tespit etmeye yöneliktir. Diğer sorularda öğrenciler; dersin önem sırası, içeriği, ders saati ve uygulama süresi, AKTS ağırlığı, sektördeki uygulama alanları, öğrencilere katkıları ve laboratuar şartları konularını değerlendirmiştir. Elde edilen bulgular grafiksel olarak değerlendirmeye tutulmuştur.



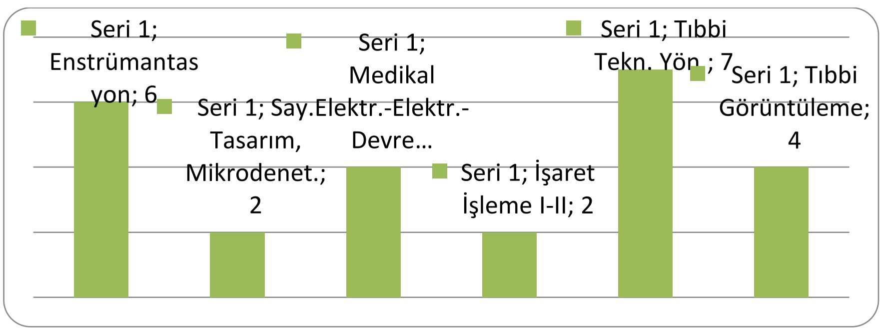
Şekil 4. Biyomedikal Mühendisliği Derslerinin AKTS Ağırlıkları Dağılımı

Ankette demografi sorularından sonra ilk sorulan soru *'Biyomedikal Mühendisliği Eğitiminde En Önemli Gördüğünüz Ders Grubu Hangisidir?' şeklindedir.* Bu soruya 25 öğrenciden 11'i Medikal Elektronik, Elektronik, Devre Teorisi cevabını vermiştir. Bulgular Şekil 5'de görülmektedir. Şekil 3 ve 4'teki bulgulardan görüldüğü üzere Başkent Üniversitesi Biyomedikal Mühendisliği Bölümü eğitimi içeriğinin %35 ağırlığı elektrik – elektronik ders gruplarından oluşmaktadır. Anketten edinilen bulgularda da en önemli ders gruplarının ilk 3 ü sırasıyla elektrik – elektronik, sektör uygulama ve teknik proje ile tıp ve tıp mühendisliği dersleridir.



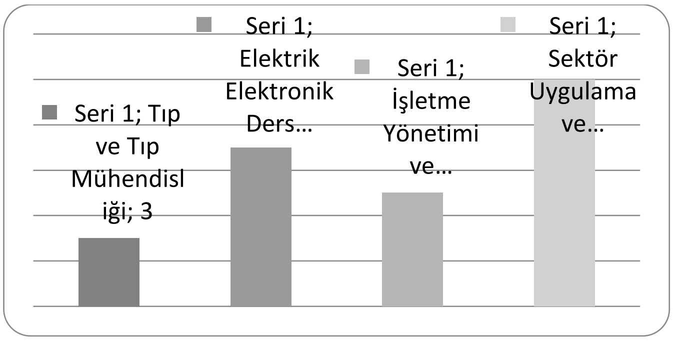
Şekil 5. Biyomedikal Mühendisliği Eğitimine En Önemli Görülen Ders Grupları

Ankette öğrencilere ikinci olarak *'Biyomedikal Mühendisliği Eğitiminde Aldığınız Dersler Arasından Sizi Sektöre En Çok Yönlendirdiğini Düşündüğünüz Ders hangisidir?'* sorusu sorulmuştur. Buna göre sektöre en çok yönlendirdiği düşünülen ders 25 kişiden 7'sine göre Tıbbi Teknoloji Yönetimidir. Bu dersten sonra Biyomedikal Enstrümantasyon I ve II gelmektedir. Arkasından 4 er kişinin tercihi Medikal Elektronik, Elektronik, Devre Teorisi Dersleri ile Tıbbi Görüntüleme Sistemleri dersleridir. Bulgular Şekil 6'da görülmektedir.



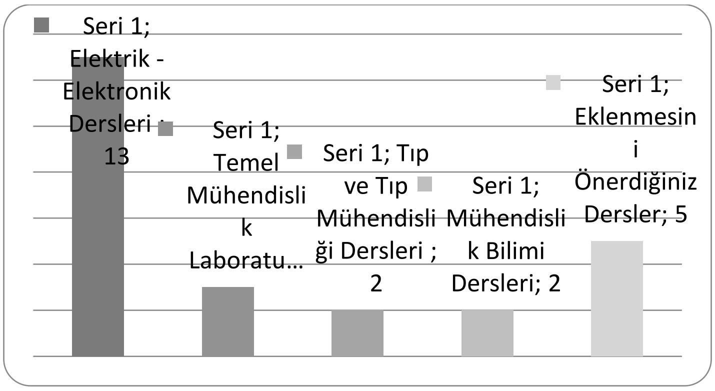
Şekil 6. Biyomedikal Mühendisliği Eğitimine Sektöre En Çok Yönlendirdiği Düşünülen Dersler

Bir diğer soru ise *'Ders Saatinin Arttırılmasını Gerekli Gördüğünüz Ders Grupları Nelerdir ?'* şeklindedir. Ders gruplarından Mühendislik Bilimleri Dersleri, Temel Mühendislik Dersleri hiçbir öğrenci tarafından tercih edilmemiştir. Ders saati arttırılması gerekli görülen ders grupları sırasıyla sektör uygulama ve teknik proje dersleri, elektrik – elektronik dersleri, işletme yönetim ve analiz dersleri sonuncu olarak da tıp ve tıp mühendisliği dersleri gelmektedir. Şekil 7'de bulgular görülmektedir.

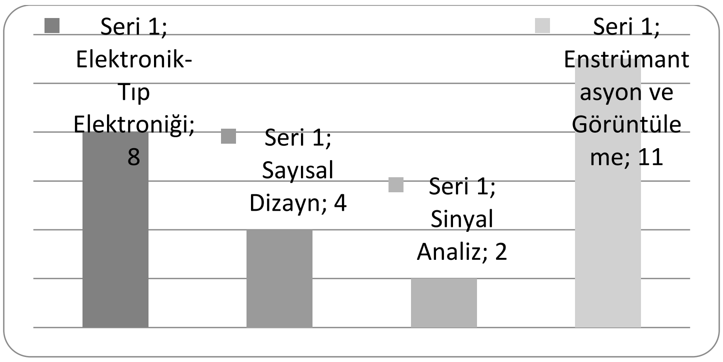


Şekil 7. Ders Saatinin Arttırılmasını Gerekli Gördüğünüz Ders Grupları

Ankette dramatik bulgulara neden olan sorulardan bir diğeri de *'Laboratuar Saatinin Arttırılmasını Gerekli Gördüğünüz Ders Grupları Nelerdir ?'* sorusudur. Biyomedikal Mühendisliği eğitiminde Temel Mühendislik Laboratuar Uygulamalarının yanı sıra mesleki derslerin de laboratuar dersleri bulunmaktadır. Öğrenciler, teorik olarak gördükleri derslerin pratik uygulamalarını bu laboratuarlarda gerçekleştirmektedir. Laboratuar saatinin arttırılmasının en çok gerekli görüldüğü ders grupları elektrik – elektronik dersleridir. Şekil 8'de bu soruya ait bulgular görülmektedir. Bulgular arasında en çarpıcı olanı öğrencilerin özellikle Teknik Seçimlik derslerde uygulama gerçekleştirilmesi önerisidir. Şekil 9'da ise elektrik – elektronik ders grupları içerisinden en çok hangi grubun uygulama saatinin arttırılması gerektiği sorusunun yanıtı görülmektedir. Enstrümantasyon ve Görüntüleme Derslerinin uygulama saatinin arttırılması bu ders grubu içerisinde en çok gerekli görülenlerdir.



Şekil 8. Laboratuar Saatinin Arttırılmasını Gerekli Gördüğünüz Ders Grupları



Şekil 9. Elektrik – Elektronik Ders Grubu İçerisinde Laboratuar Saatinin Arttırılmasını Gerekli Gördüğünüz Dersler

SONUÇ

Başkent Üniversitesi Biyomedikal Mühendisliği bölümü lisans eğitimi ülkemizdeki ilk örnek olup 240 AKTS ve 150 Krediden oluşan birçok disiplinden meydana gelen bir modeldir. Bu modelde eğitim dağılımı (Şekil 4'de görülen dağılım) %35 Elektrik – Elektronik Dersleri, %21 Temel Mühendislik Dersleri, %11 Tıp ve Tıp Mühendisliği Dersleri, %11 Sektör Uygulama ve Teknik Proje – Seçili Araştırma Dersleri, %7 Temel ve Teknik İngilizce Dersleri, %7 İşletme Yönetimi ve Analiz Dersleri, % 4 Mühendislik Bilimi ve %4'de Temel Mühendislik Laboratuar Uygulamaları Derslerinden oluşmaktadır.

Başkent Üniversitesi Biyomedikal Mühendisliği son sınıf öğrencilerine uygulanan anket ile elde edilen bulgular göstermektedir ki, bölümün elektrik-elektronik ağırlıklı çalışma disiplininin öğrenciler tarafından uygun görüldüğü sonucuna varılmaktadır. Fakat elde edilen bir başka sonuç ise elektrik-elektronik temelli derslerin içeriklerinin düzenlenmesi ve laboratuar uygulamalarının arttırılmasıdır. Ayrıca, laboratuar uygulaması olmayan derslerin bazılarının da pratiğe yönelik çalışmalara ihtiyaç duyduğu sonucuna varılmıştır. Disiplinlerarası eğitimlerin genelinde görüldüğü üzere biyomedikal mühendisliği eğitiminde de pratik uygulamaların ve laboratuarların sayısının mesleğin her alanına hitap edebilecek boyutta olması gerekmektedir.

Birçok disiplinin birarada olduğu biyomedikal mühendisliği eğitiminde öğrencilerin ilgi alanlarına göre her disipline ait derslere yer verilmesi gerektiği ortaya çıkmıştır. Gerekli düzenlemeler yapıldığında mezunların sektörde daha aktif bir rol edinilebileceği düşünülmektedir. Bu çalışmadan elde edilen bulgular, bölümün MÜDEK (Mühendislik Eğitim Programları Değerlendirme ve Akreditasyonu) başvuru sürecinde faydalanacağı bir referans oluşturacaktır. Çalışmadan elde edilecek sonuçlar düzenlenecek katalog iyileştirmeleri ve ders revizyonlarında öğretim elemanlarına da kaynak oluşturacaktır. Öğrencilerden alınan tüm geri bildirimler biyomedikal mühendisliği eğitiminin kalitesini arttırıcı yönde faydalar sağlamaktadır.

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EXAMINING THE OPINIONS OF MATHEMATICS TEACHER CANDIDATES REGARDING THE MATERIALS DEVELOPED IN INSTRUCTIONAL TECHNOLOGIES AND MATERIAL DEVELOPMENT COURSE

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ABSTRACT: The aim of this study is to examine the opinions mathematics teacher candidates regarding the materials developed in Instructional Technologies and Material Development Course (ITMD) that is given as a part of Pedagogical Formation Certificate Training Programme. 13 teacher candidates that continue Pedagogical Formation Certificate Training Programme of Çukurova University Faculty of Education, formed the study group of research. Semi structured interview form that were preperad by researchers, were used as a data collection tool. In analysis of data, content analysis method was used. At the end of the study it was figured out that, in general, teacher candidates have positive views on materials developed in ITMD. Furthermore, during the material preparation process, they pay attention to the usefulness of the materials and the educational attainments. On the other hand, during the material preparation process teacher candidates especially have difficulties in crafting, selecting the materials and timing most.

Key words: instructional technologies and material development course, mathematics teacher candidates, preparing material.

MATEMATİK ÖĞRETMEN ADAYLARININ ÖĞRETİM TEKNOLOJİLERİ VE MATERYAL GELİŞTİRME DERSİNDE HAZIRLADIKLARI MATERYALLERE İLİŞKİN GÖRÜŞLERİNİN İNCELENMESİ

ÖZET: Bu araştırmanın amacı, matematik öğretmen adaylarının pedagojik formasyon eğitimi sertifika programı kapsamında verilen Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirdikleri materyallere ilişkin görüşlerini incelemektir. Araştırmanın çalışma grubunu 2013-2014 öğretim döneminde Çukurova Üniversitesi Eğitim Fakültesi Pedagojik Formasyon Eğitimi Sertifika Programına devam eden on üç matematik öğretmen adayı oluşturmuştur. Veri toplama aracı olarak araştırmacılar tarafından hazırlanan yarı yapılandırılmış görüşme formu kullanılmıştır. Veriler içerik analizi yöntemiyle analiz edilmiştir. Araştırmanın sonucunda, matematik öğretmen adaylarının ÖTMG'de geliştirilen materyallere ilişkin genel olarak olumlu görüşlere sahip oldukları; materyallerin hazırlanma aşamasında, öğrenciye faydalı olmasına, kullanışlı olmasına, kazanımlara uygun olmasına dikkat ettikleri ortaya çıkmıştır. Öte yandan, materyallerin hazırlanma aşamasında öğretmen adaylarının en çok el becerisi, malzeme seçimi ve süre açısından sorun yaşadıkları araştırmadan elde edilen diğer bir sonuçtur.

Anahtar sözcükler: öğretim teknolojileri ve materyal geliştirme dersi, matematik öğretmen adayları, materyal hazırlama.

GİRİŞ

Günümüzde teknolojinin hızla gelişmesi bu süreçle birlikte birçok alanda değişime neden olduğu gibi materyal geliştirme sürecinde öğretim teknolojilerinde de ayrı bir önem kazanmaya başlamıştır. Öğretmenler; bilgisayar, projeksiyon ve diğer araç-gereç ve yöntemleri kullanarak öğrencilerin ilgisini konuya rahatça çekebilmeye başlaması, karmaşık öğrenme içeriklerini öğrencilere sunarken daha etkili sonuçlar alabilmesine yol açmıştır (Ayçiçek, 2007). Bu durum öğretim materyallerini aktif bir şekilde kullanılmasının bir ihtiyaç olduğunu göstermektedir.

Eğitim Fakülteleri tarafından yürütülen pedagojik formasyon eğitimi sertifika programı çerçevesinde öğretmen adaylarının eğitim ve öğretime özgü zorunlu derslerinden biri olan öğretim teknolojileri ve materyal geliştirme dersi teori ve uygulamanın bir arada verildiği meslek derslerinden biridir (YÖK, 2014). Dersin hedefleri öğretim sürecinde çeşitli materyallerin tasarlanması, geliştirilmesi ve değerlendirilmesi yer almaktadır. Bu kapsamda bilişsel, duyuşsal ve devinişsel niteliklerin öğretmen adaylarının mesleki yaşantılarında teknolojiyi öğretimle bütünleştirmelerine büyük hizmetler edeceği beklenmektedir (Gündüz ve Odabaşı, 2004). Bu süreçte öğretmen adayları ders kapsamında çeşitli materyaller hazırlamakta ve materyal geliştirme sürecini arkadaşlarıyla birlikte paylaşmaktadırlar. Öğrenciler kendi hazırladıkları materyallerle birlikte diğer materyal örneklerini de görme fırsatı elde etmektedirler (Geçer, 2010). Derslerde öğretim teknolojileri ve öğretim materyallerinin kullanımı ve geliştirilmesinin, öğretim eksikliklerinin giderilmesinde etkili olduğu görülmektedir (İnan, 2006).

Literatürde öğretim teknolojileri ve materyal geliştirme dersine ilişkin yapılan çalışmalar incelendiğinde; bu çalışmaların pek çok farklı branş dersini kapsadığı görülmektedir (Acer, 2011; Bektaş, Nalçacı & Ercoşkun, 2009; Çakır, 2010; Duruhan & Şan, 2013; Geçer, 2010; Güven,2003; Sevim, 2014; Yaman, 2007). Ancak matematik dersi bağlamında matematik öğretmenleri adaylarının öğretim teknolojileri ve materyal geliştirme dersleri hakkındaki görüşlerini irdeleyen sınırlı sayıda çalışma göze çarpmaktadır (Güneş & İskenderoğlu, 2014). Bu olgudan yola çıkarak bu çalışmanın genel amacı, matematik öğretmen adaylarının Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirilen materyallerle ilişkin görüşlerini incelemektir. Bu genel amaç doğrultusunda aşağıdaki sorulara yanıt aranmıştır.

1) Öğretmen adaylarının Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirilen materyallere ilişkin genel görüşleri nelerdir?
2) Öğretmen adaylarına göre Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirilen materyallerin hazırlanmasında göz önünde bulundurulan ölçütler nelerdir?
3) Öğretmen adaylarına göre Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirilen materyallerin hazırlanması sürecinde yaşanan sorunlar nelerdir?
4) Öğretmen adaylarının ilerideki mesleki yaşantılarında materyal kullanımına yönelik görüşleri nelerdir?

YÖNTEM

Araştırma, matematik öğretmen adaylarının öğretim teknolojileri ve materyal geliştirme (ÖTMG) dersinde geliştirilen materyallerle ilişkin görüşlerini belirlemek amacıyla yapılan nitel bir araştırmadır. Nitel araştırma, insanların gerçekliğe ilişkin algılarını, görüşlerini ve tanımlarını ortaya koyan güçlü araştırma desenlerinden biridir (Punch, 2005). Bu araştırmada da öğretmen adaylarının ÖTMG dersinde hazırladıkları materyaller konusundaki görüşleri detaylı bir şekilde incelenmiştir.

Çalışma Grubu

Araştırma evrenini 2013-2014 eğitim öğretim döneminde bir devlet üniversitesinin pedagojik formasyon eğitimi sertifika programına devam eden on üç matematik öğretmeni adayı oluşturmuştur. Görüşmeye katılan öğretmen adaylarının 5'i kadın, 8'i ise erkektir. Diğer taraftan öğretmen adaylarının üçü 2013, üçü 2009, ikisi 2008, biri 2006 ve dördü 2004 öğretim yılında lisans eğitiminden mezun olmuşlardır. Görüşmeye katılan öğretmen adaylarına mesleki deneyimleri sorulduğundan birinin hiç deneyimi olmadığı, ikisinin dört yıllık, dördünün altı yıllık, birinin dokuz yıllık, diğerinin on yıllık mesleki deneyimi sahip oldukları ve özel okul, etüt merkezi gibi özel kurumlarda çalıştıkları belirlenmiştir.

Veri Toplama Aracı

Araştırmada veriler, araştırmacılar tarafından geliştirilen yarı yapılandırılmış görüşme formu ile toplanmıştır. Yarı yapılandırılmış görüşme formu ilgili literatürden yararlanılarak hazırlanmış açık uçlu dört sorudan oluşmaktadır. Bu sorular Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersine yönelik öğretmen adaylarının genel görüşlerini, materyal hazırlamada göz önünde bulundurdukları ölçütleri, materyal hazırlamada yaşadıkları zorlukları ve ilerideki mesleki yaşantısındaki materyal kullanımına yönelik görüşlerini içermektedir. Hazırlanılan sorular matematik eğitimi konusunda iki uzmanın görüşüne sunularak görüşme formuna son şekli verilmiştir.

Verilerin Analizi

Verilerin analizinde içerik analizi yapılmıştır. İçerik analizi, birbirine benzeyen verileri belirli kavramlar ve temalar çerçevesinde bir araya getirmek ve bunları okuyucunun anlayabileceği bir biçimde organize ederek yorumlamaktır (Yıldırım ve Şimşek, 2006). Bu aşamada öncelikle görüşme kayıtları bilgisayar ortamına aktarılarak yazılı bir metin haline getirilmiştir. Görüşme metinleri iki araştırmacı tarafından ayrı ayrı okunarak kod ve temalar oluşturuluştur. Daha sonra araştırmacılar bir araya gelerek bağımsızca oluşturulan tema ve kodları incelemişlerdir. Bu incelemeler sonucunda ortak görüş sağlanarak uygun kod ve temalara karar verilmiştir. Bu kapsamda, görüşme yapılan bayan öğretmen adayları K1, K2, K3, K4 ve K5; erkek öğretmen adayları ise E1, E2, E3, E4, E5, E6, E7 ve E8 olarak kodlanmıştır

BULGULAR

Bu bölümde yapılan görüşmeler sonucunda elde edilen veriler araştırmanın alt amaçları doğrultusunda incelenmiştir.

Araştırmanın ilk alt amacı kapsamında, Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde hazırlanılan materyallerle ilişkin öğretmen adaylarının genel görüşleri belirlenmiştir. Yapılan görüşmeler sonucunda elde edilen veriler Tablo 1'de yer almaktadır.

Tablo 1. ÖTMG'de Hazırlanan Materyallere İlişkin Genel Görüşler

Tema	Kod	Alt Kodlar	Öğretmen Adaylarının Kodları	f
Olumlu görüş	Öğrenen açısından	Faydalı olma	E1, E2, E3, E4, E5, E6, E7, E8, K1, K2, K3, K4, K5	13
		Görsellik kazandırma	K1, K3, K4, K5, E1, E3, E4, E5, E7	9
		Kalıcı öğrenme	K1, K5, E2, E5	4
		Günlük hayatta kullanabilme	E2, E3, E7	3
		Eğlenerek öğrenme	E5, E6	2
		Anlamayı kolaylaştırma	K4, E8	2
		Öğrenenin dikkatini çekme	K1	1
	Öğreten açısından	Konunun kolay anlaşılması	K1, K2, K3, K5, E3,E6	6
		Eğlenceli olması	K3, K4, E1, E4, E5, E6	6
		Öğretmeyi kolaylaştırma		5
		Zamandan tasarruf	K1, K3, E6, E8	4
		Yaparak yaşayarak öğretme	E2, E5	2
Olumsuz Görüş	Derslerde etkin kullanamama		K1, E1, E3, E7, E8	5
	Kısıtlı imkan/ zaman		K1, E2, E3	3

Tablo 1 incelendiğinde öğretmen adaylarının görüşleri olumlu ve olumsuz olarak iki temada ele alınmıştır. Olumlu görüşler temasına ilişkin olarak öğretmen adaylarının görüşleri öğrenen ve öğreten açıdan olmak üzere iki kod altında toplanmıştır. Öğrenen açısından öğretmen adaylarının tamamı ÖTMG'de hazırlanan materyallerin faydalı olduğunu, çoğunluğu (9) görsellik kazandırdığını, dördü kalıcı öğrenmeye yardımcı olduğunu, üçü günlük hayatta kullanılabileceğini, ikisi eğlenerek öğrenmeye yardımcı olduğunu, ikisi anlamayı kolaylaştırdığını, biri de öğrenenin dikkatini çektiğini belirtmiştir. Öte yandan aynı temada öğreten açısından öğretmen adaylarının yaklaşık yarısı (6) konunun kolay anlaşılmasına yararlı olduğunu, altısı eğlenceli olduğunu, beşi öğretmeyi kolaylaştırdığını, dördü zamandan tasarruf sağladığını ve ikisi yaparak yaşayarak öğretime yardımcı olduğunu belirtmişlerdir. Bu kapsamda, örneğin K2 kodlu öğretmen adayının görüşü şöyledir; "*…bazı konularda öğrencilere hani aktaramayacağım şeyler olur konu hani zor olur. Yani en azından benim düşündüğümü öğrenciler bilemezler o yüzden materyallerle matematiği anlatım daha yararlı olur, bu durumun benim içinde iyi olacağını düşünüyorum. Yani öğretimi kolaylaştırmak için kullanılabilir..."* (K2).

Öte yandan, Tablo 1'e göre olumsuz görüş teması incelendiğinde öğretmen adaylarının beşi ÖTMG'de hazırlanan materyallerin derslerde etkin kullanılamayacağını, üçü zaman ve imkan açısından sınırlı olduğunu belirtmektedir. Bu yönde görüş belirten E8 kodlu öğretmen adayı görüşünü şu sözlerle ifade etmektedir: "*…Fazla bir şey kazandırmadı açıkçası yani, çünkü normal bildiğimiz şeyi yaptık, öğrenciye anlatmadık ama öğrenciye anlattığımız zaman öğrenciye bir şey kazandırabilir. Yoksa benim açımdan bana ne kazandırabilir?…*" (E8).

Öğretmen adaylarına Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirilen materyallerin hazırlanması sürecinde göz önünde bulundurulan ölçütlerin neler olduğu sorulmuştur. Bu konuda öğretmenlerin görüşleri Tablo 2'de verilmiştir.

Tablo 2. ÖTMG'de Geliştirilen Materyallerin Hazırlık Aşamasına İlişkin Görüşler

Tema	Kodlar	Öğretmen Adaylarının Kodları	f
Hazırlama aşaması	Öğrenciye Faydalı Olma	E1, E2, E3, E4, E5, E6, E7, E8, K1, K2, K3, K4, K5	13
	Kullanışlı Olma	E1, E2, E4, E5, E6, E8, K2, K3, K5	9
	Kazanımlara Uygun Olma	K1, K3, K5, E3, E4, E7, E2	7
	Maliyet Hesabı	E1, K2, E5, E8	4
	Kolay Hazırlanabilme	K2, K4	2
	Orijinal Olma	K1	1
	Çok Amaçlı Olma	E1	1

Tablo 2 incelendiğinde öğretmen adaylarının görüşleri hazırlama aşaması teması altında öğrenciye faydalı olmak, kullanışlı olmak, kazanımlara uygun olmak, maliyette hesaplı olmak, kolay hazırlanabilmek, orijinal olmak ve çok amaçlı olmak üzere yedi kod altında toplanmıştır. Öğretmen adaylarının materyal hazırlamaya yönelik görüşleri incelendiğinde, öğretmen adaylarının tamamının ÖTMG'de hazırlanan materyallerin öğrenciye faydalı olduğu, çoğunluğu (9) kullanışlı olduğu, yarısından fazlası (7) kazanımlara uygun olduğu, dördü maliyette hesaplı olması gerektiği, ikisi kolay hazırlanabilmesi gerektiği, biri orijinal olması gerektiği ve diğer biri de çok amaçlı olması gerektiği yönünde görüş belirtmişlerdir. Materyalin hazırlanması aşamasında öğrenciye faydalı olması gerektiğini belirten öğretmen adaylarından birkaçının görüşünü şu sözlerle ifade etmektedir: "*Çocuklar katı cisimleri öğrenmekte hayal etmekte gerçekten zorlanıyorlar. Çünkü içini göremiyorlar benim yaptığım küp şeffaf bir küp, üstü açık gayet net olarak öğrenci cisim köşegeni nasıl geliyor, nereden geçiyor, işte nasıl dik üçgen oluşturuyor daha rahat kavramaları için bu materyali hazırladım*"(K3), "*Şimdi öğrencilere Pisagor bağıntısını anlattığımda öğrenciler direk uzaydan düşmüş gibi algılıyor yani bu nereden geldi anlamıyorlar. Böyle olunca da ileride ne yapılır ezberliyor, sorularda ne yapacağını bilmiyor onu nasıl kullanacağını bilmiyor. En azından görsel bir şeyler verirsek öğrencinin eline daha faydalı olur diye düşünüyorum yani.*"(E7). Materyalin hazırlanması aşamasında kullanışlılığına dikkat çeken öğretmen adaylarından biri görüşünü şu sözlerle ifade etmektedir: "*Daha çok kullanışlı olmasına dikkat ettim. Çünkü öğrenciler trigonometri konusunu zor anladığı için anlattığım yöntem sayesinde akılda kalıcı her zaman herkesin yapabileceği yöntem olarak düşündüm. Mesela sinüs cosinüs tanjant kotanjant değerlerini ezberlemek yerine benim yaptığım yöntem sayesinde daha kolay öğrenilir ve her zaman kullanışlı olduğunu düşünüyorum*."(K5).

Öğretmen adaylarına Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirilen materyallerin hazırlanmasındaki sorunların neler olduğu sorulmuştur. Bu konuda öğretmenlerin görüşleri Tablo 3'te verilmiştir.

Tablo 3. ÖTMG'de Geliştirilen Materyallerin Hazırlanmasına Yönelik Sorunlar ve Buna İlişkin Dağılım

Tema	Kod	**Öğretmen Adaylarının Kodları**	f
ÖTMG Sürecinde Yaşanan Sorunlar	El Becerisi	K1, K2, K3, K4, E1, E4, E5, E7, E8	9
	Malzeme Seçimi	K1, K3, K4, E2,E3, E4, E8	7
	Çok Süre Alması	K1, K2, K4, K5	4

Tablo 3 incelendiğinde öğretmen adaylarının görüşleri ÖTMG sürecinde yaşanan sorunlar teması altında el becerisi, malzeme seçimi ve çok süre alması olmak üzere üç kod altında toplanmıştır. Öğretmen adaylarının materyal hazırlanmasına yönelik sorunlar ile ilgili görüşmelerin kodlarına bakıldığında öğretmen adaylarının çoğunluğu (9) el becerisi, yarıya yakını (7) uygun malzeme seçimi, dördü çok süre alması üzerine görüş belirtmişlerdir. Materyalin hazırlanmasına yönelik sorunlarda el becerisinin önemini belirten öğretmen adaylarından biri görüşünü şu sözlerle ifade etmektedir: "*... Sadece zarfları eşit boyutta hazırlayamamıştım. Yani birisi büyük birisi küçük olunca göze hoş gözükmüyordu. Yani tek sorun oydu işte onu eşit yapıncaya kadar çok uğraştım. Sonra bir tane yaptım kalanları da ondan kopyaladım*." (E1). İkinci olarak materyalin hazırlanmasına yönelik sorunlarda malzeme seçiminin önemli olduğunu belirten öğretmen adaylarından biri görüşünü şu şekilde belirtmiştir: "*Rulo şeffaf masa örtüsü kıvrık olduğu için bayağı da bir kalın yapısı var. Biraz kıvrık durdu ne kadar uğraşsam da sıcak suya da ıslattım… Acaba şeklini düzeltebilir miyim diye öbür tarafa çevirsem de yine kutu olarak küp olarak yaptığımda da biraz kıvrılmalar oldu. Sadece o oldu problem.*"(K3), " Öğretmen adaylarına ilerideki mesleki yaşantılarında materyal kullanımına yönelik görüşlerinin neler olduğu sorulmuştur. Bu konuda öğretmenlerin görüşleri Tablo 4'te verilmiştir.

Tablo 4. Öğretmen Adaylarının İlerideki Mesleki Yaşantılarında Materyal Kullanımına Yönelik Görüşleri

Tema	Kod	Alt Kodlar	Öğretmen Adaylarının Kodları	f
Mesleki Yaşantıda Kullanımı	Evet	Kalıcı Öğrenmeyi Sağlama	K1, K4, E2, E3, E4, E5, E7,	7
		Konunun Daha Anlaşılır Olmasını Sağlama	K3, E7	2
	Bazen	Konuya Göre Uygun Materyal Kullanma	K2, E3	2
	Hayır	Öğrencinin Yaş Grubuna Uygun Olmaması	E1	1
		Zamanın Kısıtlı Olması	K5	1

Tablo 4'e göre öğretmen adaylarının ilerideki mesleki yaşantılarında materyal kullanımına yönelik görüşleri evet, bazen ve hayır olmak üzere üç kod altında toplanmıştır. Buna göre, öğretmen adaylarının yedisi materyallerin öğrencinin kalıcı öğrenmesine katkı sağladığını, ikisi konunun daha anlaşılır olmasını sağladığını belirtmişlerdir. Örneğin E7 kodlu öğretmen adayının görüşü şöyledir; "*Yani sınıf içinde kullanılması taraftarıyım yani bütün materyaller kullanılmalı. Yani direk anlatınca havada kalıyor dediğim gibi ama şekli direk verirsek öğrencinin eline mesela direk formüllerle değil de silindirin hacmi taban alanı çarpı yüksekliktir, koninin hacmi, ise bunun üçte biridir derken elimizde bir tane silindir alıp bir tane koni alsak içine suyu doldursak silindirin şey yapsak bu şekilde öğrencinin daha çok aklın da kalır…*"

İleriki mesleki yaşantılarında materyalleri ara sıra kullanacaklarını belirten öğretmen adaylarının ikisi konuya göre uygun materyal kullanmayı tercih ettiklerini belirtmiştir. Örneğin E8 kodlu öğretmen adayının görüşü şöyledir;" *Şimdi ileride bu tür hazırlayacağımızı zannetmiyorum ama yani direk konuyu anlatacağımı düşünüyorum. Ama belki geometri olsun üç boyutlu şekillerde belki orada olabilir. .. çarpanlara ayırmada olabilir yani öğrencinin biraz daha soyut olan konularda, algılayamayacağı yerlerde belki kullanabiliriz. E sürekli de aynı materyal zaten evde olacağı için sürekli kullanabilirsin her sene o yüzden her sene ayrı bir materyal yapmana gerek yok zaten konumuz her zaman için aynıdır o yüzden aynı konuyu aynı materyalle devam edebiliriz yani. Bir kere hazırlasak emekli olana kadar devam aynı konuyu. O şekilde olur"*

İleriki mesleki yaşantılarında materyalleri kullanmayacaklarını belirten öğretmen adaylarının biri öğrencinin yaş grubuna uygun olmadığını ve biri de zamanın kısıtlı olduğunu belirtmiştir. Örneğin E1 kodlu öğretmen adayının görüşü şöyledir; "*Ben çok fazla kullanmayı düşünüyorum.. Özellikle daha küçük sınıflarda ana okul, ilköğretim, ortaokul, olabilir ama lise için çok uygun değil.*"

SONUÇLAR ve ÖNERİLER

Matematik öğretmen adaylarının Öğretim Teknolojileri ve Materyal Geliştirme (ÖTMG) dersinde geliştirilen materyallerle ilişkin görüşlerini incelemek amacıyla yapılan bu çalışmada öğretmen adaylarının olumlu görüşlere sahip oldukları sonucuna ulaşılmıştır. Materyallerin hazırlanma aşamasına ilişkin olarak öğretmen adayları en çok öğrenciye faydalı olmasına, kullanışlı olmasına, kazanımlara uygun olmasına dikkat ettikleri açıkça görülmektedir. Öte yandan, materyallerin hazırlanma aşamasında öğretmen adaylarının en çok el becerisi, malzeme seçimi ve süre açısından sorun yaşadıkları araştırmadan elde edilen diğer bir sonuçtur. Son olarak da öğretmen adaylarının ÖTMG'de Geliştirilen Materyalleri ilerideki mesleki yaşantılarında da kullanabilecekleri araştırma sonuçlarından da açıkça görülmektedir. Ancak bu çalışmada elde edilen veriler çalışma grubuna dahil edilen matematik öğretmen adaylarının görüşleri doğrultusunda incelenmiştir. İleride daha geniş bir örneklem üzerinde nicel araştırmalar da yapılabilir.

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THE PERCEPTION OF ENVIRONMENTAL KNOWLEDGE AND ENVIRONMENTAL PROBLEMS FROM PRIMARY TO HIGHER EDUCATION

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ABSTRACT: In this study, the point of view of the students who are attending their education in primary first stage and second stage schools, middle schools and high schools in North Cyprus to the environmental facts and their case of recognizing environmental problems and awareness were tried to be specified according to their cognitive enhancement. The study was conducted in the case study design proper to qualitative research methods. The study group was formed from students chosen from one primary school, one secondary school, one high school and one university which were assumed to have higher success levels. The "Environmental Knowledge and Perception of Environmental Problems Interview Form" was prepared as structured by the researcher and it was filled by means of interviewing students in person. The data gained were analyzed in the direction of qualitative research techniques by means of coding. At the end of the study, it is found that the environmental perception of students differ according to the cognitive enhancement, and some advice were given to the Textbook Commission of North Cyprus Ministry of National Education, academicians, teachers, non-governmental organizations and parents.

Keywords: primary school, secondary school, higher education, environmental perception, environmental education

İLKÖĞRETİMDEN YÜKSEKÖĞRETİME ÇEVRE BİLİNCİ VE ÇEVRE SORUNLARI ALGISI

ÖZET: Bu çalışmada, Kuzey Kıbrıs'ta öğrenimlerine devam eden ilköğretim I. kademe, ilköğretim II. kademe, ortaöğretim ve yükseköğretim öğrencilerinin çevre olgusuna bakış açıları ile çevre temalı problemleri tanıma durumları, bilişsel gelişimleri doğrultusunda belirlenmeye çalışılmıştır. Araştırma, nitel araştırma yöntemine uygun olarak, durum çalışması deseninde yürütülmüştür. Çalışma grubu Kuzey Kıbrıs'ın eğitim sistemine göre başarı seviyeleri yüksek olduğu varsayılan bir ilkokul, bir ortaokul, bir lise ve bir yükseköğretim kurumu öğrencilerinden oluşturulmuştur. Araştırmada kullanılan "Çevre Bilinci ve Çevre Sorunları Algısı Görüşme Formu" araştırmacı tarafından yapılandırılmış olarak hazırlanmış ve öğrencilerle bizzat görüşülerek doldurulmuştur. Elde edilen veriler kodlanmak suretiyle nitel araştırma teknikleri kuralları doğrultusunda analiz edilmiştir. Çalışmanın sonucunda öğrencilerin çevre algılarının gelişim düzeylerine göre değişiklik gösterdiği bulunmuş, Kuzey Kıbrıs Milli Eğitim Bakanlığı Kitap Komisyonuna, akademisyenlere, öğretmenlere, sivil toplum örgütlerine ve anne babalara yönelik önerilerde bulunulmuştur.

Anahtar sözcükler: ilköğretim, ortaöğretim, yükseköğretim, çevre algısı, çevre eğitimi

GİRİŞ

21. yüzyılın küresel bilgi dünyası, ekonomiyi, politikayı, sosyal olguları, teknolojiyi ve bilginin artan önemini yeniden düşünmeyi gerektirmenin yanı sıra, ekolojiyi de yeniden düşünmeyi ve globalleşme eğiliminin bir parçası olarak ele almayı gerektirmektedir. Çevre sorunları, günümüzde çok tartışılan, çözüm bekleyen ve tüm insanlığı ilgilendiren bir konu haline gelmiştir. Bireylerin bu konuya ilişkin farkındalık geliştirmesi ve buna yönelik tedbir alması sorunların çözümünde önemli bir adım olarak görülmektedir. Bu bakış açısından hareketle, bireylerde özellikle de gençlerde çevresel farkındalık yaratma ve çevreyi koruma bilinci oluşturma konuları akademik çalışmalarda da yerini almaya başlamıştır (Tunç, Ömür ve Düren, 2012).

Çevreye ilişkin bireysel davranışlar, kişinin tutum ve inançlarından etkilenmektedir. Ancak aynı zamanda çevreyi ele alış şekli bir ahlaki mesele olarak da görülmektedir. Çevresel farkındalığı olan ve çevresel sorunların kendisine etkisinin kaygısında olan bireylerin, yaşamlarını sürdürürken her faaliyetlerinde çevreyi önemseyerek davranması beklenmektedir. Zira bireylerin çevreye yönelik davranışları, çevreye duyarlılıklarının bir yansımasıdır (Gadanne, Kennedy ve Mckeiver, 2009).

Çevre Bilinci, çevre ile ilgili kararları, ilkeleri, yorumları içeren düşüncelerin, yaşama aktarılması olan davranışlar ve bunlarla ilgili olan çeşitli duygulardır (Türk, 2011). Çevre bilincinin kazandırılmasında eğitim programlarının başlıca önemi bulunmaktadır. Çevre eğitimi, çevrenin korunması için tutumların, değer yargılarının, bilgi ve becerilerin geliştirilmesi ve çevre dostu davranışlarının gösterilmesi ve bunların sonuçlarının görülmesi sürecidir (Özpınar, 2010). Doğal güzelliklerin korunması, çevre sorunlarına ortak bir algı geliştirilmesi ve temiz, sağlıklı bir gelecek oluşturulması, eğitime gereken önemin verilmesi ile sağlanabilir (Fırat, Kiraz ve Sepetçioğlu, 2012). Kiziroğlu (2001), çevre eğitimi ile ilgili aşağıdaki yargılara varmıştır:

- Çevre eğitimi, bireyin ekolojik davranış biçimini şekillendirir,
- Çevre eğitimi, okulda öğrencilerden istenen doğal, sosyal ve yapay çevre ile olan davranış ilişkilerini kapsar,
- Çevre eğitimi okulda sorunların çözümü için gerekli yeteneğin öğrenciye kazandırılmasına yardımcı olur, ileride siyasi yaşama katılımını sağlar,
- Çevre eğitiminin interdisipliner düzeyde verilmesi gerekir,
- Çevre eğitimini öğrenci, aile, kitle iletişim organları, sivil toplum örgütleri, okul yönetimi ve öğretmenler birlikte çalışarak şekillendirmelidir.

Kuzey Kıbrıs'ta mevcut olan 4 ve 5 yaş kapsamındaki öğrencilerin programlarında yürütülen "Sosyal Çevremiz" dersinde; ilgili yaş grubuna uygun çevre konusuna yer verilmekte, 5 ve 6 yaş grubunda aynı derse devam edilmekte ve bu ders etkinliklerle (Fen-Doğa Etkinliği) pekiştirilip güçlendirilmeye çalışılmaktadır. İlköğretim, 1, 2 ve 3. sınıflarda önceleri "Çevre, Doğa ve Trafik" dersi varken, daha sonraları bu ders müfredattan kaldırılmıştır. Şu an hayat bilgisi dersi içerisinde, çevre konuları sarmal olarak ilgili ünitelerde verilmektedir. 4 ve 5. sınıflarda sosyal bilgiler dersi kapsamında "Teknoloji ve Çevre" adı altında çevre konularına yer verilmekte ve teknolojinin çevreye fayda ve zararları irdelenmektedir.

Kolejlerin orta bölümleri olan 6 ve 7. sınıflarda "Foundation Science to GCSE" isimli fen dersinde çevre ile ilişkili olarak, besin zincirleri, habitatlar, adaptasyonlar, mikroplar ve çevre, geri dönüşüm, hava kirliliği konularına yer verilmektedir. Klasik ortaokulların 6. sınıflarındaki fen ve coğrafya derslerinin ilgili ünitelerinde çevre konularına yer verilmekte, 8. sınıfların fen derslerinde ise, çevre sorunları, çevre ve biz, Dikmen çöplüğü, CMC gibi problemler irdelenmektedir. 7. sınıflarda fen dersi ünitelerinde ekosistemler, biyolojik çeşitlilik, çevre sorunları ve etkileri üzerinde durulmaktadır. 9. sınıflarda ise haftada üç saat olan biyoloji dersinin bir saati çevre ve sağlık bilgisine ayrılmıştır. Aynı zamanda 9, 10, 11 ve 12. sınıflarda coğrafya, biyoloji, kimya derslerinde çevre konularına ünite içlerinde yer verilmektedir (Fırat, Gündüz ve Kiraz, 2011).

Lisans düzeyinde çevre temalı dersler müfredatta gerektiği kadar yerini bulamamıştır. Eğitim fakültelerinde yapılanma çalışmaları neticesinde 2006 yılı sonunda okutulan dersler yeniden oluşturulmuştur. Bu süreçte eğitim fakültesi ilköğretim bölümü sınıf öğretmenliği anabilim dalında okutulan "Çevre Bilimi" dersi yerini "Çevre Eğitimi" dersine bırakmıştır. Yeni programda çevre eğitimi dersinde bireyleri çevreye daha duyarlı hale getirmek, onlara ekolojik kavramları öğretmek, çevre kirliliğini daha yakından tanıtmak gibi temel konular ele alınmaya çalışılmıştır (Bozkurt, 2010; Fırat, 2013). Hızla ilerleyen çevre sorunlarının paralelinde sadece eğitim fakültelerinde ve sadece sınıf öğretmenliği anabilim dalında, haftada 2 saat olarak uygulanan bu dersin öğrenciye ne kadar duyarlılık, bilinç ve davranış katacağı tartışılacak bir konudur.

Bu çalışmanın amacı Kuzey Kıbrıs'ta öğrenimlerine devam eden ilköğretim I. kademe, ilköğretim II. kademe, ortaöğretim ve yükseköğretim öğrencilerinin çevre olgusuna bakış açılarını, algılarını ve çevre temalı problemleri tanıma durumlarını, bilişsel gelişim düzeyleri ve eğitim seviyeleri paralelinde belirlemektir. Algı, dış dünyadan gelen uyarıların zihinsel olarak yorumlanmasıdır. Algılar görüleni, yorumlananı, inanılanı ve davranılanı gösterirler (Arkonaç, 1998). Bu minvalde öğrencilerin çevre bilinçleri ve çevre sorunlarına yönelik algıları öğrencilerin bilişsel gelişimleri doğrultusunda belirlenmeye çalışılmıştır.

YÖNTEM

Kuzey Kıbrıs'ta öğrenimlerine devam eden ilköğretim I. kademe, ilköğretim II. kademe, ortaöğretim ve yükseköğretim öğrencilerinin çevre olgusuna bakış açıları ile çevre temalı problemleri tanıma durumları ve farkındalıklarının, bilişsel gelişimleri doğrultusunda belirlenmesi amacı ile yapılan bu çalışma, nitel araştırma yöntemine uygun olarak, durum çalışması deseninde yürütülmüştür. Nitel araştırma, insanoğlu ve sosyal yaşam ile ilgili sorunları kendine has yöntem ve metotlarla sorgulayarak anlamlandırma sürecidir (Creswell, 1998). Nitel araştırma yapan araştırmacı; gözlem, görüşme ve dökümanlardan yola çıkarak kavram, anlam ve ilişkileri açıklayıp süreci sürdürür (Merriam, 1998). Durum çalışması deseni, belirli miktarlarda değişkeni inceleyerek belirli kuralları uygulamak yerine, tek bir durum veya olayın derinlemesine boylamsal olarak incelenmesini içerir. Desende, gerçek ortamda neler olduğuna bakma, sistematik olarak verileri toplama, analiz etme ve sonuçları ortaya koyma süreçleri işler (Lawrance and William, 1991).

Çalışma, 5. sınıf öğrencisi 21 kişi, 8. sınıf öğrencisi 21 kişi, 12. sınıf öğrencisi 16 kişi ve lisans 5. sınıf öğrencisi 20 kişi olmak üzere toplamda 78 kişi ile yürütülmüştür. Okullar, akademik homojenliği sağlaması düşüncesiyle, Kuzey Kıbrıs'ta başarılı listesinde kabul edilen okulların son sınıf öğrencilerinden oluşturulmuştur. Çalışma grubunun dağılımı tablo 1'de verilmiştir.

Tablo 1. Katılımcıların Eğitim Gördükleri Okul ve Sınıflara Göre Dağılımı

Okul	**f**	**%**
Girne 23 Nisan İlkokulu 5. Sınıf	21	26,92
Güzelyurt Türk Maarif Koleji 8. Sınıf	21	26,92
Güzelyurt Türk Maarif Koleji 12. Sınıf	16	20,51
Yakın Doğu Üniversitesi Coğrafya Öğretmenliği 5. Sınıf	20	25,64
Toplam	**78**	**100**

Çalışmada araştırmacı tarafından yapılandırılmış olarak geliştirilmiş "Çevre Bilinci ve Çevre Sorunları Algısı Görüşme Formu" kullanılmıştır. Form, araştırmacı tarafından bizzat uygulanmış, elde edilen veriler nitel araştırma yöntemlerine uygun olarak kodlanmak suretiyle analiz edilmiştir. Veriler SPSS 17.00 programı ile bilgisayara aktarılmış, frekans ve yüzde tablolarıyla yorumlanmıştır.

BULGULAR VE YORUM

Katılımcıların "Çevre Kavramından Ne Anlıyorsunuz?" Sorusuna Verdikleri Cevaplar

Tablo 2'de çalışmaya örneklem olarak seçilen ilkokul, ortaokul, lise ve üniversitenin son basamağında öğrenim gören öğrencilerin "Çevre kavramından ne anlıyorsunuz?" sorusuna verdiği cevapların analizi görülmektedir.

Tablo 2. "Çevre Kavramından Ne Anlıyorsunuz?" Sorusuna Verilen Cevapların Frekans Dağılımı

TEMALAR	**İLKOKUL**		**ORTAOKUL**		**LİSE**		**ÜNİVERSİTE**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Canlı	4	19	6	29	2	13	5	25
Canlı Cansız	12	57	8	38	12	75	10	50
Cansız	5	24	7	33	2	13	5	25
TOPLAM	**21**	**100**	**21**	**100**	**16**	**100**	**20**	**100**

Katılımcıların çevre kavramını nasıl algıladıkları ile ilgili soruya verdikleri cevapların yüzde frekansları incelendiğinde, ilkokul 5. sınıfların %19'unun canlı, %57'sinin canlı ve cansız, %24'ünün de cansız kavramıyla nitelendirdikleri görülmektedir. Ortaokul 8. sınıflarda ise %29'u canlı, %38'i canlı ve cansız, %33'ü ise cansız tanımları vermişlerdir. Lise 12. sınıfların %13'ü canlı, %75'i canlı ve cansız, %13'ü ise canlı olarak algıladıklarını, üniversitede ise 5. sınıfların %25'i canlı, %50'si canlı ve cansız, %25'i ise cansız olarak algıladıklarını söylemişlerdir. Bu sonuç araştırmaya katılan katılımcıların çoğunluğunun çevre algılarının canlı ve cansız çevreyi kapsadığını göstermektedir. "Canlı – cansız" kavramı çevre tanımlamasında kabul edilen iki temel unsurdur. Ilkokul öğrencilerinden biri (İ32) bu soruya "içinde yaşadığımız, her türlü ağacın çiçeklerin olduğu, bol bol temiz oksijen bulunan, doğal güzellikleri olan, dağı ovası olan yer" olarak görüş bildirmiştir. Üniversite son sınıfta öğrenim gören bir başka katılımcı ise (Ü2) çevreyi "insanın doğayla bir bütün olarak yaşamını sürdürdüğü alandır" şeklinde tanımlamıştır. Bu sonucun yanında elde edilen bir diğer çarpıcı sonuç, ilkokul öğrencilerinin doğru cevabı daha yüksek katılımla vermiş olmalarıdır (%57). Bu neticenin ilkokul eğitim programında çevre temalı derslerin net, açık ve etkinliklerle desteklenmiş şekilde verilmesinden ve çocuğun gelişimsel olarak henüz hassasiyetinin güçlü olmasından kaynaklandığı düşünülmektedir.

Katılımcıların "Çevrenizde Kirlilik Var Mı?" Sorusuna Verdikleri Cevaplar

Tablo 3'te öğrencilerin "Çevrenizde kirlilik var mı?" sorusuna verdikleri cevapların analizleri görülmektedir.

Tablo 3. "Çevrenizde Kirlilik Var Mı?" Sorusuna Verilen Cevapların Frekans Dağılımı

TEMALAR	**İLKOKUL**	**ORTAOKUL**	**LİSE**	**ÜNİVERSİTE**

	N	%	N	%	N	%	N	%
Evet	21	100	20	95	16	100	20	100
Hayır	0	0	1	5	0	0	0	0
Toplam	**21**	**100**	**21**	**100**	**16**	**100**	**20**	**100**

Araştırmaya katılan tüm katılımcıların bu soruya yüksek oranda "evet" dediği belirlenmiştir (ilkokul %100, ortaokul %95, lise %100 ve üniversite %100). Bu sonuç öğrencilerin gelişim düzeyi farketmeksizin, çevre kirliliği farkındalıklarının yüksek olduğunu göstermektedir. Bu durumun ortaya çıkmasında aile ve okul eğitiminin yanında sosyal uyaranların da etkisinin olduğu düşünülmektedir. Öğrenciler bu soruya genellikle "evet var, yere atılan çöpler, pet şişeler, ambalajlar, sigaralar, gürültüler, bakır madeni atığı" gibi olağan yanıtlar verirken, bir ortaokul öğrencisi (O50) görüşünü şu şekilde belirtmiştir: "var, belediye grev yapıyor, çöpler birikiyor, çevre kirliliği oluyor".

Katılımcıların "Kirleten Öder İlkesinden Ne Anlıyorsunuz?" Sorusuna Verdikleri Cevaplar

Tablo 4'te katılımcıların "Kirleten öder ilkesinden ne anlıyorsunuz?" sorusuna verdikleri cevapların frekans dağılımları görülmektedir.

Tablo 4. "Kirleten Öder İlkesinden Ne Anlıyorsunuz?" Sorusuna Verilen Cevapların Frekans Dağılımı

TEMALAR	İLKOKUL		ORTAOKUL		LİSE		ÜNİVERSİTE	
	N	%	N	%	N	%	N	%
İkiside	0	0	1	5	0	0	0	0
Manevi	13	62	10	48	5	31	2	10
Para	8	38	9	43	10	63	13	65
Cevap Vermedi	0	0	1	5	1	6	5	25
Toplam	**21**	**100**	**21**	**100**	**16**	**100**	**20**	**100**

Tablo incelendiğinde, "manen öder" anlayışının yaş arttıkça azaldığı görülmektedir (5. sınıf %62, 8. sınıf %48, 12. sınf %31ve üniversite 5. sınıf %10). Bu çarpıcı sonuç, daha önce bahsi geçen çocukların hassasiyetlerinin ve duygusallıklarının güçlü olduğu noktasını desteklemektedir. Çocuklar "kirleten öder" kavramını maddi ceza olarak değil, kişisel zarar olarak yorumlamışlardır. Yaş arttıkça, maneviyatın maddiyata dönüştüğü çevre konusunda da değişmemektedir: "hükümetimizin koyması gereken yasalardan biridir, çevremizi kirletenlerin ağır cezalar ödemeleri gerekir, yaptıkları suçun bir bedelinin olması gerekir" (Ü4), "gün gelince o yerlere çöp atanlar, o kirlettiği havayı soluyacak" (O49), "doğa birgün bize bunu ödettirir" (İ25). Cevaplar bilincin arttığını da göstermektedir: "dünyamızdaki kapitalist sistemde en fazla kirleten büyük şirketlerdir, çevre ile ilgili problemlerde ilk önlemi büyük şirketler almalıdır (Ü14), "herkes yaptığından sorumludur, insanlar çevreyi kirletiyor ve bunu da acı bir şekilde ödüyor, küresel ısınma bunun kanıtıdır" (O43).

Katılımcıların "Sizce Toplumumuzun Çevre Konusunda Duyarlılığı Nasıldır?" Sorusuna Verdikleri Cevaplar

Tablo 5'te katılımcıların "Sizce çevre konusunda toplumumuzun duyarlılığı nasıldır" sorusuna verdikleri cevapların frekans dağılımı görülmektedir.

Tablo 5. "Sizce Toplumumuzun Çevre Konusunda Duyarlılığı Nasıldır" Sorusuna Verilen Cevapların Frekans Dağılımı

TEMALAR	İLKOKUL		ORTAOKUL		LİSE		ÜNİVERSİTE	
	N	%	N	%	N	%	N	%
Az	19	90	14	67	16	100	16	80
Çok	2	10	2	10	0	0	2	10
Orta	0	0	5	24	0	0	2	10
Toplam	**21**	**100**	**21**	**100**	**16**	**100**	**20**	**100**

Tablodan görüldüğü gibi tüm gelişim seviyelerinde toplumun çevre duyarlılığı "az" olarak algılanmıştır. 5. sınıfta %90, 8. sınıfta %67, 12. sınıfta % 100, üniversite 5. sınıf %80). Genelde arabalardan atılan çöplerden, piknik alanlarında bırakılan cam kırıklarından, kesilen ağaçlardan, toplu taşıma araçlarının yetersizliğinden bahsedilmiştir. Bir ilkokul ve bir lise öğrencisinin görüşleri şu şekildedir: "iyi değildir, çünkü yere çöp atanlar uyarılmıyor, toplum bilinçlendirilmiyor" (İ32), "bence toplum olarak duyarlı değiliz, sadece yaşamak için yaşıyoruz, çevreyi koruyup gelecek nesillere aktarmayı düşünmüyoruz, işimize nasıl geliyorsa öyle kullanıyoruz doğayı, ağaçları kesip yol yapmak gibi (L68).

Katılımcıların "Sizce Sizin Çevre Konusunda Duyarlılığınız Nasıldır" Sorusuna Verdikleri Cevaplar

Tablo 6'da katılımcıların "Sizce sizin çevre konusunda duyarlılığınız nasıldır?" sorusuna verdikleri cevapların frekans dağılımı görülmektedir. Tablodan anlaşılacağı üzere 5, 8 ve 12. sınıf öğrencileri çoğunlukla kendilerini "orta düzeyde duyarlı" gördüklerini belirtmişlerdir (5. sınıf %52, 8. sınıf %52, 12. sınıf %63). Fakat üniversite son sınıf öğrencilerinin %60'ı kendilerini "çok duyarlı" olarak nitelendirmişlerdir.

Tablo 6. "Sizce Sizin Çevre Konusunda Duyarlılığınız Nasıldır?" Sorusuna Verilen Cevapların Frekans Dağılımı

TEMALAR	İLKOKUL		ORTAOKUL		LİSE		ÜNİVERSİTE	
	N	%	N	%	N	%	N	%
Az	1	5	2	10	3	19	0	0
Çok	9	43	8	38	3	19	12	60
Orta	11	52	11	52	10	63	7	35
Cevap Vermedi	0	0	0	0	0	0	1	5
Toplam	**21**	**100**	**21**	**100**	**16**	**100**	**20**	**100**

İlkokul ve ortaokul öğrencileri kendilerini "çok" ya da "orta düzeyde duyarlı" görürken, genelde yerlere çöp atmamaktan, çöp kutusu yoksa çikolata ambalajlarını ceplerinde sakladıklarından bahsetmişlerdir. Gelişim düzeyi arttıkça cevaplar, ağaç dikme, yenilenebilir enerjiler, ozon dostu deodorantlar gibi diğer çevre koruma temalarına kaymıştır. Fakat kendini "az duyarlı" olarak nitelendiren bir lise öğrencisinin cevabı hayli umutsuzdur: "azdır, çünkü toplumda duyarlılık oluşmadı, ben de çok olsa bile toplumu düzeltemem" (L75). Sistemi eleştirenler de vardır: "çok duyarlı değilim, orta, bunun sebebi tamamen biz değiliz, yeni açılan kapalı çarşının önünde bir çöp kovası bile yok" (L72), "en ufak bir çevre kirliliğinde gazeteleri haberdar ederek belediyelerin ve belediye meclis üyelerinin deşifre edilmesini sağlarım, çevremizi gelecek nesillere aktarmak için bunu görev sayarım (Ü16).

Katılımcıların "Kuzey Kıbrıs'ta Çevre Sorunları Nasıl Çözülür?" Sorusuna Verdikleri Cevaplar

Tablo 7'de katılımcıların, "Kuzey Kıbrıs'ta çevre sorunları nasıl çözülür?" sorusuna verdikleri cevapların frekans dağılımları sunulmuştur. Öğrenclerin verdikleri cevaplar ceza, eğitim, eylem, siyasi kodları altında temalaştırılmıştır.

Tablo 7. "Kuzey Kıbrıs'ta Çevre Sorunları Nasıl Çözülür?" Sorusuna Verilen Cevapların Frekans Dağılımı

TEMALAR	İLKOKUL		ORTAOKUL		LİSE		ÜNİVERSİTE	
	N	%	N	%	N	%	N	%
Ceza	0	0	3	14	0	0	0	0
Ceza Eğitim	0	0	1	5	3	19	2	10
Eğitim	20	95	11	52	9	56	7	35
Eğitim Eylem	1	5	4	19	1	6	4	20
Eğitim Siyasi	0	0	0	0	1	6	1	5
Eylem	0	0	2	10	0	0	2	10
Siyasi	0	0	0	0	2	13	3	15
Cevap Vermedi	0	0	0	0	0	0	1	5
Toplam	**21**	**100**	**21**	**100**	**16**	**100**	**20**	**100**

Tablodan da görüldüğü gibi, tüm sınıf ve okul türlerinde büyük oranda Kuzey Kıbrıs'ta çevre sorunlarının eğitim yolu ile çözülebileceği algısı hakim olup sınıflar büyüdükçe alınan eğitim ve çevre farkındalıklarının artması ile eylem, siyasi ve ceza gibi unsurların da belirdiği görülmektedir. İlkokul 5. sınıf öğrencilerinin %95'i gelişim düzeyleri gereği "eğitimle çözülür" düşüncesini geliştirmişlerdir: "insanlar bilinçlendirilmelidir" (İ29). Yaş arttıkça farklı çözüm önerileri de geliştirlmiştir: "okullarda konferanslar verilerek, etrafa çevre ile ilgili afişler asarak, çevre kirliliğine yol açan iş yerlerine ceza keserek (O55), "reklamlarla ve insanların eylemleriyle farkındalık yaratmaya çalışılmalı, ilgili bakanlık yasa koymalı" (L71), "devlet önlem almalı, ağır cezalar vermeli, sanayi bacalarına filtreler takılmalı, yeşil alanlar korunmalı, çevre bilinci oluşturulmalı, seminerler konferanslar verilmeli" (Ü4).

Katılımcıların "Siz Çözüm İçin Ne Yapıyorsunuz?" Sorusuna Verdikleri Cevaplar

Tablo 8'deki, araştırmaya katılan tüm katılımcıların "Siz çözüm için ne yapıyorsunuz?" sorusuna verdikleri cevapların frekans dağılımlarına bakıldığında daha çok bireysel çözümlerin öne sürüldüğü anlaşılmaktadır. Sınıflar büyüdükçe, kişisel çabaların yanında etkinliklerle çözüme ulaşılması söz konusudur. Eğitimin artmasına paralel olarak, çevre bilincinin de oluşması ile tutum gelişmekte ve çevre sorunlarının çözümü için farkındalık yükselmektedir.

Tablo 8. "Siz Çözüm İçin Ne Yapıyorsunuz?" Sorusuna Verilen Cevapların Frekans Dağılımı

TEMALAR	İLKOKUL		ORTAOKUL		LİSE		ÜNİVERSİTE	
	N	%	N	%	N	%	N	%
Etkinlik	0	0	1	5	1	6	4	20
Etkinlik Kişisel	0	0	5	24	1	6	1	5
Kişisel	21	100	15	71	9	56	14	70
Cevap Vermedi	0	0	0	0	5	31	1	5
Toplam	**21**	**100**	**21**	**100**	**16**	**100**	**20**	**100**

5. sınıfta sadece "yere çöp atmam" türünde yanıtlar verilirken, yaş düzeyi arttıkça yanıtların "yere çöp atmam, atanları uyarırım, ozon dostu ürünler kullanırım, çevre etkinliklerine katılırım" türünde geliştiği görülmüştür. Bir ortaokul öğrencisi görüşünü şu şekilde dile getirmiştir: "çöplerimi çöpe atıyorum, toplu taşıma araçlarını kullanıyorum, çevremdekileri uyarıyorum" (O56). Üniversite öğrencilerinin düşünceleri daha geniş bulunmuştur: "sosyal sorumluluk projelerine katılıyorum" (Ü1). Bilincin ve farkındalığın yaş ve eğitim düzeyi ile birlikte arttığı aşikardır.

SONUÇ

Bu çalışmanın amacı Kuzey Kıbrıs'ta öğrenimlerine devam eden ilkokul 5. sınıf, ortaokul 8. sınıf, lise 12. sınıf ve üniversite 5. sınıf öğrencilerinin çevre olgusuna bakış açılarının, çevre temalı problemleri tanıma durumlarının ve çevre algılarının, bilişsel gelişimleri doğrultusunda belirlenmesidir. Çalışmada araştırmacı tarafından geliştirilen "Çevre Bilinci ve Çevre Sorunları Algısı Görüşme Formu" kullanılmıştır. Çalışmada elde edilen sonuçlar aşağıda sunulmuştur.

Araştırmada kullanılan görüşme formunun ilk sorusu olan "Çevre kavramından ne anlıyorsunuz" sorusuna verilen cevaplardan katılımcıların çoğunluğunun çevre algılarının canlı ve cansız çevreyi kapsadığı anlaşılmıştır. "Canlı ve cansız çevre" kavramı, çevre tanımlamasında kabul edilen iki unsurdur. Bu sonucun yanında elde edilen bir diğer çarpıcı sonuç ise, ilkokul öğrencilerinin doğru cevabı daha yüksek katılımla vermiş olmalarıdır (%57). Bu neticenin ilkokul eğitim programında çevre temalı derslerin net, açık ve etkinliklerle desteklenmiş şekilde verilmesinden ve çocuğun gelişimsel açıdan çevresine ve doğaya daha duygusal yaklaşmasından kaynaklandığı düşünülmektedir. Katılımcıların "Çevrenizde kirlilik var mı? sorusunun değerlendirilmesi sonucunda, gelişim düzeyi fark etmeksizin, öğrencilerin büyük çoğunluğunun çevre kirliliğine yönelik algılarının yüksek olduğu tespit edilmiştir. Bu durumun ortaya çıkmasında aile ve okul eğitiminin yanında sosyal uyaranların da etkisinin olduğu düşünülmüştür. Katılımcıların "Kirleten Öder" ilkesinden ne anladıklarına yönelik sorulan sorunun değerlendirilmesi sonucunda, ilkokul öğrencilerinin %62 oranında "manen öder" içerikli cevaplar verdiği anlaşılmıştır. Bu sonuç, daha önce bahsi geçen "küçük yaştaki öğrencilerin hassasiyetlerinin ve duygusallıklarının güçlü olduğu" ifadesini desteklemektedir. Çocuklar "kirleten öder" kavramını maddi ceza olarak değil, kişisel zarar olarak yorumlamışlardır. Yaş arttıkça, yaşamsal boyutta maneviyatın maddiyata dönüşmesinin çevre konusunda da değişmediği tespit edilmiştir. Çalışmaya katılanlara "toplumun çevre konusundaki duyarlılığı" hakkındaki düşünceleri sorulmuştur. Alınan cevaplar tüm gelişim düzeylerinde "az duyarlı" seviyesindedir. Genel olarak arabalardan atılan çöplerden, piknik alanlarında bırakılan cam kırıklarından, kesilen ağaçlardan, toplu taşıma araçlarının yetersizliğinden bahsedildiği saptanmıştır. Öğrencilerin kirlilik çeşitlerini tam olarak bilemedikleri için sadece çöpleri konu ettiği düşünülmektedir. Aynı soru "Sizin duyarlılığınız nasıldır" şeklinde kişiselleştirilmiştir. Alınan cevaplar değerlendirildiğinde, ilkokul ve ortaokul öğrencileri kendilerini "çok" ya da "orta düzeyde duyarlı" gördükleri ve yine yerlere çöp atmamaktan, çöp kutusu yoksa çikolata ambalajlarını ceplerinde sakladıklarından bahsettikleri görülmüştür. Gelişim düzeyi arttıkça cevaplar, ağaç dikme, yenilenebilir enerjiler, ozon dostu deodorantlar gibi diğer çevre koruma temalarına kaymıştır. Araştırmaya katılan öğrencilere sorulan, ülkemizdeki çevre sorunlarının nasıl çözülebileceği hakkında görüşleri sorulmuştur. Cevaplar değerlendirildiğinde, tüm sınıf ve okul türlerinde büyük oranda Kuzey Kıbrıs'ta çevre sorunlarının eğitim yolu ile çözülebileceği algısının hakim olduğu tespit edilmiştir. Sınıf büyüdükçe alınan eğitim ve çevre bilinçlerinin artması ile eylem, siyasi ve ceza gibi unsurların da etki sahibi olacağı düşüncesinin belirdiği görülmektedir. Bu sonuç, "eğitim seviyesi ilerledikçe çevre bilinci de artar" görüşünü desteklemektedir. Fakat çevre sorunlarının giderilmesinde ceza türlerinin çözüme yardımcı olacağı düşüncesi öğrenciler tarafından ivedi çözüm olarak sunulmuştur. Bu soruya paralel olarak katılımcıların ülkedeki çevre sorunlarının çözümü için neler yaptıkları sorusuna verdikleri cevaplar değerlendirilmiştir. Öğrencilerin "yere çöp atmam, atanları uyarırım" gibi daha çok bireysel çözümleri öne sürdüğü anlaşılmaktadır. Sınıflar büyüdükçe, kişisel çabaların yanında etkinliklerle çözüme ulaşılması söz konusudur. Eğitim basamağının yükselmesi ile birlikte, çevre bilincinin arttığı ve çevreye yönelik olumlu tutum geliştirildiği, öğrencilerin bu bilinç ve tutumla çevre sorunlarına daha çözümcü yaklaştıkları saptanmıştır.

Ailelerin ve çocuklarının çevre duyarlılıklarının artırılması için Milli Eğitim Bakanlığının, üniversitelerin, belediye ve kaymakamlıkların seminerler planlamaları, yerleşim birimlerinde bilgi verici panolar yerleştirmeleri, broşürler dağıtmaları ve kitle iletişim araçlarını etkin şekilde kullanmaları önerilmektedir. Öncelikle aileler çevre, kirlilik, kirliliğin önlenmesi ve çözümü hakkında bilinçlendirilmeli ve ailelerin çevre hassasiyetine yönelik algı düzeyleri yükseltilmelidir. Çevreyi sadece canlı veya sadece cansız olarak algılayan katılımcıların çevre algılarının artırılması için müfredatlarına çevre veya çevre ile ilgili dersler eklenmelidir. İlkokul, ortaokul ve liselerde çevre derslerine yer verilirse, öğrencilerin çevre bilgileri ve buna bağlı olarak çevre algı ve duyarlılıkları artacak ve olumlu tutum geliştirmeleri sağlanacaktır. Milli Eğitim Bakanlığı, müfredatlarını revize etmeli; ilkokul, ortaokul, lise ve üniversitelere zorunlu çevre eğitimi dersi eklemeli, ayrıca tüm derslerde çevre eğitimi ile ilgili ünitelerin yer alması sağlanmalıdır. Ayrıca devletin yasama erkinin çevre konularında daha da gayretli çabalara girişip işleyebilir yasalar yapması ve bunların yürütme erki tarafından uygulanması ve uymayanların da cezalandırılması gerekmektedir. Bunların yanında devletin, eğitim kurumlarının ve sivil toplum örgütlerinin örgün ve yaygın eğitimi destekleyici etkinlikler planlamasının, tutum ve bilinci arttıracağı düşünülmektedir.

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TÜBİTAK

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