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Message from the Editors

Happy new year to all colleagues and researchers. Up to 2013, The Online Journal of New Horizons in Education (TOJNED) has a rich nature by covering interdisciplinary researches. It has a mission to underline different practices and researches in different methodologies. Selected papers become a mirror for the field of education by the efforts of academicians and researches. In this respect, I would like to thank to editorial board, reviewers and the researchers for their valuable contributions to the journal and this issue.

Prof. Dr. Aytekin İŞMAN
Editor in Chief

It is a great pleasure for me as an editor of The Online Journal of New Horizons in Education (TOJNED) to publish first issue of 2013. I would like to wish happy new year to all authors and associate editors and thank to all of them for their contributions to the current issue of TOJNED. Papers in this issue support the development of the journal and contributes rich and dense practices to the academic agenda. By the editorial team of Turkish Online Journal of New Horizons in Education (TOJNED), it is great pleasure to welcome your original and valuable researchers. All authors can submit their manuscripts to

tojnedjournal@gmail.com for the following issues.

Prof. Dr. Cem BİROL
Edior

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A Case Study on Teacher Instructional Practices in Mathematical Modeling

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ABSTRACT

There is in fact a tendency in several countries to include more mathematical modeling in curriculums. Mathematical curriculum in Turkey focuses on the principle of "every child can learn mathematics". From this perspective; more importance is given to modeling from the sixth grade to eighth grade mathematical curriculum. Accordingly, prospective mathematics teachers are required to be trained for preparing teaching environments appropriate for mathematical modeling. In this context, 33 prospective mathematics teachers are trained of mathematical modeling based teaching. 17 of them are selected randomly for modeling based teaching applications. Modeling based teaching carried out with modeling tasks developed by 17 prospective mathematics teachers at the end of training. This study is a case study of one of these 17 cases is selected for this study to provide descriptive information about instructional practices in mathematical modeling. Modeling task is applied on randomly selected 38 8th grade students in a practicing school. Both quantitative and qualitative data collection tools are used. The study presents information about instructional practices with data drawn from classroom observations and scoring rubrics.

Keywords: *Mathematical modeling; prospective mathematics teacher; teacher instructional practices; case study.*

This study is prepared from a part of the first researcher's PhD Thesis named "Learning-Teaching Applications on Mathematical Modelling in Mathematics Education".

INTRODUCTION

Mathematics is a systematic way of thinking which enhance solution to real world statements and problems with mathematical modeling. Blum & Ferri (2009), defines "modeling competency" as the ability to construct models by appropriately carrying out definite steps as well as analyzing or comparing given models. Modeling can be determined as transformation of a problem into mathematical notions and representations (Burkhardt & Pollak, 2006; Niss, 1987; Kaiser; Blomhøj & Sriraman, 2006). Mathematical modeling is meant to help students' better understand the world, support mathematics learning (motivation, concept formation, comprehension, retaining), contribute to develop various mathematical competencies and proper attitudes, contribute to create an adequate picture of mathematics, namely using enough mathematics. In this context, purposes of mathematical modeling are; enable students make predictions, explain problems, describe and understand different situations in the real world (Galbraith & Catworthy, 1990).

Mathematical modeling is an important component of professional training, which is similar in all areas, particularly in mathematics education. The incorporation of mathematical modeling in mathematics education provides a learning environment (D'Ambrosio, 2009). There are many characterizations or modeling cycles of modeling process (Burkhardt, 1981; Edwards & Hamson, 1989; Hirstein, 1995; Berry&Houston,1995; Borromeo, Ferri,2006; Galbraith & Stillman, 2006; Pollak, 1979; Verschaffel, Greer & De Corte, 2000). In the year of 1989, Standards of National Council of Teachers of Mathematics depicted modeling as an iterative, five step process: 1.construction of a simplified version of the initial problem situation, 2. construction of a mathematical model of the

simplified problem, 3. identifying solutions within the framework of the mathematical model, 4. interpreting these solutions in terms of the simplified problem situation, 5. verifying that the solutions of the idealized problem are the solutions to the initial problem. The NCTM Standards' (1989) characterization of mathematical modeling is given in Figure 1. One of the process models to describe modeling activities is the modeling cycle proposed by Blum& Leiss (2007). In an idealised form, the solution process for a modeling problem can be characterized by a seven-step sequence of activities: (1) understanding the problem and constructing an individual "situation model"; (2) simplifying and structuring the situation model and thus constructing a "real model"; (3) mathematising, i.e. translating the real model into a mathematical model; (4) applying mathematical procedures in order to derive a result; (5) interpreting this mathematical result with regard to reality and thus attaining a real result; (6) validating this result with reference to the original situation; if the result is unsatisfactory, the process may start again with step 2; (7) exposing the whole solution process. From this point of view, the modeling process is made up of seven steps. Distinguishing between these steps is helpful for reconstructing the modeling processes used by students when solving mathematical problems. However, students' actual processes are typically not linear but rather jump back and forth several times between mathematics and reality (Borromeo Ferri, 2007; Leiss, 2007).

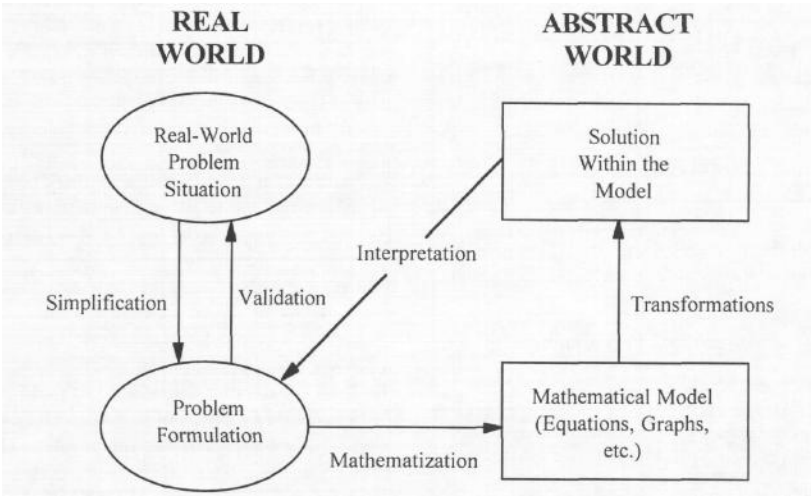


Figure1. The NCTM Standards' (1989) characterization of mathematical modeling

Demanding transfer processes between reality and mathematics are the core of modeling activities (Blum, Galbraith, Henn & Nis (2007); Pollak, 1979). Seven-step model developed by Blum & Leiss (2007) is given in figure 2. There are seven steps passed through in this cycle such that *1.understanding, 2.simplifying/structuring, 3.mathematising, 4. working mathematically, 5.interpreting, 6. validating and 7. exposing* (Blum&Borromeo Ferri,2009). One characteristic advantage of this seven-step modeling cycle is the separation between constructing a situation model, a real model and a mathematical model. This allows for distinguishing between difficulties in understanding the given situation, in simplifying and structuring the information extracted from the situation, and in choosing a suitable mathematical description of the situation during students' solution processes, and thus helps teachers in choosing appropriate, well-aimed and adaptive interventions especially in the critical translation phase at the beginning of the modeling process (Schukajlow et. al, 2011).Generally speaking, the seven-step cycle described below is both sufficiently detailed to capture the essential cognitive activities taking place in actual modeling processes and sufficiently simple to guide the necessary observations and analyses in a parsimonious way (Schukajlow et. al, 2011). A cognitive analysis of modeling process gives a model of the modeling cycle. Modeling cycle can look like algorithmic process, but indeed it is not. Especially the construction process of modeling is challenging as it include formulating a problematic situation. The process requires selection of appropriate variables, determining connections between these variables, developing a mathematical model related to these variables and connections, and testing the model and its applications (Blum & Niss, 1991).

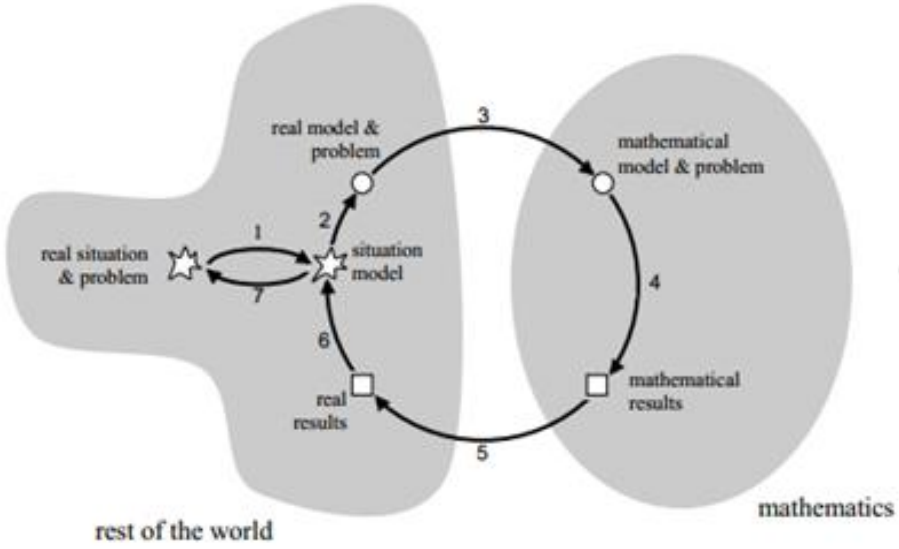


Figure 2. Modeling cycle (Blum&Leiss, 2007)

Underlying all of these justifications of modeling, are the main goals of mathematics teaching in secondary schools. In this context, there is in fact a tendency in several countries to include more mathematical modeling in the curriculum. The basic purpose of involving mathematical modeling in secondary school curriculums is to encourage students make connections between mathematics and the real world. According to the mathematics educators, students have opportunities to use and apply mathematics through mathematical modeling (Blum & Niss, 1991). Mathematics classes that are designed in the form of using mathematical modeling, give students chance to use mathematics actively. Students with mathematical modeling competencies learn and develop mathematical concepts very well which makes important contribution to their mathematical experiences outside school (Aydın, 2008).

Mathematical curriculum focuses on the principle of "*every child can learn mathematics"* in our country. Mathematics curriculum has important attainments on training individuals; students who learn through these curriculums generally have the ability to apply mathematics in their lives, solve problems, share solutions and thoughts, work as a team member, have self-confidence in mathematics and develop positive attitudes towards mathematics (Ministry of National Education, 2009). From this perspective, importance of modeling in 6^{th}, 7^{th} and 8^{th} grade mathematical curriculum is getting increasing. In this case, prospective mathematics teachers who will teach mathematics in future are required to be prepared to understand mathematical teaching environments appropriate for modeling. Modeling has crucial contributions to development of technical processes and technology because of its simple application on all areas of life. If this phenomenon can be learnt as early as secondary school, high school will be able to evaluate everything mathematically in their lives and will be more successful in mathematics classes. According to the results of PISA 2006, students all over the world experience problems with modeling tasks (EARGED, 2010).

In this context, for mathematics education, the importance of prospective mathematics teachers' using the real world problems and carrying out mathematical modeling is increasing. Prospective mathematics teachers are required to be skillful at identifying and developing mathematical modeling. The aim of this study is provide descriptive information about instructional practices in modeling based teaching. Following three research questions guide this inquiry:

1. How are the prospective mathematics teacher's skills in preparing daily lesson plan?

2. How are the prospective mathematics teacher's skills in teaching practice on modeling based teaching?

3. How are the eighth grade students' achievements on modeling based teaching?

METHODOLOGY

The study is a case study over 8th grade students who were involved in a modeling based teaching by the prospective mathematics teacher (PMT). The PMT is selected randomly from prospective mathematics teachers who have 3-month training of mathematical modeling. In this study quantitative and qualitative data are collected and analyzed descriptively.

Participants and Setting

The study is carried out in the academic year of 2010-2011. The research is applied on randomly selected 38 eighth grade students in a practicing school. Modeling based teaching is implemented according to "The Daily Lesson Plan" designed by the PMT. The PMT prepares "The Daily Lesson Plan" for organization of modeling based teaching before the teaching practice. Format of daily lesson plan consists of three parts. In the *"formal partition"*: date of practicing, school of practicing, grade, learning field, sub-learning field, gain, time, learning strategy-method and techniques, materials get involved . In the "*preparatory activity*": there is an activity that measures the readiness and is effective in preparing students for transition to the modeling task. And "*processing partition"* requires identifying a modeling task which is important, appropriate for the students' grade, learning field, sub-learning field, gain and modeling process. In this study the plan is aiming at ensuring students achieve the gain of "*Estimating surface areas of geometric objects by using strategy"* in 8th grade mathematics curriculum. Students are separated into 8 small groups (four or five students per each group) based on friendship and academic results evaluated by the PMT and students' mathematics teacher. Homogeneous distribution between the groups and heterogeneous distribution within the groups are achieved. Modeling based teaching starts with *preparatory activity* in order to measure their previous knowledge about geometric objects; then modeling tasks were given to each group in worksheet format which is easy to work on. The PMT acts as cognitive guide and offered scaffolding when the situation required intervention; for example when students weren't able to understand the problem situation. Groups completed the modeling tasks in given time and presented their solutions on the board. All of the solutions were discussed by the whole class. Session lasted about an hour. Modeling task used in the class is given in Table 1.

Table 1: Haydar Paşa Railway Station Problem

Haydar Paşa Railway Station was established on an area of 2525m^2, and 6200 m^2 of coating material was used in the construction. Haydar Paşa railway station is the first door (station) of Istanbul which opens to Anatolia and to the Middle East. It has been serving to various people since May 30, 1906.

Unfortunately, some parts of Haydar Paşa Railway Station burnt in the fire on November 28, 2010. If you were the engineer who designs the burnt roof how you would design? Which geometric shape the designed roof would look like? The designed roof needed to be robust, and coated with a special material. The cost per 1 m^2 of this material is 1 Turkish Liras. What would be the cost of the designed roof?

Data Collection Tools

In this study "The Analytic Scoring Rubric for Evaluation of the Daily Lesson Plan (ASRE-DLP)", "Observation Form for the Mathematical Modeling Process (OF-MMP)" and "The Analytic Scoring Rubric for Evaluating Mathematical Modeling Process (ASRE-MMP)" are used to collect data. ASRE-DLP was designed to evaluate the skills of the PMT in preparing daily lesson plan by the researchers. Criteria of the process in daily lesson plan are: *1. determining the preparatory activity, 2. identifying the modeling task, 3. authenticity, 4. visual design, 5. conducting research, 6. checking spelling and grammar and 7. determining the amount of time*. In this instrument, a scoring system including three types of points (1, 2 and 3) is used. In this context, 1 point is given for an inadequate approach and 3 point is given for a truly approach according to the desired situation or to demonstrate an adequate level approach. According to this system, 7 is the lowest score and 21 is the highest score. Success levels are formed in three parts as Bukova Güzel & Uğurel (2010) identify in their study: Preliminary (in this level score is between 7 and 10.4), moderate (in this level score is between 10.5 and 17.4) and high success (in this level score is between 17.5 and 21). A sample criterion of ASRE-DLP is given in order to illustrate scoring system and success levels.

	Success levels			
Criterion	Preliminary level (1)	Moderate (2)	High success (3)	Score
Authenticity	Activities are ordinary and similar	Activities are partly original and made by inspiration of similar ones.	Activities are original and different	

Figure 1. A sample criterion of ASRE-DLP

To evaluate the skills in instructional practices of PMT, an observation form named as OF-MMP is used in this study. The behaviors that makes observed environment workable are chosen to prepare an observation form (Yıldırım & Şimşek, 2005). It is important to reveal clearly of behaviors which are needed to observe to what extent. In this context, a check list is prepared. Criteria are taken into consideration to allow monitoring of modeling process as a multi-faceted observation in creating this checklist. Communication, model, mathematical context and evaluation are determined as criteria. This checklist reorganized to allow monitoring the process from the beginning of the course until the termination of the course and became the pre-form. Observation form has been rearranged with regard to the recommendations from the observers, the qualitative data analysis applications and finalized in accordance with expert analysis. Modeling based teaching is also video recorded during the session. Students' model development efforts in the modeling task named as Haydar Paşa Railway Station Problem and the PMT's interventions are monitored by an observer. Therefore the focus is on the PMT's skills in instructional practices based on mathematical modeling.

(ASRE-MMP) is designed as a scoring rubric for analyzing of 8th grade students' achievements on modeling based teaching. This scoring rubric was developed by researchers with the model of Blum & Leiß (2007); criteria of Herget and Torries-Skoumal'ın (2007); six levels of Ludwig & Xu (2008); competences of De Terssac(1996), Maaß(2006) and Berry & Houston(1995); and student activities of Kim & Kim(2010). Criteria of (ASRE-MMP) are determined as *1.understanding, 2.simplifying/structuring, 3.mathematising, 4. working mathematically, 5.interpreting, 6. validating and 7. exposing* and to measure these criteria a scoring system including three types of points (1, 2 and 3) is used. This instrument's scoring system and success levels show similarities with ASRE-DLP.

For the scope validity of the scoring rubrics, experts' opinions who have profession in educational programs-instruction and measurement - evaluation are considered. Expressions in scoring rubrics are designed in line with experts' opinions and aim of the research. Reliability of the scoring rubrics is analyzed as the percentage of coherence of researchers' scorings. Kappa statistic is used to determine the percentage of coherence between two or more evaluators. Kappa coefficient ranges from -1 to +1. If kappa coefficient is zero, there will be random coherence. If kappa coefficient has negative values, this will be worse than random coherence. +1 represents an excellent coherence. If kappa coefficient ranges between .40 and .75, this means a reasonable coherence and greater than .75, this means that there is an excellent coherence (Şencan, 2005, pp.265-267). In ASRE-DLP, percentage of observed coherence is 0.85 and percentage of coherence with chance is 0.38 and in ASRE-MMP, these values are similarly 0.85 and 0.32. In this context, kappa coefficients are calculated and found to be 0.76 for ASRE-DLP and 0.78 for ASRE-MMP. As a result, there is an excellent coherence for both ASRE-DLP and ASRE-MMP. The percentages

of coherence in subscales of the ASRE-MMP are calculated and Cohen's Kappa coefficients are respectively as K_1= 0.60, K_2 =0.81 and K_3 = 0.79, K_4= 0.72, K_5=0.79, K_6= 0.79 and K_7=0.79. Therefore these values report that ASRE-DLP and ASRE-MMP is reliable with subscales.

FINDINGS AND DISCUSSION

Findings Related To the First Research Problem

The daily lesson plan designed by PMT is evaluated independently with using the ASRE-DLP by researchers. Findings related to the evaluation of daily lesson plan are given in Table 2.

Table 2. Evaluation of daily lesson plan according to the ASRE-DLP

Criteria	The 1st researcher	The 2nd researcher
Determination Of Preparatory Activity	3	3
Determination Of The Modeling Task	2	2
Uniqueness	3	3
Visual Design	2	2
Conducting Research	3	3
Spelling And Grammar	3	2
Determination Of The Amount Of Time	1	1
Total	**17**	**16**

In line with this scoring, PMT's success in determining of preparatory activity, uniqueness, and conducting research is found to be highly successful. It can be said that preparatory activity is sufficient in measuring readiness effective for transition to modeling task. Activities are unique and different from others. In conducting research phase, there is an extensive research is made and reflects on the content of plan. There is not any error in formal partition. Modeling task is seen as inappropriate for the 8th grade students' levels, thus his ways of determining the modeling task is found to be acceptable. Applying of visual, verbal and charming elements is found to be partially sufficient and this criterion partially facilitates the understanding of the problem. Determining the amount of time is considered as inappropriate for modeling process. As a result from the scores given by researchers, the PMT shows a moderate level of success in preparing the daily lesson plan.

Findings Related To the Second Research Problem

Modeling based teaching is observed by an observer who had a 3- month training on mathematical modeling like PMT and researchers. Observer is selected randomly for this study. Observer took field notes by using the OF-MMP. Observation data were analyzed descriptively and thematic-coding was made. Table 3 presents the finding with regard to observation of the mathematical modeling process.

Table 3: Findings related to the observation of the prospective mathematics teacher's skills in teaching practice on modeling based teaching

Themes	Sub-themes	Codes	Field notes
Preparing environment of the class	The physical structure of the class	Appropriateness for the modeling applications	The physical structure of the class was not appropriate to the study, but prospective teacher organized the class to be effective
	Having knowledge about subjects	High level of success Effective communication	PMT knew that there were many successful students in the class from observations of other prospective teachers' applications, conversations with mathematics teachers and he knew some of the students from out of class. PMT had an effective communication with students and mathematics teacher.
	Creating groups	Without help Taking student opinions Before teaching Group number Homogeneous distribution between groups Heterogeneous distribution intra-groups Time	PMT formed the groups without the assistance of the mathematics teacher at the beginning of the course. PMT had the knowledge about students and took their opinions for creating groups. Creation of groups before teaching was more appropriate but if he had taken help to create groups it would be good. 8 is a reasonable number of group decision. There was homogeneous distribution of the groups. Groups were similar to each other. There was heterogeneous distribution intra-group. Creating the groups took 5 minutes.
Preparation activity	Effects on the students	Prepared students to the modeling task Recalled the preliminary information Attracted attention Measured readiness Served to its purpose	Activity prepared students to the modeling task, recalled the preliminary information about prisms, attracted their attention and measured readiness. Preparation activity served to its purpose.
Modeling task	Modeling process	Understanding with assistance Active participation Working cooperatively Participating in class discussions Expressing ideas advocating groups' solutions Deciding to the correct solutions with discussions.	They read the question immediately and tried to figure out the problem. Groups understood the problem with the assistance of PMT. PMT made explanations to be needed. Groups dealt on the modeling task with all of the members. They had difficulties at the first time but then they got used to the application. They actively involved and worked cooperatively. Participation level was high. Groups completed the task in the given time. Students participated in class discussions, were able to express their ideas and advocated their groups' solutions. They decided to the correct solutions with discussing all of the groups' solutions.
	Mathematical context	Using mathematical representations and terminology correctly Making comparisons Using approximate values for numerals.	Groups used the mathematical representations and terminology correctly. They made comparisons solutions by using approximate values for numerals. Their drawings were accurate.

Themes	Sub-themes	Codes	Field notes
		Accurate drawings	
	Effects on students	Attracting attention Arising curiosity Reinforcing learning Inquiry- critical thinking Higher-order thinking Abstract thinking Peer learning Developing common thought Experiencing a different application. Permanent learning Effective learning Realizing mistakes	I think modeling task was effective on attracting of their attention, aroused their curiosity, amused them and reinforced learning. Inquiry- critical thinking skills, higher-order thinking and abstract thinking skills were attained. They learned from each other. Creative ideas emerged. They developed a common thought and experienced a different application. Permanent learning and effective learning took place. They realized their mistakes.

PMT started the course with asking questions about situations that students face daily in life. In this process, he asked questions such as, "There are buildings all around us, and all of them have roofs. Which geometric shapes do these roofs look like?" Students' responses were triangular prism, square pyramid, square prism, rectangular prism etc. Accordingly, he asked what the triangular prism and pyramid look like. In this context, he asked one more question that provided enrichment to the learning and supported organizing different thoughts.

PMT*: Well, you have got a block of cheese in the cubic. We want to make triangular prism with this cheese. How do you cut the cheese?*

Students: Diagonal, at the corners.

(There were signifiers with their hands; one student raised her finger to come to the board. She drew a cube, and showed the section by scanning. She said that if we cut and divided the part into two, we can obtain two triangular prisms.)

PMT*: So, what are the bases of prisms?*

Students: Triangle, square, rectangle...

PMT*: Is the base rectangular? Which geometric shapes are the sides of surfaces?*

Students: Square...

PMT*: Square? Are you sure?*

Students: Square, yea…

PMT*: I said that the cheese is in cubic shape.*

Students: We said that, sides are squares...

PMT*: I did not say it is the wrong answer... Well, what are the bases?*

Students: Triangle…

The following is understood from this conversation: He was evaluating the readiness of students, giving students' some opportunities to acquire mathematical competencies and preparing students to the modeling task. After submission of the modeling task, groups started the modeling cycle. Firstly, the problem situation has to be understood by the groups. The PMT deals primarily with groups who are asking questions and then fallows all of the group studies. He provides an effective and learner-oriented classroom and guidance; fosters students' independence and supports thought; stimulates cognitive and meta-cognitive activities and gave students' various opportunities to explain their thoughts independently. These skills are similar to the skills identified by Lesh & Doerr (2003, p. 11). In the last section of modeling cycle, teacher started the process of inquiry. He asked questions to whole class such as;

"*Which of these solutions do you think is most sensible? Which results are more convenient to real situation?", "Does this result fit the real situation?*"…etc. Teachers' modeling treatments in the classroom are described by Blum & Ferri (2009) as such: acting like a maestro while teaching a mathematical subject, ensuring cognitive activation of learners and effectively managing a learner-oriented classroom. These treatments have similarities with skills in teaching practice of the PMT in our study.

When students deal with modeling tasks, prospective mathematics teacher stimulates groups' thought with cognitive and meta-cognitive activities. For example, the dialogues between groups and PMT are given as follows:

S2: If we thought lengths of the roof are 25m and 100m, we could find an approximate value.

PMT*: Have you ever notice the number of windows for calculating the lengths?*

S3: No, we did not include windows.

After this dialogue, students turn back to the picture again and get another perspective when they engaged in cognitive and meta-cognitive activities. Students give the estimated values to the lengths according to the data given in the modeling task. Another group expresses that the train station looks like a prism and so they begin with the surfaces of prism. PMT asks some questions on what they think, in this way he is questioning their thought processes in reasoning. Their interaction is given below to illustrate this situation.

S1: $6a^2 = 2525$. Divide 2525 by 6.

PMT*: Why will divide 2525 by 6?*

S1: because this part is absent.

S2: Then, it must be 5, not 6.

They counted the surfaces of the station by thinking that the station is like a prism. The consensus was about 6. Thereupon, PMT says that the building's ground floor is 2525 square meters and wants them to think about the houses' sitting area, floor. K1 makes drawing on paper by separating the station into 3 parts and says that:

S1: So, there are 3of a^2

S2: How is there 3 of a^2?

S4: teacher is saying that, look at the sub-base of eraser.

*(*S1 is scanning the base by drawing a cube in the meantime)

S2: ok, I say the same.

The consensus was provided on the ground. Then they start to question about the data given in the problem. But this time their focus is on the geometric shape of the train station.

S1: train station is as a whole, he says, sitting in the garden with 2525 square meters, 6200 is only the total of the roofs.

S2: 2525 is a full-square? I do not understand, this figure as a whole is a rectangle or square?

Prospective mathematics teacher: What do you think it looks like?

S3: Rectangle

S1: I think, square.

S2: Then, I say that 2525 has to be square of something.

The 3rd group passes similar paths in reasoning like the former group did. A student from 3rd group says that: "there are 4 parts so we divided 2500 by 4. If we divide by 3, we'd take account the garden but we divided by 4 and we calculated all of them separately except the garden. We found 625 square meters". When the prospective mathematics teacher asked what the form of the roof is one of them says "triangle" as another student says "no, square". The form of the roof is considered as a planar shape.

In the modeling process, PMT gives students' various opportunities and encourages them to explain their thoughts independently. An effective and learner-oriented classroom management is exhibited by PMT and he supports students' independence such as a dialogue in another group study gives evidence as follows:.

S1: If we divide the whole of the roof into three parts (he is showing the burned roof), I thought that we could find the area of one of them.

S2: Ok, what do we do with two of them? (he is asking for the numeric information of 2525 square meters and 6200 square meters)

S3: Look at the area covered by this (2525 square meters), this is the entire surface area with garden. This is only for the roof (6200 square meters).

S2: Good, will we divide this by 3 (showing 6200 square meters)?

S4: Why do we do it?

S5: It cannot be divided to 3. 6 plus 2 equals 8 and 8 cannot be divided by 3e. (He is explaining the divisibility of 6200 by 3)

Students: let's think over the task…

When students are dealing with modeling tasks, PMT makes adaptive, independence-preserving interventions. These interventions are observed as suitable for the determinations of teacher role in the study of Blum & Ferri (2009). The PMT also creates an atmosphere which supports students' individual views besides his role of guiding students in the processes of developing models to solve problems instead of exhibiting solutions. He encourages whole class discussions in order to defense the models groups developed in each group. According to Schukajlow et.al.(2011) teachers are to be involved in the conditions when students' independency is kept optimal level. From the observations we made in our research, it can be said that the balance between his guidance (minimal) and (maximal) students' independence maintained during the modeling process. Marcou&Lerman(2007), asserts that student-centered teaching environments provides opportunities for student. Therefore, students in this study develop their modeling skills and creative thinking through an effective and student-centered modeling process with the help of the PMT.

Findings Related To the Third Research Problem

In the modeling based teaching, groups paraphrased the information given by the problem situation, explained their thoughts to each other, made drawings in the shape of the station and then most of them thought dividing the area into equal parts according to the information related to 2525 square meters. When they were developing their conceptual systems or models through the mathematization, they found relationships between the lengths of burned roof, area of station and coating material; they resized, quantified or made predictions. As they work with the rich contextual data, they would need to surface and communicate their mathematical ideas to clarify their thoughts and ensure the validity of their ideas. In this context they wrote symbols and made diagrams related to designed roofs. From this perspective, at the end of the observed modeling process, groups developed similar models. In the study of English(2009), students checked their interpretation and reinterpretation of problems and data sets, identified key problem factors, determined and applied quantification process to transform the data, and documented and supported their actions in various representational formats. Cognitive analysis of groups' modeling process are made according to the modeling cycle given in Figure 2 and evaluated by using ASRE-MMP. PMT' s scoring of groups' efforts with taking into consideration the criteria in modeling process is given in Table 4.

Table 4. Scores of groups according to the criteria in mathematical modeling process.

Criteria	1st group	2nd group	3rd group	4th group	5th group	6th group	7th group	8th group
Understanding	1	2	1	2	2	1	1	2
Simplifying/ structuring	1	2	1	3	2	1	2	3
Mathematising	2	2	1	3	2	1	2	3
Working mathematically	3	1	1	2	3	2	3	3
Interpreting	3	1	1	2	3	2	3	3
Validating	3	1	1	3	3	2	3	3
Exposing	3	1	1	2	3	2	3	3
Total score	16	10	7	17	18	11	17	20
Success level	**moderate**	**low**	**low**	**moderate**	**High success**	**moderate**	**moderate**	**High success**

Four groups did not understand the problem situation but the other four groups understood the problem situation with the help of PMT. The fourth and eighth groups only completed the simplifying/structuring phase successfully, as they completed the previous phase with assistance. The first, third and sixth groups understand only problem situation but they could not organize and simplify the situation and couldn't associate problem situation with any mathematical idea. The second, fifth and seventh groups made the list of problem features, created a list by looking at certain features but neither they could describe the variables used in the model nor did an accurate drawing /table. Similarly the fourth and eighth groups completed the mathematization process successfully. The second, fifth and seventh groups are to be moderately successful. The first, third and sixth groups neither took into account each variable in creating model nor used mathematical representation and terminology correctly. Their model is not suitable for the problem situation.

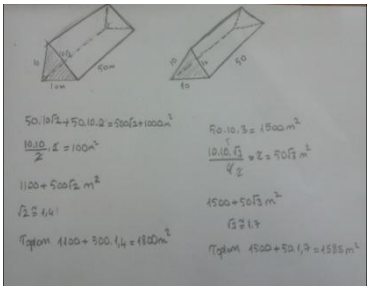
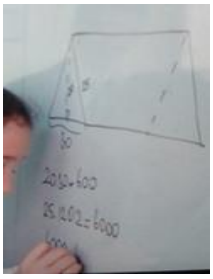
The first, fifth, seventh and eighth worked over the mathematical problem using mathematical model and reached the correct solution. 4^{th} and 6^{th} groups made processing error and remaining 2 groups could not work mathematically. Almost all of the groups (75%) were unable to interpret achieved mathematical results with real outcomes in an adequate level. Accuracy of the mathematical model with appropriate data was tested, mathematical model was affirmed and the developed mathematical model is not able to be generalized for any other problems in the second and third groups. The sixth group is unable to generalize their model. The 1^{st},4^{th},5^{th},7^{th} and 8^{th} groups completed validating at high success level.

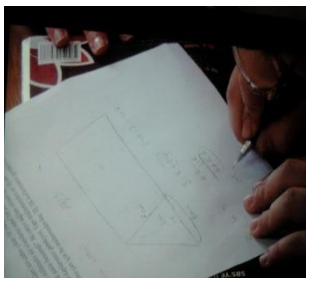
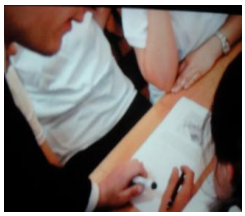
The 1^{st},4^{th},5^{th},6^{th},7^{th} and 8^{th} groups submitted verbal solutions of the problem and explained the solution correctly. But when different opinions were mentioned by other groups, the 2^{nd}, 3^{rd}, 4^{th} and 6^{th} groups were unable to defend their own solutions against them. The 2^{nd} and 3^{rd} groups could not successfully complete the last four phases. These findings are clearly pointed out in solutions.

In the exposing phase, solutions were presented on board. A student from the 8^{th} group drew a triangular prism on the board. The floor of the station was regarded as square and total area was 2500 m^2. Lengths of the roof floors were approximately 50 m and 10 m. She drew a floor of the building that is placed on the square shaped station in order to increase the visual understandability of the shape. They used an isosceles triangle in the form of base 10m and edges 5√2m. Accordingly, the height of the triangle was 5m. Their mathematical solution was: (50x10)+(50x5√2x2)+(10x5)/2+(10x5)/2=550+500√2= 1255 square meters. In this context, required material was found to be 1255 square meters. Lengths of roof floor were regarded as 30m and 120m by the fourth group. Height of the isosceles triangle was found to be 20 m according to the right triangle (3-4-5) which is used to ease the calculation. Their mathematical solution was: (120x25x2)+(120x30)+(30x20)= 10200 square meters which was the required amount. The sixth group who designed the roof and triangular prism regarded the length of the roof floor as 150 m and 40 m. Height of the triangles were 25m, edge lengths were 40m, 5√41m and 5√41m. In this case (150x40)+(150x5√41x2)+(40x25)=6000+1500√41 square meters approximately refers to 14500 square meters of material. The roof was designed as a triangular prism by fifth group and thus a^2=2525, a=5√101m. Accordingly, their solutions and results were similar with the eighth group. The first group calculated the roof floor to be 50m and 20 m. Length of the base of the triangle was 20m, edges were 5√5m, the height was 5m. The required material was found to be (50x20)+(50x5√5x2)+(20x5)= 1100+500√2=1805 square meters. The seventh group's solution is: Right triangles with the lengths of (10m-10m-10√2m), the lengths of the roof floor were 50m and 10m. 1100+500√2 square meters (1800 square meters) material was required. In the case of an equilateral triangle (10m-10m-10m) without any changes on the roof floor, 1500+50√3 square meters (1585 square meters) material was required. According to group discussion, the eighth, fifth, first and the seventh groups' solutions are accepted to be correct solutions. Some figures are given below for illustrating the modeling process.

As a result, two groups showed a high level of success, 4 groups showed moderate level of success and 2 groups showed a low level of success according to the evaluation of ASRE- MMP.According to the results of PISA 2006, students all over the world experience problems with modeling tasks (Blum & Leiß, 2007). This situation is related to complexity structure of modeling tasks by Schukajlow et. al.(2011). In this study, students sometimes have difficulties in developing the models. This is an expected situation because of the difficulty and uncertainty of the data given in problem situation. PMT gives a sufficient time (more than the specified time in the daily lesson plan) for modeling processes and guidance. As Eric (2010) and Schukajlow et.al. (2011) pointed out, this intervention is effective on students' development of models. Students are even believed and encouraged to be successful in doing modeling tasks by prospective mathematics teacher. According to Nyman&Berry(2002), this technique-mathematical modeling- may be useful or practicability when students actively participated to the activities and ready to class discussion. However, when students forced to explain and argue their models, they uncover inaccuracies and misunderstandings. Lingefjard(2006) emphasizes a clear focus on validating process. In this study modeling process is

successfully done. Students expressed that modeling task is charming and they feel enjoyment while they are learning mathematics with modeling. In this way, mathematical modeling provides students a qualified mathematics learning environment.

CONCLUSIONS

In modeling, students are presented with real world situations and are expected to use mathematics in order to rationalize these situations. Students need more mathematical understanding in order to construct valid and useful models. Mathematical modeling plays a significant role in the mathematics. Modeling, as incorporated in the curriculum recommendations of NCTM, forms the basis of classroom activities.

In this context, this study offers information about the modeling applications of students and the role of teacher. Modeling provides an effective context for developing students' problem solving skills. Moreover, modeling promises to highlight mathematical connections, addresses to the aspects of learning and reinforces students' understanding of mathematics. Modeling provides teachers an additional tool for connecting with students and motivating them. The need to study with different level students and prospective mathematics teachers aroused in order to use the research data in future researches in terms of different modeling. Modeling is difficult to teach and learn. On the other hand, by developing awareness of teacher instructional practices; students' modeling competencies can be facilitated and developed through well designed tasks with collaborative studies between researchers and PMTs in educational faculties. Finding an appropriate context within which modeling can be undertaken is not a simple task as it needs to be readily understandable and seen as relevant by students, required an appropriate level of mathematical training on modeling.

REFERENCES

Aydın, H. (2008). "İngiltere'de öğrenim gören öğrencilerin ve Öğretmenlerin matematiksel modelleme Kullanımına yönelik fenomenografik bir çalışma." Yayımlanmamış yüksek lisans tezi. Gazi üniversitesi, eğitim bilimleri enstitüsü, Ankara.

Berry, J. & Houston, K. (1995). Mathematical Modelling. Bristol: J. W. Arrowsmith Ltd.

Blum, W., Galbraith, P., Henn, H-W&Niss M. (2007). *Modelling and applications in Mathematics Education*. New York: Springer.

Blum, W. & Borromeo Ferri, R. (2009). Mathematical Modelling: Can It Be Taught And Learnt?. *Journal of Mathematical Modelling and Application*. Vol. 1, No. 1, 45-58

Blum, W. & Leiß, D. (2007). How do students' and teachers deal with modelling problems? In: Haines, C. et al. (Eds), *Mathematical Modelling: Education, Engineering and Economics*. Chichester:Horwood , 222-231

Blum, W. & Niss, M. (1991). Applied mathematical problem solving, modelling,applications, and links to other subjects – state, trends, and issues in mathematics instruction. *Educational Studies in Mathematics,* 22(1), 37-68.

Borromeo Ferri, R. (2006). Insight into Teacher's unconcious Behaviour while dealing with mathematical Modelling problems and implications for teacher education. [online]: http://www.unige.ch/math/EnsMath/Rome2008/WG2/Papers/BORR.pdf

Borromeo Ferri, R. (2007). Individual modelling routes of pupils-analysis of modelling problems in mathematical lessons from a cognitive perspective . In Heines, C. Et al. (Eds), Mathematical Modelling (ICTMA 12): Education, Engineering And Economics(pp.260-270).Chichester: Horwood publishing.

Bukova Güzel, E. & Uğurel, I. (2010). Matematik Öğretmen Adaylarının Analiz Dersi Akademik Başarıları İle Matematiksel Modelleme Yaklaşımları Arasındaki İlişki. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*,29(1),69-90.

Burkhardt, H. (1981). The realworldandmathematics.Glasgow: Blackie.

Burkhardt, H. & Pollak, H. O. (2006). Modelling in mathematics classrooms: reflections on past developments and the future. *Zentralblatt für Didaktik der Mathematik* 38 (2), 178–195

D'Ambrosio, U. (2009). Mathematical modeling: cognitive, pedagogical, historical and political dimensions. *Journal of mathematical modeling and applications*.1(1), 89-98.

De Terrsac, G. (1996). *Savoirs, Competences Et Travail*. J.M. BARBIER (Ed.), Savoirs Theoriques Et Savoirs D'action. Paris: Presses Universitaires de France, 223-247.

EARGED (2010). PISA 2006 Uluslararası Öğrenci Değerlendirme Programı Ulusal Nihai Rapor,[online]: http://earged.meb.gov.tr/earged/Ol%C3%A7me/dokumanlar/uluslararasi/PISA2006.pdf

Edwards, D., & Hamson, M. (1989). Guide to mathematical modeling. Boca Raton, FL: CRC Press.

English, L.D. (2009). Promoting interdisciplinarity through mathematical modelling. *ZDM Mathematics Education*, 41:161-181.

Eric, C. C. M. (2010). Tracing Primary 6 students' model development within the mathematical modelling process. *Journal of mathematical modelling and Applications*.1(3),40-57.

Galbraith, P. & Clathworthy, N. (1990). Beyond Standard Models – Meeting the Challenge of Modelling. *Educational Studies in Mathematics* 21(2), 137-163

Galbraith, P. & Stillman,G. (2006). A framework for identifying student blockages during transitions in the modeling process. *Zentralblatt für Didaktik der Mathematik*,38(2),143-162.

Herget, W. & Torres-Skoumal M. (2007). In Werner Blum, Peter L. Galbraith, Hans-Wolfgang Henn, Mogens Niss, (Eds.) Modelling and Applications in Mathematics Education. The 14th ICMI Study, Springer, Volume10, 379-386

Hirstein, J. (1995). Assessment and mathematical modeling.In C. Sloyer, W. Blum, &I. Huntley (Eds.), Advancesandperspectives in the teaching ofmathematical modelling and applications (pp. 163-174). Yoridyn, DE: Water Street Mathematics.

Kaiser, G., Blomhøj, M. & Sriraman, B. (Eds.) (2006). Mathematical Modelling and Applications: Empirical and Theoretical Perspectives. *Zentralblatt für Didaktik der Mathematik, 38*(2).

Kim, S. H. & Kim, S. (2010). The effects of mathematical modeling on creative production ability and self-directed

learning attitude. *Asia Pasific Educ. Rev.*,11:109-120.

Leiss, D. (2007).Hilf mir es selbst zu tun. Franzbecker: Lehrerinterventionen beim mathematischen modellieren.["help me to do it myself". Teachers' interventions in mathematical modelling processes]. Hildesheim: Franzbecker.

Lesh, R. & Doerr, H. (2003). A modelling perspective on teacher development. In Lesh, R. & Doerr, H. (Eds), *Beyond Constructivism – Models and Modeling Perspectives on Mathematics Problem Solving, Learning and Teaching*. Mahwah: Erlbaum, 125-140.

Lingefjärd, T. (2006). Faces of mathematical modelling. *Zentralblatt für Didaktik der Mathematik*, 38 (2), 96-112.

Ludwig, M. & Xu, B. (July 6-13, 2008). A comparative study on mathematical modelling competences with German and Chinese students. Proceedings from Topic Study Group 21 at the 11th International Congress on Mathematical ducation in Monterrey, Mexico. In Morten Blomhøj, Susana Carreira(Ed.), IMFUFA Tekst nr 461- June 2009,197-206.

Maaß, K. (2006). *What Are Modelling Competencies?* Zentralblatt für Didaktik der Mathematik, 38(2), 113-142.

Marcou, A. & Lerman, S. (2007). Changes in students' motivational beliefs and performance in a self –regulated mathematical problem-solving environment. Paper presented at the CERME 5. Cyprus

Ministry of National Education (2009). *Elementary (6th-8th grades) mathematics curriculum*. Milli Eğitim Bakanlığı Talim ve Terbiye Kurulu Başkanlığı, Ankara: Devlet Kitapları Müdürlüğü Basım Evi.

National Council of the Teachers of Mathematics-NCTMA (1989). Curriculum and evaluation standards for sclioolmathematics.Reston, VA: Author.

Niss, M. (1987) Applications and modelling in the mathematics curriculum – state and trends. *Int. J. Math. Educ. Sci. Tecnol.*, 18 (4), 487-505.

Nyman, M. A. & Berry,J. (2002). Developing transferable skills in undergraduate mathmetics students through mathematical modelling. *Teaching Mathematics And İts Applications*.21(1), 29-45

Pollak, H. (1979). The interaction between mathematics and other school objects. New trends in mathematics teaching IV(pp.232-248). Paris:UNESCO.

Schukajlow, S. ,Leiss, D. , Pekrun, R., Blum, W. , Müller, M. & Messner, R. (2011). Teaching methods for modelling problems and students' task-specific enjoyment, value, interest and self-efficicay expectations. *Educ Stud Math.*

Şencan, H. (2005). Sosyal ve Davranışsal Ölçümlerde Güvenilirlik ve Geçerlilik. Ankara: Seçkin Yayıncılık.

Verschaffel, L., Greer, B. & De Corte, E. (2000). *Making sense of word problems*. Lisse: Swets and Zeitlinger.

Yıldırım, A. & Şimşek, H. (2005). Sosyal Bilimlerde Nitel Araştırma Yöntemleri. Ankara: Seçkin Yayıncılık.

Critical Thinking Level of Biology Classroom Survey: Ctlobics

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ABSTRACT

Within this study, Critical Thinking Level of Biology Classroom Survey (CTLOBICS) was developed to determine to what extend Biology classroom environment supports Critical Thinking Culture. The survey was developed by following the scale development model by McMillan & Schumacher (2010). The theoretical framework of the study was adapted from Critical Thinking Strategies (Paul et al., 1990). The item pool of the survey was composed of these strategies expressed in sentences and a 59-item- scale was prepared along with the collected expert opinions. The pilot study was conducted with 387 9th, 10th and 11th grade students from two different secondary schools located in Trabzon in Turkey. The survey was finalized after Exploratory and Confirmatory Factor Analyses. The Survey has 32 items and 5 factors (Affective Critical Thinking Skills, General Thinking Skills, Basic Critical Thinking Skills, Associating with Real Life, Reasoning Skills). The inner consistency coefficient α of the scale was calculated as 0,92.

Keywords: *Critical thinking, biology education, survey, higher order thinking*

INTRODUCTION

"*Everyone thinks. But much of our thinking, left to itself, is biased, distorted, partial, uninformed or down-right prejudiced*." (Paul & Elder, 2002, p.15). The quality of our life is correlated with the quality of our thinking. We should be aware of our thinking process and we should systematically improve it (Paul *et.al.*, 1990).

Different cognitive skills have been referred as Higher Order Thinking Skills (HOTS) by different resources (Lewis & Smith, 1993; Zohar & Dori, 2003; Paul, 2005; Tilestone, 2005 p.47-58, Mulnix, 2011). Critical Thinking (CriT), Creative Thinking (CreT), Problem Solving and Reflective Thinking have been the most frequently mentioned HOTS. These HOTS overlap and coincide at times. Still, we think that CriT and CreT Skills are fundamental and it is possible to express the latter two by various combinations of CriT and CreT.

Even the basic literacy and calculation skills were redefined with the interpretation from the point of view of HOTS (OECD, 2005, p. 16; Kirsch, 2001, p. 1-5). Some scientists associate HOTS with the upper three levels of Bloom's Taxonomy of Educational Objectives (Bloom *et.al*., 1956; Krathwohl & Anderson, 2001). So, they associate lower three levels and all other irregular thinking styles with Lower Order Thinking (Zohar & Dori, 2003; Duron *et al*., 2006). Classifying HOT and Lower Order Thinking by referencing Bloom's Taxonomy is acceptable. However, it must be kept in mind that the Bloom's Taxonomy is only a classification to categorize objectives whereas HOTS like CriT or CreT are larger scale processes substantially reflecting on human behaviour.

CRITICAL THINKING

De Bono (1995) argues that "*many highly intelligent people are **bad thinkers***". He resembles the intelligence to horsepower of a car. One may still drive the car very badly even she/he has a very powerful engine. CriT Skills are like

one's driving skills. After reviewing widely accepted CriT definitions, Huitt (1998) evaluated the definition "*reasonable reflective thinking focused on deciding what to believe or do*" by Ennis (1992) as the best definition and defined CriT himself as; "*the disciplined mental activity of evaluating arguments or propositions and making judgments that can guide the development of beliefs and taking action*." Unlike intelligence, CriT Skills are improvable (Walsh& Paul 1988, p13) and they do not depend on age so they should be thought at all ages (Lipman *et.al*., 1980)

Conceptualization of CriT would be incomplete without quoting the staggering annotation added by Kuhn (1993) arguing that almost all the things we teach as CriT skills are nothing but some meta-cognitive strategies whereas CtiT is rather congenital and developmental.

CRITICAL THINKING & EDUCATION

"*Both Piaget and Vygotsky thought learning is what leads to the development of higher order thinking"* (Blake & Pope, 2008). Since the sixties governments have had tendency towards educational policies to adopt teaching /learning approaches and curricula teaching how to learn, expecting students to apply academic knowledge on daily life and to analyse situations and problems when they face for the first time. This situation so escaladed the significance of concerning HOTS in education that there were even some mass campaigns launched directly aiming to increase the CriT level of all stakeholders of education (King *et al.*, n.d.). What we end up today is all contemporary teaching/learning theories require altering the instructional paradigm in a way to ensure teaching and assessing HOTS with proper instruments (Brooks & Brooks, 1993; Tileston, 2005; Paul, 2005; Keles & Cepni, 2006; Jensen, 2008; Radin, 2009; MoNET, 2007, 2008a, 2008b, 2009, 2010).

There are standardized tests to assess CriT (Ennis, 1993; Stein, 2003), CreT (Torrance, 1966) and Problem Solving (Ross & Ross, 1976). Ennis (1993) evaluated certain standardized tests assessing personal CriT skills and dispositions. It would not be unfair to mention California Critical Thinking Dispositions Inventory (CCTDI) and Watson-Glaser Critical Thinking Appraisal (WGCTA) as most popular CriT tests. CCTDI is composed of 75-Likert items and assess only dispositions towards CriT (Stein, 2003; Facione & Facione, 1994). It has translated into several languages and applied on very large samples in different countries. WGCTA has 80 items (Watson& Glaser, 1980). Although WGCTA has some inspiring CriT texts and covers different daily-life bound issues deeply, it is a multiple choice test. In the same way, Stein (2003) reported; possible test bias, lack of cross-validation studies, and low item correlations for this appraisal.

Critical Thinking Level of Biology Classroom Survey (CTLOBICS) aims to evaluate CriT Culture *of* the classroom. Although the literature review yielded variety of standardized tests measuring CriT skills and dispositions of the individuals (Ennis, 1993; Stein, 2003; Insight Assessment, 2011) as individual scores by directing problems to be solved to reveal the attainment of individuals over determined HOTS objectives, no scale was found so as to assess the state of CriT environment in the classroom *holistically* by inquiring about classroom environment and teacher habits based on student opinions.

Extensively applied, Constructive Learning Environment Survey (Taylor & Fraser, 1991) is a good example of such tests measuring the state of learning environment holistically in terms of certain aspects. One of the best ways of assessing a thinking skill is to define the sub-skills and seeking them in related settings. The CriT sub-skills were listed by different researchers (Ennis, 1985; Paul *et al*., 1990; Facione, 1990). The CriT Strategies or 35-Dimensions of Critical Thought, put forward by Paul and his team (1990), have been one of the most widely accepted CriT Sub-skill Classifications.

Dr. Richard Paul and the Critical Thinking Community (CTC) are widely accepted contributers of CriT knowledge (The Critical Thinking Community, 2011). Based on 35 Dimensions of Critical Though, CTC remodelled various level lesson plans (K-3, 4-6, 6-9 and High-school) for the USA curricula (The Critical Thinking Community-Strategy List…, 2011). Some researchers cited and applied these CriT Dimensions in their studies (Greenockle & Purvis, 1995; Allen, 2003; Harrigan & Vincenti, 2004; Dolapci, 2009; Cimer & Timucin, 2010).

Turkey, where CTLOBICS piloted, has revised all primary and secondary level curricula referencing to contemporary learning theories since the year 2000 (Ministry of National Education Turkey MoNET, 2007; MoNET, 2008a; MoNET, 2008b; MoNET, 2009). The change was sudden but all the stakeholders of education have somehow internalized the new system by time. Now the curricula, approaches and teachers are partially capable of conducting instruction minding HOTS. However, the national university entrance examination poses multiple choice questions of Application or lower level of Bloom's Taxonomy. Teachers, students and even parents use the pressure put by this examination as an excuse and they favor a very uncritical way of learning by aiming marking the right choice of the

questions in the shortest time possible, generally with little reasoning (Cimer, 2004; Icbay, 2005; Timucin, 2008; Azar, 2010).

The situation for Biology course is even worse. The number of Biology course hours in most secondary school types is quite low, which makes it difficult to apply an innovation effectively or to create a continuous course culture. Thus, for Turkey case, it can be argued that the pressure caused by university enterance exam and the state of Biology course are two of major elements fundamentally shaping CriT and other HOT habits in classrooms (Ozden, 2007; Cimer & Timucin 2010).

In Turkey, Science and Anatolian Secondary Schools are popular with students with higher academic profile. Supposing the state of Biology course instruction is better and factorization would be clearer, one from both types was chosen for the pilot study.

PURPOSE

Within the frame drawn above; the aim of this study is to develop a scale to be applied on students to detect the status of CriT culture of secondary school Biology classrooms. In the reviewed literature, there is a tendency to assess CriT entities of individuals *separately* and to interpret averages of the individual scores to reflect the state of whole group. However, opinions of the individuals about the social process on-going in the classroom are another *shared* dimension. What makes CTLOBICS significant is its focusing this frequently missed dimension, which offers an innovative perspective and data triangulation opportunities. We also believe that this attempt will provoke further research and considerations about students' perception of the CriT aspects in their learning environment.

METHOD

Although this scale was planned to be supported by qualitative data, "Critical Thinking Friendly Biology Classroom Environment Survey" itself is a complete quantitative instrument. Roots of a quantitative study can be said to anchor into positivistic paradigm (Alev, 2003). Survey method fits the requirements of the studies aiming quantitative scales (Cepni, 2001, p.40). CTLOBICS was developed by following the scale development steps determined by McMillan & Schumacher (2010).

Sample

The sample of the study was 387 students attending 9^{th}, 10^{th} and 11^{th} grades at two different secondary schools in Trabzon/Turkey, as students of 4 different biology teachers. Minding the considerations about university entrance examination preparations, 12^{th} grades were not included in the study. The participants were asked to mark the frequency of the given event in the classroom by thinking about their biology course and teacher.

Table 1 summarizes the gender and school year distribution of the students in the sample. Prior to the application, the participant students were informed about the aim of the survey. All of the students were participated voluntarily. The printed form of the survey was applied. The average completion duration of the survey was about 15 minutes.

Table 1. Gender and Educational Level Distribution of the Participants

		Frequency (f)	Percent (%)
Gender	Female	183	47,30
	Male	204	52,70
	Total	387	100
Level (Grade)	9	193	49,87
	10	99	25,58
	11	95	24,55
	Total	**387**	**100**

Step One: Reviewing Literature and Writing Items

After reviewing the literature, setting the goals and theoretical framework (see *Introduction*), Critical Thinking Basic Strategies and explanatory examples (Paul *et.al*., 1990) were translated into Turkish. In order to avoid translation mistakes, Turkish scripts retranslated into English by a language expert and compared with the original text. Then

from this source the item pool of the pre-scale was formed with 62 Turkish items scripted from the strategies suitable to be expressed with statements of frequency. The items of the scale were 5-choice Likert type inquiring the frequency of the given teacher/classroom habit. They were graded as; (1) Less than 1 or 2 in a year / (2) 3-4 times in a month / (3) Once in 3-4 class hours / (4) A few times in each class hour / (5) A lot of times in each class hour.

Afterwards the scale was subjected to Validity Procedures, Item Analysis, Exploratory Factor Analysis, and Confirmatory Factor Analysis. Concerning the nature of the related data, the brief explanations and findings of these procedures are presented in *Results* section.

RESULTS

Content and logical validity procedures were applied to check whether the items in the pre-scale fit the defined aims and assessment aims (Fraenkel & Wallen, 2008). For this aim the pre-scale was subjected to the supervision of 3 related field and 1 assessment expert. Along with the feedback, the items of the scale were revised and altered; 3 items were removed for being almost coincident. 59-item pilot scale was formed. All the items were favourable things desired to happen more frequently for the sake of CriT. All the items were positive statements except for item 55 '*Never gets angry when we tell the truth*' but then it excluded in the factor analyses. Then two Turkish Language Education experts checked the pilot scale in terms of language comprehensibility and spelling. Finally, pilot scale was pre-applied to a 9th grade classroom in another school than the sample and the students were interviewed about whether/how they understood the items of the scale. The implementation was conducted as defined in *Sample* part.

Step Two: Item Analysis

Item analysis procedures were applied on the data set obtained from the sample by the 59-item scale. In the first place, item total correlation values were calculated to determine discrimination power index of the items. It was concluded that, item total correlation values varied between 0,41 and 0,69 and the values were greater than the acceptable limits (Buyukozturk, 2009).

Then, skewness, kurtosis, standard deviation and average score values were examined to test the data distribution. It was observed that, standard deviation values varied between 0,84 and 1,36 while average item scores were between 2,29 and 4,35. Skewnees index value were between -1,26 and 0,68 and kurtosis index value were between -1,16 and 1,40 and these values support the normality of the distribution of the data set.

Step Three: Exploratory Factor Analysis

This step tested the structural validity of the scale. The concept of structural validity was defined as; "*the degree of precise measurement of an abstract concept in the context of the behaviour which is to be measured*" (Buyukozturk, 2007). In this study, explanatory factor analysis and basic components analysis were applied to picture the factor structure of the scale (Tabachnick & Fidell, 2007). Varimax Rotation Technique, which is frequently applied and easy to interpret, was used as factor rotating method (Pallant, 2001; Brown, 2006). Prior to the factor analysis, Kaiser-Meyer Olkin (KMO) and Barlett tests were performed to test the compatibility of the data and the sample for basic components analysis (Tabachnick & Fidell, 2007).

KMO coefficient was calculated 0,902 and since it was greater than 0,6 it was concluded that the sample size is sufficient for factor analysis (Hutcheson & Sofroniou, 1999). On the other hand, Barlett test was significant at ($p<0,000$). That Barlett test was significant at ($p<0,001$) indicates that the data set is significant for factor analysis and can be factorized (Field, 2005).

Following KMO and Barlett tests basic component analysis was carried out. Factor load values of the items were calculated. While factors were being formed, it was tried to be arranged so as to each item has only one great factor load value in a single factor. If it has two great factor load value in two different factors the difference between them was arranged greater than 0,1 and the factor load of the factor which they belong was arranged greater than 0,4 (Bandalos& Finney, 2010; Field, 2005).

When the factor load values formed by the conducted factor analysis were examined, it was found out that 14 items were coincident and they were excluded from the scale. As a result of the repeated basic component analysis with the remaining 45 items, it was observed that 7 more items had more than one great factor load values and they were excluded, too. In order to define the factor structure of the scale basic component analysis re-applied with

Varimax Rotation Technique on these 32 items. KMO value was found as 0,917 and BTS revealed an Approx. Chi-Square value of 4938,380 with a significance value of 0,000. These values granted that the sample is proper and data set can be factorized. As seen in Table 3, the factor loadings of 32 items on the scale ranged from 0,42 to 0,69. The communalities were acceptable. Components factor loading and varimax factor loading values are presented in Table 2.

The analysis of these 32 items yielded 5 factors with factor load values greater than 1.0 and explaining the 52,26% of the total variance. The variance ratio that is explained by 5 factors (52,26%) is acceptable for social sciences (Scherer, Wiebe, Luther & Adams, 1988). Eigenvalue and variance explained by each factor were; 1st factor 9,913 and %30,98 ; 2nd factor 2,678 and %39,347; 3rd factor 1,482 and %4,63; 4th factor1,459 and %4,559; 5th factor 1,193 and %3,729 respectively. When the values obtained by Varimax Rotation was reviewed, it was observed that rotated factor load values of the items varied 0,43 – 0,73. The related values were within the acceptable limits (Field, 2005). Table 3 presents variance ratios explained by each factor and eigenvalues before and after the Varimax Rotation:

Table 2. Factors and Factor Loading Values of the Items

Factors & Items	Factor Loadings	Varimax Factor Loadings	Factors & Items	Factor Loadings	Varimax Factor Loadings
Factor 1 Affective Critical Thinking Skills			Factor 2 General Thinking Skills		
Item28	,601	,725	Item15	,593	,737
Item23	,590	,717	Item17	,548	,714
Item22	,653	,685	Item24	,553	,689
Item29	,576	,678	Item16	,537	,612
Item31	,557	,673	Item18	,631	,561
Item32	,526	,672	Item19	,624	,430
Item30	,613	,657	Factor 3 Basic Critical Thinking Skills		
Item24	,553	,641	Item3	,461	,696
Item25	,667	,632	Item4	,536	,635
Item20	,640	,627	Item8	,485	,596
Item27	,553	,614	Item2	,392	,533
Item26	,616	,556	Item5	,540	,519
Item21	,672	,551	Item1	,506	,512
Factor 4 Associating with Daily Life			Factor 5 Reasoning Skills		
Item7	,487	,722	Item12	,559	,681
Item6	,506	,669	Item13	,518	,578
Item9	,599	,668	Item11	,529	,484
Item10	,525	,602			

Table 3. Principal Component Factoring Analysis: Total Variance Explained

	Extraction Sums of Squared Loadings		Rotation Sums of Squared Loadings	
Factor	Eigen Value	Percentage of Variance (%)	Eigen Value	Percentage of Variance (%)
1	9,913	30,980	5,957	18,614
2	2,678	8,368	3,747	11,711
3	1,482	4,630	2,243	7,009
4	1,459	4,559	2,203	6,883
5	1,193	3,729	1,824	5,701
Cumulative %		55,579		55,579

After the explanatory factor analysis 27 items were excluded from 59-item pilot scale and a 32-item, 5-factor scale was obtained (*see CTLOBICS available as supplementary material accompanying the online article*). The first factor (*Affective Critical Thinking Skills*) had 13 items, the second (*General Thinking Skills*) and the third (*Basic Critical Thinking Skills*) had 6 items, the forth (*Associating with Real Life*) and the last (*Reasoning Skills*) had 3 items. The factor names were given concerning the factor content and the related literature.

Step Four: Confirmatory Factor Analysis

Following to the explanatory factor analysis, confirmatory factor analysis (CFA) was applied to test the suitability of formed structure (model) to the data and structural validity of the factors (Maruyama, 1998; Kline, 2005). "*The purpose of CFA is to identify latent factors that account for the variation and co-variation among a set of indicators.*" (Brown. p.40). In this study, Chi-Square (χ^2), χ^2/degree of freedom, Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Non-Normed Fit Index (NNFI) and Comparative Fit Index (CFI) were referred as fit indexes. After CFA, the mentioned fit index values were formed as; χ^2= 995,80; χ^2/df=2,37; RMSEA=0,060; SRMR=0,06; GFI=0,86; AGFI=0,83; NNFI=0,96; CFI=0,96. Since χ^2 value is not significant, χ^2/df ratio is below 3, RMSEA value is smaller than 0.08, SRMR index value smaller than 0.08, GFI index value greater than 0,90, AGFI index value greater than 0,80 and NNFI and CFI index values are greater than 0,90, the produced model can be said highly fit (Brown, 2006; Klem, 2000; Kline, 2005; McDonald & Ho, 2006). When fit index values after CFA were evaluated, it was concluded that the 32-item scale is fit and applicable without any modification.

Step Five: Reliability Analysis

Reliability concept; explains the consistency of the measurement process (Fraenkel & Wallen, 2008). Internal Consistency Reliability was applied to test the consistency among the individual items in the scale as a measure of reliability (Scott & Morrison, 2006). The reliability of the 32-item scale was expressed with Cronbach's Alpha (α) correlation coefficient as 0,92.

The individual reliability coefficients of the factors were determined as; *1st Affective Critical Thinking Skills*: 0,89, *2nd General Thinking Skills*: 0,77, *3rd* Basic Critical Thinking Skills: 0,74, *4th Associating with Real Life*: 0,72, *5th Reasoning Skills*: 0,69. It was obvious that overall scale and individual factor reliability coefficients were very close to reliability range 0,70 and above the ideal reliability limit (Creswell, 2005). On the other hand item total correlation values were calculated to determine discrimination power of the items in the scale. They varied between 0,31 and 0,63. These values imply that discrimination powers of the items in the scale were in acceptable limits (Buyukozturk *et.al.*, 2010). This step finalized the 32-item, 5-factor scale.

The final form of the survey was translated from Turkish into English by two different experts and the translations were compared. In the end, the English survey form translated back into Turkish and it was compared with the original Turkish text and the survey form was reached. The parts in *italic* were items excluded from the survey after consecutive factor analyses (*see CTLOBICS available as supplementary material accompanying the online article*).

In order to obtain feedback about the content validity of the survey and a kind of informal consent from the founder of the initial theoretical framework of the study, the survey was sent to a field expert (Dr. Enoch Hale, a fellow of the CTC and co-worker of Dr. Richard Paul, an author of Paul *et al.* (1990), personal communication *via* e-

mail, September 22, 2011). He offered some alterations like specifying words towards comprehensibility and critical thinking terminology for items 1, 3, 4, 5, 6, 9, 10, 12, 13, 20, 22, 25, 29, 32, 33, 37, 40, 41, and 54. Concerning statistical requirements, possible changes were reflected on the survey form. One comment by him needed splitting an item so it could not be reflected. He thought that it may be more useful if item 1 was broken into two as: *"#1 Grounds content concepts, principles and processes with examples. #2 Challenges us to extrapolate general rules from the examples presented in class"*

Discussion & Conclusion

Setting sail from the point of supporting HOTS and assessing them with proper tools is vital part of the contemporary teaching and learning theories, we end up with a survey having 32 items and 5 factors with the inner consistency coefficient α=0,92. Although there are variety of scales to detect different HOT components, CTLOBICS seems to be unique with measuring the state of CriT holistically by referencing the student opinions about the frequency of CriT inducing events in classroom environment. This environment is shaped not only by teachers but also by the interaction between teachers and students. CTLOBICS focuses on not individualized talent, but the total social effect. This perspective, we believe, will yield another layer of quantitative data and pave way for further researches into this field.

As well as teachers and school managers may use CTLOBICS to evaluate classroom environments, it can also be used in variety of study areas particularly scientific studies conducted in contemporary teaching/learning approaches based classroom environments prioritizing HOT. CTLOBICS can gather data to constitute quantitative legs of such groups of existing studies (Cimer & Timucin, 2009):

- Determining CriT skill level of various learner and teacher groups,
- Developing or improving educational components like learning environments, instructional materials *etc*. by concerning CriT and/or other HOTS
- Investigating effects of educational innovations on CriT features of learners/teachers,
- Evaluating or developing curricula with respect to CriT or HOT elements.

CTLOBICS can be scored in a way to have 1 for the least frequent, 2 for the next and so on, and 5 for the most frequent choices for each item. Therefore all-32 items will yield maximum total score of 160. Classroom averages can be used to have an idea about the CriT state of the Biology course for that classroom. In further studies, all over survey scores of CTLOBICS may be compared to sub-scale scores and their relations can give further ideas about the CriT state of the classroom. As there are more studies to be referenced, the factor scores and the overall score of the survey can be classified as high, medium, and low. If there are no results to compare, the median value of the applications can be used to manage such classification.

To a large extent, factorization of the survey was in an expected way. Based on CriT literature and definitions, the factors were named as; *Affective Critical Thinking Skills, General Thinking Skills, Basic Critical Thinking Skills, Associating with Real Life, Reasoning Skills*. It was realized that the clarity and comprehensibility of the items had an important part in healthy factor formation and eventually the existence of the items in the final form. Therefore, it must be focused on preparing items with single statement and with clear, single meaning when similar scales are being developed or the scale is being translated into other languages. Still, the researchers or teachers to apply this survey should reconsider the comprehensibility of the survey concerning the level of their students.

For availability reasons this study was conducted with 4 teachers teaching 9^{th}, 10^{th} and 11^{th} grades, the final form of CTLOBICS can be applied or re-piloted in different school types or with more homogenous samples. Moreover, the survey can be applied cross-culturally in different languages and the results may be compared. The effect of gender was not monitored in this study; further studies may inquire about the probable impact of the gender factor.

CTLOBICS has no direct reference to 'Biology Course' in the body text so pilot studies for different courses may be designed. Backed with literature and the observations conducted within the other steps of the present study (Cimer & Timucin 2010), it can be argued that adding items or even factors concerning student- student interaction and humour domains may positively affect content validity of further studies. For future improvements of similar scales it can be recommended that; instead of 'slicing out' CriT Skills, holistic scales sensitive to all types of HOTS in the classroom environment may be prepared containing factors or sub-factors as; Critical Thinking, Creative Thinking, Reflective Thinking and Problem Solving. Last but not least, customized assessment of thinking skills is generally more

valid (Stein, 2003). So, quantitative instruments should always be combined with qualitative complements, preferably rubrics prepared for the unique cases of teachers or researchers.

REFERENCES

Alev, N. (2003). Integrating Information and Communications Technology (ICT) into Pre-service Science Teacher Education: The Challenges of Change in a Turkish Faculty of Education. Unpublished Doctoral dissertation, University of Leicester, School of Education, UK.

Allen J., (2003). Fostering Ethical Competence in Nursing Education. Clinical Research and Regulatory Affairs, 20(4), 373-377.

Azar, A. (2010). The effect of critical thinking dispositions on students achievement in selection and placement exam for university in Turkey. Journal of Turkish Science Education, 7(1), 61-73.

Bandalos, D. L., & Finney, S. J. (2010). Factor analysis: Exploratory and confirmatory. In G. R. Hancock & R. O. Mueller (Eds.), The reviewer's guide to quantitative methods in the social sciences (pp. 93-114). New York: Routledge

Blake, B., & Pope, T. (2008). Developmental psychology: Incorporating Piaget's and Vygotsky's theories in classrooms. Journal of Cross-Disciplinary Perspectives in Education, 1(1), 59-67.

Bloom, B., Englehart, M., Furst, E., Hill, W., & Krathwohl, D. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive Domain. New York: Longmans Green.

Brooks, J.G., & Brooks, M.G. (1993). In search of understanding: The case for constructivist classrooms. Alexandria, VA: Association of Supervision and Curriculum Development.

Buyukozturk, S. (2009). Sosyal Bilimler icin Veri Analizi El Kitabı (10th Ed.). Ankara: PegemA Yayıncılık.

Creswell, J. W. (2005). Educational research: Planning, conducting and evaluating quantitative and qualitative research. New Jersey: Pearson Prentice Hall.

Cepni, S. (2001). Arastırma ve Proje Çalışmalarına Giriş. Trabzon: Erol Ofset.

Cimer, S. (2004). An Investigation into Biology Teachers' Perceptions of Classroom Assessment in Secondary Schools in Turkiye, Unpublished Doctoral dissertation, The University of Nottingham, UK.

Cimer, S., & Timucin, M. (2008). Formative assessment perceptions and habits of primary school english teachers: Trabzon Case, VII. International Educational Technology Conference (IETC-2008), Eskisehir, Turkey.

Cimer, A., & Timucin, M. (2009). Critical Thinking Theses in Turkey. Paper presented in 3rd International Computer and Instructional Technologies Symposium (ICITS 2009), Trabzon, Turkey, p.173.

Cimer, A., & Timucin, M., Content of an in-service training to develop and assess activities minding critical thinking. World Conference on Teaching Learning and Administration, The American University Conference and Visitor Center, Cairo, Egypt (29-31 October 2010).

Cimer, A., & Timucin, M. (2010). Content of an in-service training to develop and assess activities minding critical thinking. Procedia Social and Behavioral Sciences, 9, 958–962.

De Bono, E. (1995). Mind Power. New York:Dorling Kindersley.

Dewey,J., (1982). How we think. Lexington, MA: Heath, (Originally published in 1910).

Dolapcı. O.C., (2009). The evaluation of the workshop about informing the teachers on the subject of critical thinking. (Unpublished master's thesis) Institute of Social Sciences. Yeditepe University. Istanbul, Turkey.

Duron, R., Limbach, B., & Waugh, W. (2006). Critical thinking framework for any discipline. International Journal of Teaching and Learning in Higher Education, 17(2), 160-166.

Ennis, R. H. (1993). Critical Thinking Assessment. College of Education, 32 (3), 179-184.

Facione, P.A., & Facione, N.C. (1994). The California Critical Thinking Skills and Test Manual. Millbrae, CA: California Academic Press.

Field, A. (2005). Discovering statistics using SPSS. London: Sage.

Greenockle, K.M., & Purvis G.J. (1995). Redesigning a secondary school wellness unit using the critical thinking model. The Journal of Physical Education, Recreation & Dance, 66(6), 49-52.

Harrigan, A., & Vincenti. V. (2004). Developing higher-order thinking through an intercultural assignment: A scholarship of teaching inquiry project. College Teaching 52(2), 113-120.

Ho, R. (2006). Handbook of univariate and multivariate data analysis and interpretation with SPSS. Florida: Chapman & Hall/CRC.

Huitt, W. (1998). Critical thinking: An overview. Educational Psychology Interactive. Valdosta, GA: Valdosta State University. Retrieved 19 April, 2011, from, http://www.edpsycinteractive.org/topics/cogsys/critthnk.html

Icbay, M. A. (2005). A SWOT Analysis on the university entrance examination in Turkey: A case study. Mersin Universitesi Eğitim Fakultesi Dergisi. 1(1), 126–140.

Insight assessment. (2011). A Division of California Academic Press. Retrieved 10 December, 2011, from http://www.insightassessment.com/Products

Jensen, E.P. (2008). A fresh look at brain-based education. (cover story). Phi Delta Kappan, 89(6), 408-417.

Keles, E. & Cepni, S. (2006). Brain and Learning. Journal of Turkish Science Education, 3(6), 66-82.

King, F.J., Goodson, L., & Rohani, F. (n.d.) Higher Order Thinking Skills: Definition, Teaching Strategies, Assessment. Report by Center for Advancement of Learning and Assessment. Retrieved September 15, 2011, from www.cala.fsu.edu/files/higher_order_thinking_skills.pdf

Kirsch, I. (2001). The International adult literacy survey (IALS): Understanding what was measured, educational testing service research report RR-01-25, Princeton, New Jersey.

Klem, L. (2000). Structural equation modeling. In L. Grimm & P. Yarnold (Eds.), Reading and understanding multivariate statistics, Vol. II. Washington, DC: American Psychological Association.

Kline, R.B. (2005). Principles and Practice of Structural Equation Modeling (2nd ed.). New York: The Guilford Press.

Kuhn D. (1999). A developmental model of critical thinking. Educational Researcher, 28(2), 16- 46.

Krathwohl, D. R, & Anderson, L.W. (2001). A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. Allyn & Bacon. Boston, MA

Lewis, A., & Smith, D. (1993). Defining higher order thinking. Theory into Practice, 32(3), 131–137.

McDonald, R. P., & Ho, M-H. R. (2002). Principles and practice in reporting structural equation analyses. Psychological Methods, 7, 64 – 82.

MoNET (2007). Directorate of Student Discipline Board, Secondary Education 9th Grade Biology Course Curriculum, Ankara.

MoNET (2008a). Directorate of Student Discipline Board, Secondary Education 10th Grade Biology Course Curriculum, Ankara.

MoNET (2008b). Directorate of Student Discipline Board, Secondary Education 11th Grade Biology Course Curriculum, Ankara.

MoNET (2009). Directorate of Student Discipline Board, Secondary Education 12th Grade Biology Course Curriculum, Ankara.

MoNET (2010). Oğretim Programlarının Yenilenmesini Zorunlu Kılan Nedenler. MEB (The Reasons Obliging the Renewal of the Curricula). Retrieved June 21, 2010, from http://ttkb.meb.gov.tr/programlar/prog_giris/prog_giris_6.html

Mulnix, J. W. (2012). Thinking Critically about Critical Thinking. Educational Philosophy and Theory, 44(5), 464-479. doi: 10.1111/j.1469-5812.2010.00673.x

OECD (Organisation for Economic Co-operation and Development), Directorate for Education (2005). Definition and Selection of Key Competencies: Executive Summary. Retrieved from: http://www.oecd.org/dataoecd/47/61/35070367.pdf (July 5, 2011)

Ozden, M. (2007) Problems with science and technology education in Turkey. Eurasia Journal of Mathematics, Science & Technology Education, 3(2), 157-161.

Paul, W.R., Binker., A., Jensen, K., & Kreklau, H. (1990). Critical Thinking Handbook: A guide for remodeling lesson plans in language arts, social studies and science. Rohnert Park, CA: Foundation for Critical Thinking.

Paul, R., & Elder, L. (2002). Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life. New Jersey: Financial Times Prentice Hall

Paul, W.R. (2005). The state of critical thinking today. New Directions for Community Colleges, 130, 27-38.

Radin, J.L. (2009). Brain-compatible teaching and learning: Implications for teacher education. Educational Horizons, 88(1), 40–50.

Ross. J., & Ross, C. (1976). Ross test of higher cognitive processes manual. Los Angeles, CA: Western Psychological Services.

Scott, D., & Morrison, M. (2006). Key ideas in educational research. London: Continuum International Publishing Group.

Stein, B.S., Haynes, A.F., & Unterstein, J., (2003). Assessing Critical Thinking Skills. Contribution to SACS/COC Annual Meeting / Nashville, Tennessee / December 6 - 9, 2003.

Tabachnick, B.G., & Fidell, L.S. (2007). Using Multivariate Statistics (5th ed.). Pearson Education, Inc. / Allyn and Bacon.

Taylor, P.C., & Fraser, B.J. (1991, April). Development of an instrument for assessing constructivist learning environments. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, L.A.

The Critical Thinking Community (2011). The Critical Thinking Community Foundation for Critical Thinking. Retrieved December 10, 2011, from http://www.criticalthinking.org/pages/dr-richard-paul/818

The Critical Thinking Community-Strategy List. (2011). The Critical Thinking Community Foundation for Critical Thinking. Retrieved December 10, 2011, from http://www.criticalthinking.org/pages/strategy-list-35-dimensions-of-critical-hought/466

Torrance, E.P. (1966). Torrance Tests of Creative Thinking: Norms technical manual. Princeton NJ: Personnel Press.

Tileston, D. (2005). 10 best teaching practices (2nd ed.). Thousand Oaks, CA: Corwin Press. Retrieved September 20, 2011, from Google Books, http://books.google.gm/books/about/10_best_teaching_practices.html

Timucin, M. (2008). Turkish Primary School Teachers' Perceptions About Formative Assessment, XIII World Congress Of Comparative Education Societies Living Together: Education And Intercultural Dialogue Program, Sarajevo, Bosnia-Herzegovina

Timucin, M. (2009). History of Critical Thinking. Paper presented in 3rd International Computer and Instructional Technologies Symposium (ICITS 2009), Trabzon, Turkey.

Walsh, D., & Paul, R. (1988). The goal of critical thinking: From educational ideal to educational reality. Washington, D.C.: American Federation of Teachers.

Watson, G., & Glaser, E. M. (1980). Watson-Glaser Critical Thinking Appraisal. San Antonio, TX: Psychological Corp.

Willingham, D.T. (2007). Critical thinking: Why is it so hard to teach? American Educator, 31(2), 8-19.

Zohar, A., & Dori, Y.J. (2003). Higher order thinking skills and low achieving students: Are they mutually exclusive? The Journal of the Learning Sciences, 12, 145–182.

Experiences of First Day of Teaching

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ABSTRACT

Purpose of this study is to investigate new teachers' first day expectation, challenge and coping strategies. In order to investigate this phenomenon 16 pre-service early childhood education teachers studying at the same teacher education program were interviewed immediately before their graduation. Participating teachers started to teach at different cities in public schools. Then, researchers contacted with them at the end of the first semester they taught to have another interview. Moustakas's (1994) phenomenological analysis was utilized to analyze the data. Findings have revealed that pre-service teachers were aware of some problems that they would probably encounter in their first day of teaching such as crying children. Yet, teaching children who did not know Turkish or teaching 56 children in their first day were not exactly what they expect initially.

Keywords: *Teaching, Experiences*

INTRODUCTION

It has been long assumed that first day of teaching has pivotal role to shape forthcoming school year (Flaxman, 1999; Kellough, 2009; Wong & Wong; 1998). Therefore, first day of teaching requires special preparation and implementation. It is the time for setting course purpose, discussing syllabus, and getting accustomed to each other (McKeachie, 2002). Well-planned and successful first day is indicator of successful year in which both students and teacher can satisfy their needs. Meeting with students and setting and explaining rules take priority among the many first day activities. If rules are not clear, relevant, simple, and straightforward, then the teacher should be ready for disorganization in the class (Brooks, 1985; Emmer, Everston & Anderson, 1980). Consequences of appropriate and inappropriate behavior should be predetermined and clarified in class and applied consistently to establish credibility and predictability (Emmer, Everston & Anderson, 1980). Effective primary grade teachers spend more time and use variety of instructional materials and motivate students by using praise in their first day of teaching. (Bohn, Roehrig & Pressley, 2004). Many studies have showed that early career stage of teachers is characterized by lack of confidence, frustration, anxiety, stress, self-doubt, sense of incompetence, classroom management problems, lack of support, pressure, low confidence, concerns, and challenges since they have to deal with the teaching load and the other responsibilities at school (Achinstein, 2006; Evans, 1997; Gold, 1996; Huberman, 1992; Ingersoll, 2001; Stokking, Leenders, Jong, & Tartwijk, 2003; Veenman, 1984).

The first day of the class has long lasting effect on students. When students experience a positive first day, they have positive attitude towards both the course and the instructor, feel more motivated, and even have higher grades. On the contrary, students with negative first day experience feel less motivated even when the instructor behave kindly throughout the course (Wilson & Wilson, 2007). The literature on the first day of school concentrated more on elementary and high school students and teachers or even college students, and less on preschool students and teachers. This study aimed to investigate first day of beginning early childhood education (ECE) teachers by focusing on their first day expectations before they start the profession and the first day experiences when they start teaching. Investigating beginning teachers' first day experiences could bring a comprehensive understanding of what they need

and how they would overcome problems in that day.

RESEARCH METHODOLOGY

The study was a part of a more comprehensive study investigating beginning early childhood teachers' first year experiences. As the more comprehensive study was conducted in two phases, the present study was also conducted in two phases. The detailed recruitment process of the participants for each study and data collection procedures are described below.

Study I

A total of senior 25 pre-service early childhood education female teachers who were studying at the same early childhood education program in Turkey participated in Study I. Participants had field experience courses in their 2nd, 5th, 7th, and 8th semesters in the program, each required them to spend one day per week during the semester. Although pre-service teachers were only expected to observe their cooperating teachers in their first field experience courses, they generally could not stay as non-participant observers, and engaged in teaching earlier than other teacher education students. They carried on field experience in private schools at the first three practicum courses and they gained experience in public schools at the last practicum course. All of the field practice schools were located in Ankara, Turkey and served middle and high income level parents; thus, participants had no experience with children coming from low income level and rural areas. The participants were in their end of the 8th semester when Study I was conducted.

The participating pre-service teachers were asked to imagine their first day in class with their students immediately before their graduation. They were interviewed through semi-structured interview protocol designed for the actual study. They had never been in a practicum school on the first day of teaching since practicum starts after schools were opened, and were asked to imagine their first day of teaching, expectations, preparation and coping strategies if they would encounter problems in that day.

Study II

Many participants of Study I were hired by the Ministry of National Education (MONE) to work at public schools due to the efforts in increasing the schooling rate in early childhood education in Turkey. Considering that the participants mostly had private school experiences in a large capital city, Study II participants were chosen among the Study I participants who were working in public schools and were likely to have a first day experience in an unfamiliar context. A total of 16 participants working in 10 different cities in Turkey were recruited for Study II and it was performed after the first semester that participating teachers taught. They were asked about their experiences in the first day of teaching, their preparation process, and their experiences. Three participants provided written answers for the interview questions since they worked in the most distant cities during the study.

Data Analysis

The phenomenological analysis developed by Moustakas (1994) was used in this study to analyze the data. The interviews conducted for the study were transcribed verbatim for the phenomenological analysis. The analysis started with highlighting significant statements that provided an understanding of the how participants experienced the phenomenon. Then, the meaning or meaning units are listed from the significant statements. Researchers removed overlapping and repetitive statements so that clusters and themes had appeared. Textural descriptions of the experience was formed using clustered themes and meanings and essence of the phenomenon were constructed (Moustakas, 1994). Data analysis process was monitored by researchers in the field of teacher education and early childhood education. Participants were referred by "P" followed by a number.

FINDINGS

Study I

Participants' perceptions and expectations about their first day at school was asked in order to investigate the types of problems or supports they thought they might have at schools. P1 summarized all participants' expectations of first day:

"Due to separation anxiety children might not want to come to school, do not want to come into the class. I know that the type of children I will meet first day are crying children... When I imagine first day it is a chaos".

P3 associated her concern with being an ECE teacher:

"I do not know what should I do or what should I say… but I have self doubt. Do I look like a teacher? If I were a content area teacher I would explain units, I would ask their expectation about course… Content area teachers' first day is easy but ECE teachers' [first day] is not".

They expected chaos in the class where many children would cry and not knowing what to do lead some participants to plan the first day ahead.P9 expressed her imagined first day as follows:

"Probably it will be most planned day of my teaching life...I might plan an activity involving parents. I meet parents, children get know each other...children introduce themselves and mention about their characteristics".

Participants seemed to plan to focus on helping children to overcome their school anxiety due to being separated from their parents in their first day. P15 was planning to separate children from their parents step by step to lessen their fear of being alone in the class:

"Children might insist that their mothers do not leave class. At first I let mothers to stay in class then they will stay in front of the door. I mean mothers leave the class step by step so that it would not be a sudden separation both for children and parents".

P7 claimed that she would try to make children take possession of class so that they would get used to school easily:

"I will ask children to bring something from home in order to make children take possession of class or they will draw a picture and hang it on wall. I want to create a sense of community in the class".

P12 remembered her first day in an ECE class when she was a child and her problems. She expected to receive the support that beginning teachers might need:

"I went to ECE class for a week and I remember my first day that I really struggled. It was difficult to get used to other children and the teacher. Besides, it was difficult to be separated from mother and to come to school... I suppose there is a guide to inform me about children. I think schools never suddenly leave teacher with children alone. At least if I had a school I never leave beginning teacher with children".

Study II

Even in normal circumstances handling first day of school is difficult for new teachers. This study showed that Ministry of National Education's (MONE) inappropriate practice made first day of teaching even more troublesome for novice teachers. Infrastructure problems and delay in teacher appointment for public schools were main problems originated from MONE itself. In this study most of the participants were appointed after school opened which made them start to teach suddenly. P5 exemplified a typical entry into teaching in public schools:

"We visited school for getting information about school. I have not applied for official procedure. We just visited the school to see. Administrators had so many works and they were busy. They asked me to enter class in that day. I accepted"

MONE's unorganized hiring policy increased negative effects of sudden entry. Beginning teachers would have some time to get used to school and local culture where the school is located. However, MONE appointed teachers with delay and beginning teachers lost that chance to orient themselves in an unfamiliar situation. P3 expressed her negative feelings in following quotation:

"Our appointment was delayed. Normally we needed to start on September 1st but my start-up was September 18th. I came and started. There was no orientation for me. I was not familiar with this town, I was not familiar with school, and I did not know anyone. I hope it will not happen to this year's newly appointed teachers. They would be appointed in August and know where they will go. I arrived in town with my father and here you go I started. It was just like a nightmare. I do not even want to remember."

First day of teaching was not much different than what beginning teachers expected. Teachers had to deal with crying children. P1 mentioned about her first day:

"First day many many children cried... First week passed with crying children and separation anxiety. We could not make activities orderly in the first week. Just orienting and enjoying school [activities]".

First day of school is even more difficult with young age groups. Number of children in young age group is restricted according to early childhood education legislation. Yet, administrators sometimes register more children than the class capacity. Large class size and having young age group made things harder for P5 in first days. Fortunately, all of the participants were well aware that chaotic class atmosphere was temporary and it would last quite a while until the class order settle down. She was not panicked and handled the situation:

"First days passed terribly. I think 24 children were even too many for 6-year-old class. Besides, some of the children were too young. They were 2.5 years old. I was surprised. [Her mother] brought such a small child into class. I would not do that. They were all crying. Especially 8 children were crying badly. They were crying madly. They were not ready. They cannot separate from mothers. School made an unreasonable decision by registering such a young children...They were all crying and I realized that it was meaningless to play or do something else. Nothing else took their attention. They were screaming, struggling desperately due to their mother's absence. I found it hard to handle children but I was not panicked that much. I knew that it was a temporary situation."

Keeping 3-years old children in class was considered as accomplishment at first day. P9 explained difficulty of working with young age group:

"My first day in class was very difficult. I chose to work with 3-year-old children but first 10 days passed with regret. I remember that I said: I wish I had chosen 6-year-old children. I had 13 children...They were continuously crying...they were escaping class to see their siblings at upper classes.

I was sitting in front of the door. Children were shocked at first day. Beside I was kicked and hit [by children]"

Uncertainty stemming from lack of experience was characteristics of the first day of teaching. Even though they prepared daily plan and activities before coming class, all of the beginning teachers had time management problems in first days. Beginning teachers needed some time to set the flow of day. P2 mentioned about her first days:

"It has finished in 3 or 4 hours. I felt that I do know anything. As if I did not study ECE program. I was puzzled what to do. Then I gave painting papers. I said Oh! Should I have given this? I was panicked. [Daily plans] were not enough first 2-3 months and I was going with 2-3 plans."

Beginning teacher's problems could not be restricted in first days rather whole week can be considered as settling down process in school as illustrated by P4:

"After talking about what we are going to do whole day, we looked around the school. We showed dining hall and sleeping room. First week passed with crying children and children who did not want to separate from mother. Besides activities was not conducted regularly because [we wanted to] made them just get used to school and love school. Let them play with what they want to play. It passed freely."

Similarly, P10 expressed how hard her first week of teaching:

"I could not even differentiate as first day. My first week was a chaos. Let's say. I was not even aware of what was I doing because there was a bunch of things that I did not know which one I should handle. I was trying to know people, children, and parents. Everything simultaneously came over me."

Even though participants expected challenging first day of teaching, their experience exceeded what they predict in remote areas. Beginning teachers sometimes experienced region specific problems. Substantial regional differences between eastern and western part of Turkey caused some problems for teachers. P6 was unable to use most vital tool for teachers that language:

"I was shocked when I saw preschool children. We could not communicate because children did not know Turkish. There were 60-70 children and 6-7 teachers in class and it was exactly a chaos".

P13 found her own solution for children who did not know Turkish:

"At the beginning we communicate with body language. 3 or 4 children know Turkish. The others understand but cannot speak. Some of them neither understand nor speak. I used body language and showed visual materials...To say "sit down" I show sitting"

Challenges of first days even affected teachers' health. Twelve participants lost their voice in first weeks because of speaking loudly or using wrongly. Problems with P8's voice continued throughout year and caused inconvenience in her teaching:

"I had pharyngitis when I began to teaching. I lost my voice for ten days in first semester. My voice still goes time to time. It is awful. Nothing can be worse than losing voice for teachers. I am still in a difficulty and I cannot speak for a long time."

Beginning teachers' fear and concern about being responsible of all class diminished in time as stated by P11:

"At first I frighten a lot. I was thinking in practicum course that what would happen, if I totally in charge of this class. I was seriously frightened. Would I be able to manage? Would I be able to direct? Is a problem going to arise? Would I be able to make crying children calm down? However, I had a courage when I began. My fear has gone".

Not all beginning teachers experienced problems in their first days. P14 explained why she did not have much trouble in first day:

"Additionally, I did not experience much trouble the first days because we played so much play. I did not let children free. We continuously played, and sang. There was a continuous action. We never sit and conduct table activities. We continuously played, jumped, played music and made sport. It passed like that."

DISCUSSION AND CONCLUSION

This study examined how pre-service teachers feel about their first day of teaching and their preparation for that day. Findings indicated that pre-service teachers feel insecure about their first day and they do not feel ready to handle first day of teaching. They expected to experience chaos in class because of crying children which makes them suspect their self- efficiency, proficiency to keep young children under control, content knowledge and ability to meet the needs of all children, parents, and administrators. Participants had concerns about their self-confidence both before starting the profession and at the beginning of the profession. According to Fuller's (1969) teacher concerns theory, teachers' primary concern is self oriented and focus on being successful as a teacher at the beginning of profession. They are concerned with their self-efficiency and suspect their proficiency to control classes, their content knowledge and meeting the needs of students, parents, and administrators. However, teacher's concerns lessen as they gain experience (Ghait & Shaaban, 1999). The first day of teaching was not much different than what beginning teachers expected. Almost all of them had to deal with terribly crying children and tried to make them calm, get used to school, and accept their mother's absence in class. They even spent weeks attempting to settle down classroom activities. At first teachers allowed parents to enter class to lessen children's fear and make them feel secure in class. Then, they sent parents away step-by-step. After that, they tried to introduce school, daily routines, and basic rules.

The findings of this study revealed that most of the problems originated from MONE's system itself. Unfortunately, standards are changing region to region in a distinct way in elementary and secondary education. Participants were expecting to meet crying children in their first day of school. Nevertheless, they did not expect to encounter large class population for young age groups, start to teach in the middle of semester, and teaching children who did not know Turkish. Several problems might stem from sudden increase in schooling rate in ECE as the increase in the quantity of ECE classes brings the question of quality. Twelve participants experienced some sort of difficulties because of infrastructure problems and material shortage. For instance, two participants were appointed in schools which are still under construction and two participants were appointed to schools which do not have ECE classes. The others experienced infrastructure problems in different levels. Infrastructure problems did not always appear in school structure. In some situations schools were totally ready and children were already registered but teacher appointment did not take place on time. Infrastructure problems negatively affected parents, administrators, and children, yet the worst outcome is for beginning teachers. They might be disappointed greatly and lose their enthusiasm with the negative start in profession For instance; one of the participants had to teach 56 students at first days since other two teachers have not been appointed yet. Considering that classroom management is one of the biggest problems of beginning teachers, large class size might affect their teaching practice severely (Wyatt & White, 2007; Fottland, 2004; Pigge & Marso, 1997). The increase in classroom population decreases child-teacher interaction as it limits the capacity of teachers to deal with behavior problems (Essa, 2003). Although infrastructure problems are characterized in remote areas, it also appears in more developed cities.

The beginning teacher's entry into teaching profession is sudden, immediately after graduation they have the same responsibility with the experienced teachers (Lehman, 2000). MONE recruitment policy makes this situation worse since beginning teachers should have some time to orient themselves in a new profession and local culture where the school is located. However, beginning teachers were hired after schools opened and they lost that chance to get used to unfamiliar circumstances. Furthermore, they did not expect to encounter a construction area instead of a fully organized class, large class population for young age groups, starting to teach in the middle of the semester,

and teaching children who did not know Turkish. Beginning teachers already feel puzzled because of their inexperience and those infrastructure problems make beginning teachers' first day even more chaotic.

MONE curriculum also results in additional problems as the education system in Turkey highly centralized and teacher education program does not include any course about regional differences. Most of the children in eastern part are bilingual and their mothers do not speak in Turkish; however, sole and similar teacher education programs for all population do not consider target population's characteristics (AÇEV, 2002). Participants in this study did not work with children coming from different socio economic background during their undergraduate education. They had worked with children with middle and upper-middle socio economic status. They did not meet what they were trained for and they did not have time for getting ready for this unexpected situation. As such, this study addressed the weaknesses of early childhood teacher education programs in training teachers for children with diverse backgrounds and for managing the challenges in the first days in teaching. Besides, current study pointed out that most of the problems take its roots from cumbersome bureaucracy in MONE. Yet, the findings of the study was limited to the self-reports of the participants. Observing beginning teachers in their first day of teaching could bring a comprehensive understanding of what they had experienced and how they would overcome problems in that day.

REFERENCES

Achinstein , B. (2006). New teacher and mentor political literacy: reading, navigating and transforming induction contexts. *Teachers and Teaching: theory and practice,12*(2), 123-138.

Anne Çocuk Eğitim Vakfı (2002, January). *Türkiye'de okulöncesi eğitimi: Hizmete duyulan ihtiyaçların saptanması ve çocuğun dil yetisi düzeyinin değerlendirilmesi araştırma raporu.* Ankara

Bohn, C., Roehrig, A., & Pressley, M. (2004). The first days of school in the classrooms of two more effective and four less effective primary-grades teachers. *Elementary School Journal, 104*(4), 269-287.

Brooks, D. M. (1985). The first day of school. *Educational Leadership,* 76-78.

Emmer, E. Evertson, C., & Anderson, L. (1980).Effective classroom management at the beginning of the year. *Elementary School Journal, 80*, 219-231.

Essa, E. L. (2003). *Introduction to early childhood education* (4th ed.). Canada: Delmar Learning.

Evans, L. (1997). Addressing problems of conceptualization and construct validation in researching teachers' job satisfaction. *Educational Research, 39,* 319-331.

Flaxman, S.G. (1999). Openning bell. Get organized for the first day of school with this hand checklist. *Instructor, 110*, 20-21.

Fottland, H. (2004). Memories of a fledgling teacher: a beginning teacher's autobiography. *Teachers and Teaching: Theory and Practice, 10*(6), 639-662.

Fuller, F. F. (1969). Concerns of teachers: A developmental characterization. *American Educational Research Journal, 6*, 207–226.

Ghaith, G, & Shaaban, K. (1999). The Relationship Between Perceptions of Teaching Concerns, Teacher Efficacy, and Selected Teacher Characteristics. *Teaching and Teacher Education, 15*(5), 487 - 496.

Gold, Y. (1996). Beginning teacher support: Attrition, mentoring and induction. In J. Sikula, T. J. Buttery, & E. Guyton (Eds.), *Handbook of research on teaching education* (pp. 548–594). New York: Macmillan.

Huberman, M. (1992). Teacher development and instructional mastery, in: D. Hargreaves & M. Fullan (Eds) *Understanding teacher development*. New York: Longman Publishers.

Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal, 38*(3), 499–534.

Kellough, R. D. (2009). *Your first year of teaching : guidelines for success*. Boston: Pearson

Lehman, M. B. (2000). *Expectations, social support, and job satisfaction among first-year Oregon teachers*. Unpublished doctoral dissertation, University of Oregon.

McKeachie, W. J. (2002). Meeting a class for the first time. In W. J. McKeachie and others, McKeachie's *Teaching tips*: *Strategies, research and theory for college and university teachers* (11th ed., pp.21-28) Boston: Houghton-Mifflin.

Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage

Pigge, F. & Marso, R. (1997) A seven-year longitudinal multi-factor assessment of teaching concerns development through preparation and early years of teaching, *Teaching and Teacher Education,13*(2), 225–235.

Stokking, K., Leenders, F., Jong, J. D., & Tartwijk, J. V. (2003). From student to teacher:

Reducing practice shock and early dropout in the teaching profession. *European Journal of Teacher Education, 26*(3), 329-350.

Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research, 54*(2), 143-178.

GPSS Interactive Learning Environment

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ABSTRACT

This work presents an open source web environment to learn GPSS language in Modeling and Simulation courses. With this environment, students build their models by selecting entities and configuring them instead of programming GPSS codes from scratch. Teachers can also create models so that students can apply, analyze and interpret results. Thus, it includes a simulation engine that stores snapshots of models as they are executed, and allows students to navigate through these snapshots. The environment may be combined with existing learning management systems.

Keywords: *Mathematical modeling; prospective mathematics teacher; teacher instructional practices; case study.*

INTRODUCTION

Programming discrete simulation models can be successfully accomplished using general purpose programming languages, such as Java or C++, or specialized languages like General Purpose Simulation System (GPSS) or Simula. While the former are known by any programmer, the latter introduce entities and processes in a higher abstraction level as well as a set of analysis tools to obtain data from simulated models. Thus, simulation languages greatly facilitate the development and execution of simulations of complex real-world systems. Most general purpose programming languages are designed around a set of instructions that control the execution of an algorithm: sequences, iterations and conditions are organized in objects, routines and subroutines. According to this simplification of programming languages, learning to build programs requires understanding what basic routines do and how they can be combined to deliver a recipe for the computer to execute.

The behavior of a system as it evolves over time is usually studied by developing a simulation *model*. This model usually takes the form of a set of assumptions concerning the operation of the system and, once developed and validated, it can be used to investigate a wide variety of "What if?" questions about the real-world system. Each simulation language generally possesses an orientation to real-world situations, which may be classified as event-oriented or process-oriented. Simulation languages exist to make it easier to build models for analysis and to answer those *what-if* questions. Understanding the output of a simulation after it was executed is as important as programming the model. To learn an event-driven simulation approach, a few major concepts need to be incorporated: entities, events, queue theory, simulation times, etc. Thus, learning a simulation language requires understanding the syntax and semantics of the language to manage those new concepts. Unlike general programming languages, simulation languages are not built around basic or atomic instructions. Instead, they are based on high level sentences representing entities with abstract attributes and specific behavior. The combination of these sentences describes several system components and their interactions. Simulation languages are so powerful because they allow programmers to create complex models with very few lines of code, run those models and finally retrieve information – general data and statistics – that explains the behavior of the system. In the academia, GPSS (General Purpose Simulation System) is a widely used alternative for modeling and simulation used for teaching discrete systems. GPSS is processes-oriented and defines the structure of models based on a set of language commands. Each

command describes processes, with attributes and subroutines inside, which affect the model being represented. The language supplies lots of entities for the programmer and more than 50 commands to deal with them: create, use, release and query their status. There exists a small set of available tools and integrated development environments (IDE) for GPSS dialects. Most of them offer a place to write the model and to run it and they display reports regarding the simulation execution results. Code assistance and visual aids for the user during the programming stage are rarely seen here. Besides, deep analysis tools of how the simulation – and its entities – progressed and changed are quite unusual too. All of these tools are tremendously useful once programmers know GPSS well, but they are not suitable for newcomers that need to learn everything from the ground up. Consequently, students spend most class time learning how to specify and combine entities in a particular language instead of focusing on acquiring important simulation skills, such as mapping real systems into abstract models, identifying input and output variables and so on.

In this work, a web-based interactive learning environment (ILE) for GPSS is presented. The ILE was built upon an intuitive graphic user interface (GUI), based on dialogues and visual aids and a simulation engine improved for learning purposes. As with most web applications, no installation process is involved since the whole application can be exposed through a web server. In addition, the application architecture –split into several layers based on the client-server model– enables the ILE to be plugged into other web systems, in particular Learning Management Systems (LMS) such as Moodle (Moodle, 2012) Sakai Project (Sakai Proyect, 2012) and LRN (LRN, 2012). Models created on the client side of the ILE can be sent to the simulation engine on the server for its execution. The engine handles everything related to code parsing, interpretation, simulation running and report generation, keeping the client lightweight. Last but not least, for each simulation run, the server registers all changes as different simulations' snapshots which are kept in persistent media. Thus, students can fetch *snapshots* of their simulations and analyze in deep detail how the whole model –or even a particular model entity– progressed during execution time. The following section shortly reviews some previous modeling and simulation related publications as well as current GPSS implementations. Next, in the *Methodology* section, some issues related to GPSS learning are explained and the most important aspects of this work are introduced. Then, the application is presented and its implications related to those issues are described, followed by a section with some important notes about the development and its advantages. Finally, suggestions for future work have been included in order to offer a wider point of view of the project.

RELATED WORK

Simulation teaching in general and GPSS learning in particular are topics that have already been discussed over the last decades. Zikic and Radenkovic (Zikic, A. M.; Radenkovic, L. J, 1996) discussed GPSS learning problems. After some years of observation, they have summarized in four points the reasons why it takes so long for students to accept an entirely new approach to programming:

- Students acquired programming skills based in Pascal or C, which employ strict and explicit typing for variables/objects;

- GPSS does not have explicit declaration or strict typing of variables and objects;

- Pascal and C propose a very structured and organized approach for programming;

- GPSS syntax is of assembler type, with labels and transfer statements, which completely clashes with structured programming;

In their work, the authors introduce a new simulation language, based on GPSS concepts but oriented to a structured programming layout. This language, named ISDS, has different syntax rules and semantics compared to traditional GPSS dialects, and introduces some important changes such as explicit declaration, types and routine code organization. Even though the base concept seems correct, the authors suggested that it could delay the learning process in a second stage: the students would eventually have to use GPSS or some other commercially available system. Thus, once they have learned ISDS, they would still need to learn GPSS or another simulation language.

There exist few active implementations of GPSS language, among which MinutmanSoftware's version, named GPSSw (Minuteman Software, 2012), excels other developments as the most widely used one. GPSSw is a desktop application, and quite fast for developing and running simulations under MS Windows. To code models, GPSSw users have at their disposal a plain text area to write GPSS sentences. The application allows the creation of the simulation as well as to start its execution by inserting a *START* command. Simulations are usually run in a few seconds; the results are displayed in a text report which summarizes the most important aspects of the previously run model. GPSSw also offers some debugging tools such as pause and resume points during runtime, and some live examination tools for most GPSS entities (facilities, storages, transaction chains, etc...). GPSSw is also very useful to generate

screening, optimization or user defined experiments. Wolverine Software Corporation (Wolverine Software, 2012) has also developed a GPSS implementation, which shares some common points with GPSSw. It is also a MS Windows application which lets users run models over the simulation engine and outputs a simulation report similar to that of GPSSw. However, models have to be compiled first, which results in a MS Windows executable program representing the simulation ready to be run. Compiling source files allows users to define external so-called ampervariables (routines) in C++ programming language, which will be compiled altogether with the model file(s). Even though the compilation process adds an extra step, it proves very useful for users to enable the extension of the simulation engine, either to connect the model to external data sources or to generate different output files. WebGPSS is another application that implements GPSS dialect. Models are created by defining and connecting block diagrams. This facilitates learning since engineering students are used to representing models with diagrams and charts. Models are created in a client desktop application and sent to a server for execution. The term *web* is owing to the fact that the server process could be run in a remote computer and thus be accessed. Both server and client are executable programs included in the package.

As learning tools, all GPSS dialects presented above share some common aspects that students and teachers need to deal with. As mentioned before, no current GPSS implementation includes either code assistance or syntax highlighting. On one side, WebGPSS implements a drawing-based alternative in which the user chooses blocks from figures and arranges them in a connected network. On the other side, GPSSw includes a plain text editor and GPSS/H has no editor at all. All GPSS alternatives require some installation process and all of them are also MS Windows dependent. Even though all alternatives can be run in Unix-based platforms using an MS Windows layer like Wine or Crossover, there is of course some performance drop. Besides, and more important, although some developers include a limited or trial version, there exist neither open source nor free alternatives available. In education environments, only WebGPSS includes some visual aid for the user. However, all mentioned versions are intended for users that already handle GPSS syntax, semantics and entities usage. In addition, there is no possible integration with existing web LME's.

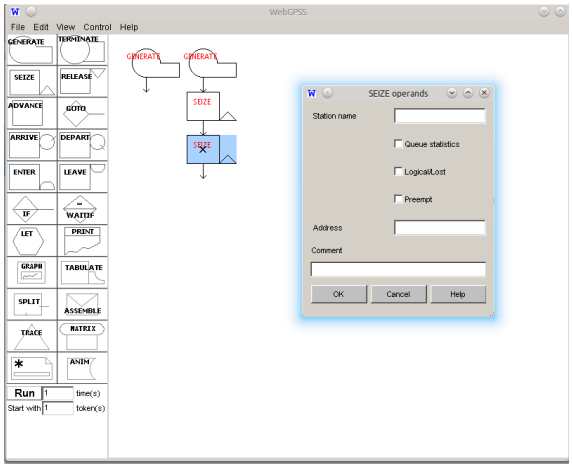

Figure. 1: WebGPSS IDE displays dialogues and graphs

Desporovic et all implemented a GPSS/FON (another less used GPSS dialect) based environment, which they called FONWebGPSS. The purpose of their work is to combine a GPSS implementation with Moodle. With this purpose in mind, teachers prepared case studies and problems related to the area of discrete event simulation, and students used GPSS/FON via Moodle to write and run the models. Simulation execution results are also integrated into Moodle, mixing standard GPSS reports with statistics charts created ad-hoc. Although the simulation engine was not adapted for teaching purposes, this work exposes the need to transform simulation learning via web environments, and to integrate simulation tools in existing LMS. In a different approach, Fonseca et all designed a framework with a Java-based desktop application to build GPSS models from graphics. The framework lacks, on purpose, the implementation of the simulation engine. The main idea of their work is to let students complete the engine by programming themselves the behavior of GPSS entities. This would help students understand how the engine works and would motivate them to write their own simulation engine. In addition to the *empty shell*, JGPSS also includes a regular GPSS engine and statistics generator. Note that in that work the authors considered the importance of understanding a

simulation engine by accessing its core implementation and modifying its source code in a language they feel comfortable with.

METHODOLOGY

Between 2005 and 2011, during the development of Simulation and Modeling courses in Computer Science School at the National University of La Plata, students mainly used Minuteman Software's version of GPSS. During that period, some common obstacles that most students came across when starting with GPSS were identified:

- Unlike general purpose programming languages, GPSS has many sentences and only two sentence categories: blocks and commands
- Each sentence may require a different amount of parameters; some of them are mandatory and some are optional, some refer to other entities and some expect numeric expressions only
- Although GPSS blocks are semantically different from GPSS commands –and that difference is key to understanding the simulation model– they are displayed in the same way, in the same place and they might even be syntactically mixed
- Some blocks are used for general flow control, while others are used specifically to deal with a single entity
- There is no code assistance or highlighting. One of the obstacles that arises from this is that it is hard to remember which entities have already been defined –especially in large models– and how they must be referenced
- When the simulation ends, the system displays a report which resumes in few statistics what happened during the execution of the model. Thus it is not easy to know what really happened: when entities were created or destroyed, how the system clock advanced or which entities were interacting
- The code organization and the language itself are very different from other programming languages that students *had learned before (i.e. C++, Pascal* or Java)

This paper proposes an interactive learning environment (ILE) to improve GPSS learning which tackles all previous issues in the very first stages of simulation courses. The bottom concept of the ILE is quite simple: instead of programming models by writing code from scratch, students can build their models by selecting and configuring entities and sentences. To that end, the GUI has been designed to explain some commonly confusing aspects of GPSS from the beginning and to allow students to focus solely on core simulation concepts and entities. The application presented here is suitable during the simulation development stage and also after the simulation has been executed, in the results analysis stage. In the next two sections, most elements introduced in both stages (development and analysis) are expounded.

Aids During Development Time

During the stage of development, students need to focus on their model and the flux of entities through it. They should not be distracted by issues of one particular programming language. To that aim, a first visual element introduced is the use of dialogues to insert blocks and commands, instead of writing code. Many efforts have been put into dialogue boxes, including a set of small but useful visual elements that avoid dispersion and most common mistakes.

- Dialogue boxes show all possible parameters for each sentence (block or command)
- Parameters include hints for the user to get a clue of what they are for
- Mandatory fields are clearly distinguished from optional data
- Since some sentences require the use of previously created entities, many dialogues display a list of optional entities to choose from
- Listed entities are just the ones having the correct type required for the sentence which narrows the

possibilities to cause a mistake, mixing sentences with entities of incorrect type

In addition to dialogue boxes design, the ILE displays available blocks and commands grouped by their main function or by the entity they deal with. For example, since ENTER and LEAVE blocks are used to access and free *storage* units, they are shown in the same group; similarly, given that SEIZE, RELEASE, PREEMPT and RETURN blocks exist for *facilities* manipulation, they are shown in another group. Grouping blocks helps students make associations between blocks and entities and among related blocks too. Block groups are also separated from command groups, which reinforces the idea that, even though they look similar, they are not. Once confirmed, dialogues create GPSS sentences and entities in an inner representation and they are displayed in a GPSSW-like dialect. Code is rendered highlighting keywords and parameters, and again sentences have been split into two code zones: commands above and blocks below. In addition to GPSS code representation, blocks are presented as a list, and commands as a queue, which is the actual internal representation of the simulation engine. Among other features, blocks and commands can be moved up/down, dragged and dropped from the list (or queue respectively) and removed. Code parts can be intuitively organized, although blocks and commands can never be mixed. The GPSS model, created in the web client application, can be sent to a server for its execution, which contains a GPSS interpreter and a modified simulation engine that runs the simulation.

Simulation execution analysis

GPSS is designed for the sub-area of discrete simulation systems, which basically means that each simulation is controlled by a finite simulation clock that changes discretely. For each clock change (*tick*) the system being simulated updates its status, cascading to all entities in order to be ready for the upcoming clock change. This behavior affects both permanent entities (facilities, storages, chains) and temporary entities (transactions). Hence, a simulation run can be decomposed as a sequence of clock changes and entity updates associated with those changes. Each component of that sequence represents a *snapshot* of the simulation in a precise clock time. This concept leads to a different way of interpreting a simulation run, based on the analysis of entity changes during running time. Even though this might not be very useful for real simulation analysis, it clearly helps students understand how the simulation advanced and what *really* happened in each advance: how the clock moved forward, which entities existed in each *clock time*, what they were like and how they interacted with each other. It is of particular interest that this model also helps to understand the transaction scheduling system inside the system chains, which is a particularly problematic topic. The previous concepts were implemented by making major changes to the GPSS interpreter and the simulation engine to enable them to take full snapshots of the simulation during runtime. Snapshots are taken each time the system clock changes and they are queued in an in-memory data structure as the simulation runs. It must be considered that snapshots are quite heavy in memory and CPU terms, since they represent the whole simulation graph, composed by all model entities and its relationships. Once taken, each snapshot is persisted in a relational database system (RDBMS) for further analysis. Persistence is also a heavy task that involves saving all entities to a relational database and it is handled by a concurrent thread that maps objects to tables and stores them in the DB in disk.

When the simulation is sent to be run in the server, it only takes few seconds until the execution ends but it could actually take a while to be fully stored by the persistence thread. To make that clear for the user, the system GUI has been designed to display a brief simulation report in the final stage and to show the user the persistence process as it advances. Once all snapshots have been persisted, the GUI enables the user to access snapshots, sorted by its system clock. Then, the student can browse snapshots, and inspect the status of self created entities as well as system default entities and data structures. Each entity can also be selected individually, which results in a specific report for the entity itself displaying it status in each system clock and other entities being affected. Again, these entities can also be selected, allowing the user to recursively navigate through entities and simulation snapshots.

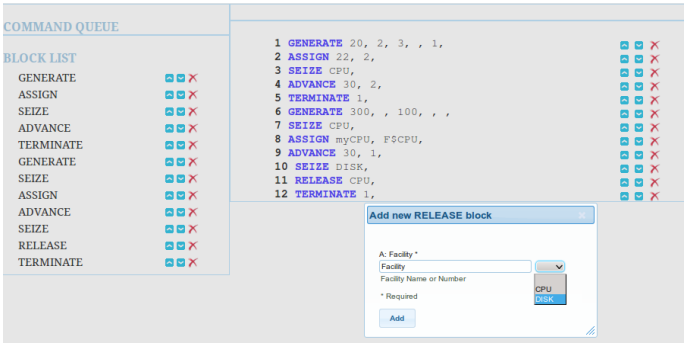

Figure 2: GPSS ILE: dialogues display entities lists and field hints

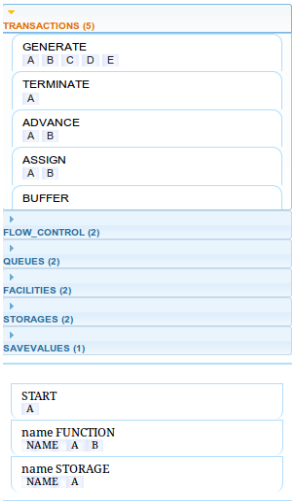

Figure 3: Block and commands grouped by function or entity

RESULTS

The application has been organized into a multi-layer architecture mainly composed by a thin client on one side and GPSS interpreter with the simulation engine and the RDBMS on the other side. Both parts of the application are completely independent one from the other. For them to work together, a MVC application has been developed to acts as a bridge between them, transforming requests from the client to messages to the interpreter and vice versa. The high decoupling level also allow application parts to be easily embedded into other environments. The client side was built using only HTML, Javascript and Cascading Style Sheets (CSS), and works as an independent pluggable module. The GPSS interpreter and engine is a common open source Java and MySQL application. It has been adapted to the Maven2 standard, which makes it really easy to download, extend and compile. Even though it is not likely that GPSS students will try to modify or extend something they still do not understand at first, accessing the source code of the simulation engine is a powerful way to understand how GPSS entities really behave inside, by reading it in a well known language. Similarly, having snapshots that compose a simulation stored in a database gives the students an opportunity to write their own SQL queries and to research much deeper about the entities than any front-end could offer. The application can also load and execute *preexisting models*; teachers can create their own models and leave them available for students to understand particular issues, review any class subjects or prepare quizzes and activities. Once models are created by the teacher, students will see an icon to load them in one click. After a model is loaded, users have full access to it just as if they had written it block by block and command by command. They are able to modify it too or even to extend it, which proves very suitable for some activities of interpretation and system improvement or optimization. In the meantime, as they analyze the model, the system will have sent it to be run in the background and at the end it will output the same kind of results as any model created by hand.

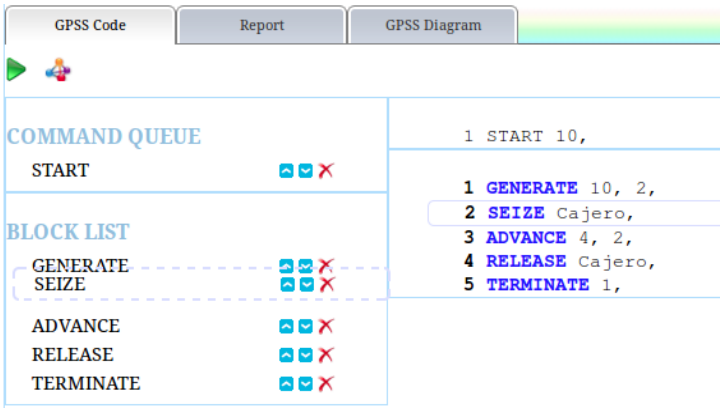

Fig. 4: Drag and Drop over the block list

Social implications in education were also considered in this work. An open source application results in a helpful teaching tool and the ability to plug it into other systems represents a great opportunity for teachers and students. In third world countries, license fees are hard to afford. Commercial applications and trial versions are not a real solution, although they mitigate limitations. Platform dependent applications make it even harder for non Windows users. By using a web application, students can use it in any computer, tablet or even mobile phone: all they need is an operative system with a web browser. No installation process is required. Last but not least, colleges can naturally host their own GPPS full stack: client, web application and interpreter. This allows them to count with a full repository of new learning objects: GPSS models ready to be run, modified or extended, and already executed GPSS models to deeply analyze and understand them from the ground up.

CONCLUSION

A web application for GPSS learning has been presented here. The application is targeted to students in their very first encounter with modeling and simulation subjects, in special with a programming language like GPSS. The main purpose of this work is to shorten simulation learning times by eliminating the need for students to deal with specific issues of a particular simulation language and letting them focus solely on important modeling and simulation concepts such as abstraction, resources, statistics and experimentation. To that end, the application focuses on two key stages of modeling and simulation learning: model building and simulation run. The former is tackled by providing the students with an interactive GUI that helps them build the model by selecting and configuring sentences, organizing code parts, and laying GPSS elements out making key aspects clear from the beginning. The latter is faced under the premise that a simulation run is too complex to be understood from a single text report with some statistics results, especially when students are still learning what a simulation is or should be. The solution presented proposes a *navigable report*, where the students can surf from their simulation entities and access the state of each one in all simulation clock changes. This way, they can understand how entities are affected by other entities and how the simulation system deals with the execution of temporary entities created on the fly. Another important aspect of this work is that it has been released as open source software. This license has two main implications in this context. First, and as with any other open source software, anyone can download, use and extend the applications as needed; of particular interest is the possibility of integrate it with other LME's or with any web application. Secondly, students can be encouraged to study the software as it is, to improve it and extend it, either on their own or as a class exercise.

FUTURE WORK

There is much work to do to improve this environment. Many but not all GPSS entities have been implemented, so a first improvement would be the inclusion of more entities and their associated sentences. Dialogue boxes can also be improved by including visual clues for students to make associations between GPSS entities and real-world objects: if the student is creating a FACILITY, the GUI would show something that *works* as a facility, like a toll barrier or a computer processor. Reports can also be extended to include new entities and to allow students to compare different snapshots side-by-side, highlighting changes in existing entities as well as entities created on one side only. The ILE still lacks a view for the professor, to create models and organize activities and class members. Even though the latter can be accomplished by most existing LMS, model creation, testing and publication must be improved to encourage teachers to add new models for their students. Integration with existing LMS must also become better. As any web application, the GPSS ILE in its current state can be embedded into any web page using, for example, an iframe. However, it would be very helpful to integrate it with existing LMS via installable plug-ins/extensions. This would demand many efforts, since each addition must be customized by hand, but would encourage system administrators to offer the tools to its users.

REFERENCES

Aho, Alfred V et al. Compilers: principles, techniques, and tools. Pearson/Addison Wesley, 2007.

Banks, Jerry, and John S Carson. "Discrete event system simulation." (1984).

Cox, Springer W. "GPSS World: a brief preview." Simulation Conference, 1991. Proceedings. Winter 8 Dec. 1991: 59-61.

Crain, Robert C. "Simulation using GPSS/H." Proceedings of the 29th conference on Winter simulation 1 Dec. 1997: 567-573.

Despotovic, MS, BL Radenkovic, and DM Barac. *GPSS for e-learning environment*. Telecommunication in Modern Satellite, Cable, and Broadcasting Services, 2009. TELSIKS'09. 9th International Conference on 7 Oct. 2009: 318-321.

Fonseca i Casas, Pau, and CJ Casanovas: *JGPSS, an open source GPSS framework to teach simulation*. Winter Simulation Conference (WSC), Proceedings of the 2009 13 Dec. 2009: 256-267Ref 4

Garcia, Heriberto, and Martha A Centeno. "SUCCESSFUL: a framework for designing discrete event simulation courses." Winter Simulation Conference (WSC), Proceedings of the 2009 13 Dec. 2009: 289-298.

Kirkerud, B.: Object-Oriented Programming with SIMULA, Addison-Wesley, 1989

Klein, Ulrich, Steffen Straßburger, and Jürgen Beikirch. "Distributed simulation with JavaGPSS based on the High Level Architecture." SIMULATION SERIES 30 (1998): 85-90.

Kleijnen, J.P.C. 2005. Supply chain simulation tools and techniques: a survey. *International Journal of Physical Distribution & Logistic Management* 30(10): 847-868

.LRN TM (May 22 2012) ".LRN Home: Learn, Research, Network" [On line] http://dotlrn.org/

Minuteman Software. (May 22 2012) "Computer Simulation" [On line] http://www.minutemansoftware.com/

Moodle (May 22 2012) "All we want to do is to give you powerful free tools to help you educate the world" [On line] www.moodle.com

Paulsen, M. F. (2003). *Experiences with Learning Management Systems in 113 European Institutions*. *Educational Technology & Society*, 6 (4), 134-148

Sakai Project (May 22, 2012), "Collaboration and learning - for educators by educators". [On line] http://www.sakaiproject.org/

Ståhl, Ingolf. "GPSS: 40 years of development" Proceedings of the 33nd Conference on Winter Simulation 9 Dec. 2001: 577-585.

Storch, Matthew Francis, and Jane WS Liu. "A framework for the simulation of complex real-time systems." (1997).

Wolfgang K. and K. Osterbye, 1998. BetaSIM a framework for discrete event modeling and simulation. *Simulation Practice and Theory* 6(6): 573-599

Wolverine Software Corp. (May 22 2012) "Welcome to Wolverine Software!" [On line] www.wolverinesoftware.com/

Zikic, A. M.; Radenkovic, L. J.: *New Approach to Teaching Discrete Event System Simulation*. International Journal of Engineering Education; VOL 12; NUMBER 6; 457-466; 1996

Graphical design elements that should be considered in computer based instruction

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ABSTRACT

Educational technology has emerged as a new field of education because the main means of having access to information has become technology. Thus, basic curriculums in all over the world have been in the process of restructuring; Classical teaching materials have been replaces by technological equipments (Smart boards, tablet PCs, mobile phones etc.) and new materials are designed for these technological tools (Course presentations, notes for distance education, educational software etc.). With the design of teaching materials for technological tools, graphical designs have become one of the most important ways of presenting information. Therefore, instructors should be knowledgeable about graphical design elements such as color of the background, the font used, the size of writing, the density of the text and the relationships among background color and font contrast etc. In this paper, the main focus is the elements to be considered in color selection and harmony which are among the principles of graphic design while designing computer based instruction materials.

Keywords: *Computer based instruction; Computer assisted language learning; Educational software; Educational technology; Ggraphical design*

INTRODUCTION

Graphic design started with the drawings on cave walls by primitive human beings. The designs drawn on cave walls by first people were the visual reflections of verbal language. Hence, graphic design is one of the ways of a person's expressing himself/herself. Therefore, the choices made by an individual while forming the design include elements of his/her inner world; and like fashion, they change depending on some factors such as the education taken, the environment resided (city, country), upbringing (oppressed, free), gender, politics of the era, technological and scientific developments, peace or war atmosphere etc. In case of graphic design suggestions are not made not to restrict the creativity of the person, only factors to be considered and situations to be avoided can be mentioned (Fiell, 2005).Yet, the design has some basic components and the greatest care should be taken while making educational designs as it is very difficult to correct them.

PRINCIPLES OF DESIGN

Graphic design is viewed to be a discipline in the field of visual arts. However, it has many sub-concepts. The components of design can be subsumed under two categories. These are principles and elements. The basic principles are balance, rhythm, proportion, and unity. Elements are line, shape, texture, white space, mass, value and color (Fidan, 2012). The present study only focuses on the element of color.

Features of color and its use in design

Color is one of the cornerstones of a design. Sometimes, color can lay the basis of creative thinking and all the design is built on color (Wong, 1997, Fidan 2009):

Colors existing together with the light can create various effects on people. There are three dimensions of color: Length (type of the color), width (shade of the color), and depth (intensity of the color).

1. The type of color is the terms used to describe the color such as yellow, red, blue, purple, green, orange etc.

2. The shade of color is its lightness or darkness. When a color is enriched with white color, it becomes lighter, and when black is added, it becomes darker.

3. The density of color is related to brightness. The colors with high density are bright colors.

The most important one among these three dimensions is the shade value of color. The element which describes a visual image best is the shades it contains.

Effects induced by color on people

In addition to reflecting the sensitivity of the designer, the choice of the colors in the design of educational software should be in compliance with the color preferences of the target group. Therefore, it is of great importance to know the effects of colors on people. Some of the effects induced by colors on people are personal and some are generalisable. For instance, warm colors' becoming stimulating and cold colors' being soothing can be considered to be the generalisable effects of colors.

Generalisable effects of colors

Green and blue colors are known to be cold, red and yellow colors are regarded to be warm colors. By bringing cold and warm colors, new colors can be obtained. For instance, a cold color, blue, can be mixed with a warm color, red, then we get a color of blue close to purple. This new color is a bit warmer than blue. In this way, we can have less cold color.

Grays called to be neutral colors can be cold or warm depending on the mixture ratios in their pigments.

While warm colors stimulate and cheer watchers, cold colors soothe and relax them. The reason why restaurants are painted with warm colors is to stimulate visitors to eat fast and in the similar manner, hospitals are painted with cold colors to calm the people who are panicked. Excessive use of cold colors may result in the emergence of gloomy and depressing atmosphere. In the same token, excessive use of warm colors may lead people to aggression.

On graphical surfaces, warm colors seem as if they would leave the surface and they seem in the front. Yellow is the color which is seen at the forefront of all the colors. Cold colors on the other hand give the impression of distance.

Psychological effects of colors

When the psychological effects of color are considered, it is usually accepted that green means jealousy; blue is the symbol of loyalty and sincerity; red represents activity and courage; brown and purple are the symbol of monotony and boredom; white represents submission; black symbolizes pessimism. In addition to these, some researchers argue that red increases blood pressure and pulse beating.

Cultural effects of colors

When the colors are considered from a cultural perspective, they have various connotations. For instance, in oriental culture, the golden yellow is considered to be a sacred color; yet, in some westerns cultures it is the symbol of cowardliness and treason. Red stands for passion. Orange represents science, civilization, energy and power, purple close to blue is the symbol of spirituality and purple close to red is the symbol of courage.

Blue which is a passive and cold color symbolizes both distance and formality and honesty and loyalty. It connotates authority and power. It is cooling and associated with sky, ice and water.

Green is the symbol of freshness and fertility. It symbolizes environment and nature and it is relaxing and soothing. White represents honesty and innocence; black is the symbol of sorrow, gloom, grief and dead. Moreover, it

connotates extreme passion and elegance.

Female and male colors

There are two important concepts to be considered while selecting not only the color of the surface but also the color of the letters of the writing on the surface. These are female and male colors.

Female colors: light color on dark surface. For example; white writing on blue surface

Male colors: dark color on light surface. For example; blue writing on white surface

However, there are no certain formulas showing how to operationalize these concepts in a design. A graphic designer should consider following four elements in color selection:

1- Cultural connotation of a color,

2- Color preference of the target culture,

3- Character of the product,

4- Type of approach to design

Things to be considered in color use

The designer should know how colors are perceived by the eye, their wavelength characteristics and their effects on the health of eye. For instance, yellow color is first perceived as purple and the process through which the color is perceived to be yellow is tiring for the eye. Long-time focusing on yellow color may lead to visual disorders. Therefore, yellow should not be selected as the color of surface or front color while designing products requiring long-time reading. Moreover, the designer should be knowledgeable about the effects of visual disorders on the perception of colors by people. For example, he/she should know what color blindness is and what effects it induces; learn how to use red and green colors on the same surface or to create a contrast appropriately so that undesired outcomes can be avoided.

The use of colors in computer assisted language learning software

In most of the educational software programs, pictures, figures, tables etc. are used in teaching of subjects, yet, in language teaching, particularly in teaching of grammar, most powerful elements to enhance teaching are colors. Suffixes and prefixes, tense suffixes, changes and differences in verb inflections can only be emphasized through colors. Look at the following example to teach some suffixes in Turkish (Figure 1):

Figure 1. Educational software sample to teach some suffixes in Turkish

In figure, you can see the subject selection screen of the educational software programs developed by Turkish language pre-service teachers to teach some suffixes in Turkish. In this screen, you can click on the subject you want to learn and then you are directed to the relevant screen (Figure 2).

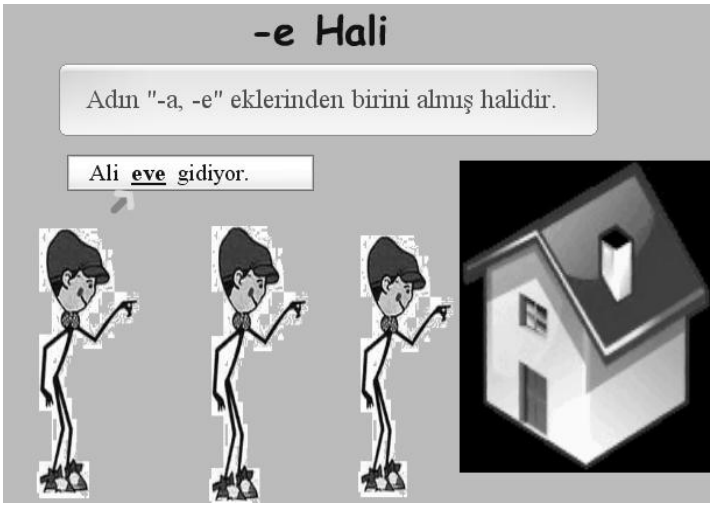

Figure 2. Subject teaching screen (-e suffix added to word "ev")

In figure 2, there is a hero in this software program: "Ali". The subject is taught through the activities Ali carries out. As an object "Ev" (house) is selected. Some suffixes are taught by using the interactions between Ali and "Ev". In the sentence "Ali eve gidiyor", the purpose is to teach –e suffix. The subject is taught with a sentence. In the example, for better presentation, -e suffix can be shown in a different color or at least it can be underlined or written in bold. In subject teaching, while presenting the word ev(e) in the sample sentence, -e suffix can be zoomed. Moreover, a color inside the house (for example, blue) may be selected, and Ali's hat, the title of the subject and –e suffix in the title and –e suffix in the sample sentence can be in blue, in this way subject teaching can be consolidated.

In figure 3, the sample sentence is "Ali evde" and here the purpose is to teach –de suffix. In the subject selection screen, Ali's entrance to the house should be shown through an animation and in this screen, the subject should be taught by showing that Ali is in the house. To teach better, the door of the house can be yellow and –de suffix can also be written in yellow. Moreover, the teaching can be consolidated by making the color of the room where Ali is yellow, subject selection button (-de) in subject selection screen can be in yellow, subject title (figure 3) can be in yellow.

Fig. 3. Subject Teaching Screen (Suffix showing the state of being inside the house)

As a result, every element used in the design (character, surface color, font color, button design, subject title,

sample and explanation) should be designed in such a way that each should complete each other and contribute to the teaching of subject.

CONCLUSION

When the fact that educational technologies are developing fast and all the educational settings will be presented in digital environments in the future is considered, it seems to be clear that the people who will design educational software programs should be knowledgeable about the basic principles of education and main principles of graphic design. In this paper, we focused on one of the most important elements of design, color, and some samples were given here to show how color can be used to make language teaching more effective. It should be noted that "Design is not a magic, many trails are made until the correct design is found (Atasay, 2012)". Therefore, it should be underlined that for good design, much time should be spent on the material. But it is worth doing because in the digital environment, the information can be reached by millions of people.

REFERENCES

Atasay, B., (2012). Grafik Tasarım, Lesson Tutorials of Gazi University.

Fidan, B. (2009). Grafik tasarımın temel ilkeleri ve bilinmesi gerekenler. *Journel of Grafik Tasarım, August 2009.*, http://www.grafiktasarim.org/index.php?option=com_content&view=article&id=374:grafik-tasarmn-temel-lkeleri-ve-bilinmesi-gerekenler&catid=42:sektoer-haberler&Itemid=87.

Fidan, B. (2012).Tasarımın İlkeleri. *Journel of Grafik Tasarım*, May-June 2012, 83-85.

Fiell, P. (2005). *Graphic Design Now*. Singapore: Taschen, (Introduction).

Wong, W. (1997). *Principles of Color Design: Designing with elecktronic color*. (2nd ed.), Canada, (Part 2).

Has Anything Changed about the Teachers and the Teaching of High School Economics in 20 years?

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ABSTRACT

This paper surveys high school economics instruction in the state of Indiana (U.S.A). Compared to results from previous such surveys (1996, 2003), current survey results indicate the following: 1) A larger proportion of the instructors are female, younger and have more experience in teaching economics. This change in demographic profile (if reflected nationally) has important implications for the gender composition of economics-related professions and the gender-gap in earnings. 2) While computer-based instruction and classroom experiments have become somewhat more common, the lecture method is still the dominant pedagogy. This learning environment is far removed from the one that "neomillenials" are drawn to with not so salutary implications for the development of economics fluency. 3) The dual pursuit of personal finance literacy and economics literacy may be blunting the effectiveness of the latter competency.

Keywords: *focused survey, economics literacy, "neomillenials"*

INTRODUCTION

Students entering high school in the state of Indiana prior to the Fall of 2007 fell under the General Diploma curriculum. Under this curriculum, students were required to take 4 credits of social studies courses including 2 U.S. History credits, 1 credit in U.S. Government, and 1 credit in "Any social studies course". For students entering high school in the Fall of 2007 and later, the Indiana General Assembly has mandated that students complete the Core 40 curriculum as a requirement for graduation. Further, the Assembly mandated that from the Fall of 2011 all Indiana public Universities (four-year institutions) are to have the Core 40 diploma as a requirement for admission. Besides other differences, the Core 40 curriculum increases the social studies requirement to 6 credits of which one credit must be in the area of economics. This increased focus on economics in the high-school curriculum and for admission to a university forms the impetus for the current study. Specifically, this study seeks to examine how the increased focus has impacted the: 1) demographic characteristics of those engaged in high-school economics instruction in Indiana. 2) pedagogies employed in the teaching of economics, and 3) distribution of class-time among different economics topics (as outlined in the economics standards set forth by the Indiana Department of Education).[1]

METHODOLOGY

[1] Note that this paper steers away from examining the impact of the increased economics focus on learning outcomes in non-economics/finance-related curricula for high school students in Indiana. This may be a worthwhile endeavor for future research as there is some evidence that economics mandates are associated with a decrease in general educational attainment by high school students (Belfield and Levin, 2004).

This paper seeks to address the concerns described above by developing and implementing a focused survey. Using a listing of qualified economics teachers within the state of Indiana – maintained at the Indiana Department of Education's website, 437 (relevant) individuals along with their respective email-addresses were identified. Surveys about "Economics Instruction at the High School Level" were administered online through the University of Southern Indiana's Office of Planning, Research, and Assessment. Potential respondents were contacted through their respective email-addresses and asked to take the Survey. After two weeks, a round of 'reminder-emails' was sent out. At the end of four weeks from the first round of emails, the survey instrument was taken offline and the data were tabulated. There were a total of 69 responses for a response rate of 15.8%.[2]

Findings and Discussion on Demographics

As part of the survey, demographic information about the teachers was collected. This data is summarized in Table 1 below.

Table 1: Summary Demographics

Variable	Range	Mean	Se
Gender; 1 = Female (n=68)	0-1	0.382	0.060
Age	25-66	44.2	1.2
Years Experience Teaching	0-42	17.5	1.2
Years Exp Teaching Econ	0-39	13.5	1.1
Highest Degree = Bachelors	0-1	0.290	0.055
Highest Degree = Masters	0-1	0.667	0.057
Highest Degree = Doctorate	0-1	0.014	0.014
Highest Degree = Other	0-1	0.029	0.020
Year Graduate with undergrad (n=20)	1986-2006	1998.7	1.3
Year Graduate with grad (n=45)	1970-2011	1995.9	1.8
Year Graduate with Highest Ed (n=2)	1979-2002	1990.5	11.5
Attended Workshop at regional center?	0-1	0.618	0.059
Teach Only Standard Econ Course	0-1	0.721	0.055
Teach Only AP Econ Course	0-1	0.044	0.025
Teach Both AP and Standard Econ Courses	0-1	0.235	0.052

Surveys similar to the current one were implemented in 1996 (Quddus and Valentine; 1998) and 2003 (Khayum, Valentine, and Friesner; 2006). Interesting comparisons emerge between the data from these earlier surveys and those from surveys in the current study. Quddus and Valentine (QV, hereafter) find that 21% of the surveyed respondents are female, and Khayum, Valentine and Friesner (KVF, hereafter) find that this proportion is 25%. Table 1 above reveals that 38% of the respondents are female. This suggests that over time the proportion of females teaching high school economics courses in the state of Indiana is growing. No such clear trend emerges with respect to the average age of the respondents. QV report an average age of 45, KVF, 46.6, and the current study, 44.2. Table 2 helps shed further light on this age-issue.

[2] Anecdotal evidence indicates that the list of teachers may include a few who are not currently teaching economics but have been licensed to teach economics.

Table 2: Frequency Distribution of Demographic Traits

Variable	Frequency	Cumulative Distribution
Age Range		
25-29	3	5%
30-39	20	35%
40-49	20	65%
50-59	18	92%
60-69	5	100%
Teaching Experience - number of years		
0-9	16	24%
10-19	25	62%
20-29	17	88%
30-39	7	99%
40-49	1	100%
Econ Teaching Experience - number of years		
0-9	28	42%
10-19	22	75%
20-29	12	93%
30-39	5	100%
Highest Degree	0	
Bachelors	20	29%
Masters	46	96%
Doctorate	1	97%
Other	2	100%

The above table reveals that 65.2% of the survey respondents are under the age of 50, and 40%, below the age of 40. In contrast, KVF find that only 22% of respondents are below the age of 40. Further, while KFV find that 39% of respondents have less than 20 years teaching experience, the current study finds this proportion to be 62%. In keeping with this phenomenon, while KVF find that 82% of the respondents hold a graduate degree (83% in QV), survey data from the current study reveals that this proportion is only 66.7%. Thus the combined evidence indicates that the age-profile of economics instructors is growing younger over time.

While the overall teaching experience is lower, economics teaching experience is higher among respondents in the current study. QV, in their 1996 survey data, find that respondents have an average of only 2 years of economics teaching experience. This proportion rises considerably to 12.9 years in the 2003 survey data of KVF and experiences a further increase to 13.5 years in the survey data from the current study.

The above results indicate that as older educators retire (through natural attrition), they are being replaced by educators who are younger, with a greater female proportion, and with greater economics teaching experience – with the latter phenomenon being perhaps linked to the greater societal emphasis on economics literacy.

FINDINGS AND DISCUSSION ON PEDAGOGY

High school students' waking-hours are characterized by the use all kinds of electronic communication devices that, among other things, help integrate the Internet into their daily functioning – making for a diverse, hyper-stimulated environment. Are the modes of instruction reflecting or capturing the reality of such an environment? To address this question, the survey implemented in this study also asked a series of questions about how the instructor presents material to the students. The responses pertaining to these questions are summarized in the following table.

Table 3. Presentation Tools

	Audio/Pod Casts	Web based instruction/YouTube presentations	Guest Speakers	Lecture	Power Point slides	Team Teaching	TV programs	Other
Never	52%	15%	16%	3%	9%	71%	13%	32%
Little Use	31%	18%	36%	7%	13%	17%	25%	9%
Some of the Time	11%	57%	45%	36%	41%	11%	57%	43%
Most of the Time	3%	4%	1%	51%	33%	2%	4%	13%
All of the Time	2%	6%	1%	3%	4%	0%	0%	3%

In discussing the data in the above table, some comparisons to older Indiana teacher surveys are again interesting. As expected, since 1993, the only other time that data was collected on presentation tools, the use of computers and the other internet resources has increased dramatically. In particular, in the 1996 survey, QV note that 80% of responders stated that they never used audio as a classroom presentation tool. In the current survey, this has decreased to about half of the responders at 52%. Even so, comparing the previous study with this one, it still seems that audio is not the most important tool in the class room. Interestingly, TV programs have not become more important in the high school classroom. One would expect that since the recession of 2008 and the increasing attention that economics gets within the scope of national television programming that TV programs would have become a more valuable tool in teaching economics. Nonetheless, the use of TV programs has not increased but that usage has distinctly decreased. 71% percent of the respondents in the current survey state that they never use TV programs compared to 23% stating the same in QV. It is likely that there has been a reallocation of time away from the use of TV programs and towards the use of Internet resources and other digital media.

In the current survey, 87% of teachers say that they use lecture either some or most of the time. In the 1996 survey of QV, 95% of the respondents indicated that lecture was used some or most of the time. Since teaching is a profession which requires an undergraduate degree, it is reasonable that teachers in a high school setting will mimic the ways in which they were taught. On a national scale, Watts & Becker (2008) have surveyed college economists about teaching methods in universities with surveys being completed every five years since 1995. They show that, although there is some movement away from using lecture as the main presentation tool, academic economists still use somewhere between 69-83% of their time in the classroom lecturing.

While Lecture still seems to be the dominant mode of presenting educational material, what else is going on in the classroom? That is, what type of diversity do students encounter with regard to the vehicles for learning the material, and how has this changed with time? Table 4 below helps address this issue.

Table 4: Classroom Activities

	Classroom Experiments	Computer Labs	Games and Simulations	Group Projects	References to Sports, Drama, etc.?	Other Activities
Never	23%	11%	4%	6%	6%	47%
Little Use	34%	17%	22%	19%	11%	11%
Some of the Time	36%	61%	59%	60%	56%	35%
Most of the Time	6%	8%	13%	12%	20%	7%
All of the Time	0%	3%	1%	3%	8%	0%

In both the current data and QV, group projects and, games and simulations seem to be the most favored classroom activities, with 73% stating that they use games and simulations at least some of the time (compared to 80% in QV) and 85% stating that they use group projects at least some of the time (compared to 76% in QV). One other interesting note is that classroom experiments seem to have diminished in use with 42% in the current survey

stating that they use it at least some of the time compared to 51% stating the same in the data collected in QV. One would expect that as a younger demographic of economics instructors begin teaching at the high school level, this pedagogy would become more prevalent, not less so. Nonetheless, data from national surveys of economics instruction in colleges and universities show that classroom experiments are not common pedagogy in college economics courses and this may contribute to the lack of familiarity with using experiments as a learning tool (Watts and Becker 2008).[3]

While there is some increase in the presence of Internet and digital resources, the educational environment that high school students encounter neither has been nor currently is characterized by much diversity with regard to the modes of learning.

Given that Lecture is the primary mode of instruction, the use of a textbook is likely to have an important impact on learning. The survey implemented in the current study also asked instructors to identify which texts, if any, they were using in the class room. The list of 'approved' texts was compiled by drawing on information from the website of the Indiana Department of Education.[4] Respondents were then asked to identify the textbook they respectively employed from this list. Options for 'no text' and 'other text' were also included in the survey. [5] Responses on the Textbook question are summarized in Table 5 below.

Table 5: Textbook Selection

Title	Publisher	Proportion Using
Essentials of Economics	Bedford, Freeman & Worth	1.5%
Contemporary Economics	Cengage	0%
Economics, New Ways of Thinking	EMC Publishing	2.9%
Economics: Principles and Practices	Glencoe/McGraw-Hill	29.4%
Economics: Today and Tomorrow	Glencoe/McGraw-Hill)	8.8%
Economics: Concepts and Choices	Holt McDougal	10.3%
Economics	Holt McDougal	2.9%
Economics: Principles in Action	Prentice Hall	30.9%
Contemporary's Economics	Wright Group/McGraw-Hill	0%
Other		16.2%
None		4.4%

As expected, the results in Table 5 show that only 4.4% of respondents said that there was no textbook used in the course. Of the available texts, two account for more than 60% of all text book usage by respondents. These are Prentice Hall's *Economics: Principles in Action* and Glencoe/McGraw-Hill's *Economics: Principles and Practices*. It is not clear why these particular textbooks were popular choices. Future surveys could perhaps drill down further into this finding by inquiring about the process regarding the selection of the textbook – especially, exploring the linkage with learning outcomes.[6]

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[3] Care must be taken when discussing classroom activities such as experiments and, games and simulations because it is difficult to ascertain what the survey respondent considers to be a game versus a classroom experiment. In future surveys, this issue should be clarified. However, the current survey is conducted using these descriptions to facilitate the comparison to older surveys which use these same categories of activities.

[4] Specifically the information on approved texts comes from http://dew4.doe.in.gov/WF/TEXTBOOK/r07/2008_dpita07.cgi which was accessed through the textbook portion of the Indiana Department of Education's website here: http://www.doe.in.gov/opd/textbook/ .

[5] The state of Indiana, although it does textbook approvals at the state level, gives individual schools much leeway about choosing a text. This is illustrated in an open letter to educators penned by the current director, Dr. Tony Bennett. The letter is available on the Indiana Department of Education's website here: http://www.doe.in.gov/opd/textbook/docs/TextbookFlexibility020609f.pdf

[6] Note that previous surveys did not collect data on textbook choices and use.

FINDINGS AND DISCUSSION ON CLASSROOM CONTENT

One of the mandates of Indiana's Department of Education is determining content-coverage for school-courses. For economics, the Department has identified 8 topics that must be covered. Do all topics receive 'equal treatment' in terms of the time spent covering them? Addressing this question carries implications for identifying the domains of strength in the economics literacy of high school graduates.

The survey in the current study asked each respondent to estimate the number of class periods that he/she spends on each prescribed topic. The percentage of total time spent on each topic was then computed (for each respondent) in the following fashion. First, the sum of all periods spent on all topics was taken and then and multiplied by 0.75 (1.5) if the respondent stated that he/she used standard periods (block periods). This gives us an estimate of the total number of hours spent on teaching economics content. Second, the number of periods spent on each topic is multiplied by the appropriate factor (1.5 or 0.75) and then divided by the total. Table 4 summarizes the distribution across topics.

Table 4. Percent of time spent on Economics Content by Topic

ECONOMICS CONTENT – as % of total time in economics	Proportion	Std. Err.
Scarcity and Economic Reasoning	0.119	0.006
Supply and Demand	0.195	0.010
Market Structures	0.121	0.007
The Role of Government	0.114	0.005
National Economic Performance	0.106	0.006
Money and the Role of Financial Institutions	0.128	0.007
Economic Stabilization	0.095	0.006
Trade	0.080	0.006

Not surprisingly, the bulk of the time spent covering economics content is on the study of the supply and demand model (as it forms the basis for understanding price movements across all types of industries – both goods and services). The rest of the time spent on economics instruction seems to be more or less evenly distributed among the remaining 7 topics with Trade receiving the smallest average proportion of time spent – the latter phenomenon can perhaps be attributed to the fact that international trade is a relatively small fraction (around 20%) of overall economic activity (GDP) in the U.S.

Effective July 1, 2009, the Indiana Department of Education implemented Indiana Code 20-30-5-19, as added by Public Law 154-2009 which provides direction for Personal Financial Responsibility instruction. This law mandates that each School Corporation, Charter School, and accredited nonpublic school include in its curriculum for all students in grades 6 through 12, instruction concerning personal financial responsibility. Furthermore, the law states that these schools may meet the requirement by: (1) integrating relevant content in its overall curriculum or, (2) conducting a seminar that is designed to foster overall personal financial responsibility in a manner appropriate for each grade level as a separate subject or as units incorporated into appropriate subjects. The guidelines further state that all students in grades 6 – 12 will participate in financial literacy education via an instructional unit at least once by the end of the eighth grade and more than once by the end of the twelfth grade.

Personal finance is arguably closely related to economics even though they are deemed to have two different sets of objectives as determined by the Indiana Department of Education. As a result, one may maintain that schools may seek to cover personal finance topics in their economics courses. To test this conjecture, the current survey included the explicit question of whether personal finance topics were covered in the economics course. 84% of the respondents stated that they covered at least one personal finance topic in their economics course (providing substantial evidence in support of the conjecture). The survey also asked how class periods were distributed across the different personal finance topics. Table 7 below documents the distribution of time across economics and personal finance content.

Table 7. Personal Finance vs. Economics Instruction

	Mean	SE
Total Time (estimated hours)	**75.3**	**4.659**
Total Time on Economics (estimated hours)	**52.4**	**2.798**
Total Time on Personal Finance (estimated hours)	**22.9**	**3.809**
Proportion on Economics	**0.742**	**0.025**
Proportion on Personal Finance	**0.258**	**0.025**

Caution should be used in suggesting that economics and personal finance are entirely disconnected subjects. Even so, the results in Table 7 suggest that approximately 25% of the total economics class time was allocated towards covering personal finance topics. This is an important finding as it has bearing on the quality of economics literacy of high school graduates and their preparedness for College-level economics courses.

CONCLUSION

This paper sets out to examine how the teachers and the teaching of economics at the high school level have undergone change following a legislative measure that elevates the subject's relative importance in the curriculum in the State of Indiana. This examination is undertaken by implementing a focused survey of high school teachers in Indiana and comparing the results with those of previous such surveys. The principal findings are as follows:

1) An important demographic change is uncovered; a higher proportion of the survey-respondents are younger, female, and have greater experience in the teaching of economics compared to previous, similar surveys (1996, 2003). Following Correll (2001), this may encourage more female students to consider an economics-related career path as the culturally-induced perception-bias of economics being a 'male subject' is challenged and, in many cases, dismantled. If this demographic effect were to occur on a national scale, then it may help contribute to a further narrowing of the gender-gap in earnings by blurring the gender-stratifications that underlie the occupationally-linked earnings-ladder.

2) Lecture continues to be the predominant mode of instruction accompanied by little diversity in modes of learning. As Dede (2007) points out, this learning environment is at complete odds with the "learning strengths, styles, and preferences neomillenial students acquire from their use of immersive collaborative media, such as multiplayer online games." This 'alien' learning environment bodes ill for not just the economics fluency of high school students but their command over other disciplines as well.

3) Another legislatively induced focus on personal finance literacy may be crowding out the pursuit of effective economics literacy skills, highlighting the pitfalls of implementing seemingly uncoordinated, piecemeal legislative directives.

REFERENCES

Belfield, Clive R. and Henry M. Levin (2004). Should high school economics courses be compulsory? *Economics of Education Review*, vol. 23, pp. 351-360.

Corell, Shelly, J. (2001). Gender and the Career Choice Process: The Role of Biased Self Assessments. *American Journal of Sociology*, vol. 106 (6), pp. 1691-1730.

Dede, Chris. (2007). Transforming Education for the 21st Century: New Pedagogies that Help All Students Attain Sophisticated Learning Outcomes. *Harvard University*: White Paper commissioned by the NCSU Friday Institute.

Khayum, Mohammed, Gregory P. Valentine, and Daniel Friesner (2006). A Response of High School Teachers to the Adoption of State Economic Standards. *The Journal of Economics and Economic Education Research* , vol.7 (2), pp.47-72.

Valentine, Greg and Munir Quddus (1998). A Status Report of Indiana's High School Economics: Survey Results. *Journal of the Indiana Academy of the Social Sciences*, vol. 2, pp.52-58.

Watts, Michael, William E. Becker (2008). A Little More than Chalk and Talk: Results from a Third National Survey of Teaching Methods in Undergraduate Economics Courses. *The Journal of Economic Education*, vol.39(3), pp. 273-286.

Indiana Standards for Economics retrieved January 12, 2012 from http://learningconnection.doe.in.gov/Standards/Standards.aspx?st=&...

Personal Finance Responsibility Instruction Guidelines for Implementation retrieved January 12, 2012 from http://www.doe.in.gov/octe/facs/docs/_09_9-2_StBrd_Guidelines_PersFinResp_Approved.pdf

FACS: Financial Literacy Education, High School Academic Standards retrieved January 12, 2012 from http://doe.in.gov/octe/facs/IndianaFinLitEd-HighSchStandards.html

The Investigation of the Learning Styles of University Students

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ABSTRACT

The subject of this study is to determine the learning styles of university students and to compare it with gender, and departments differences. In this study, McVay Lynch Learning Style Inventory was used. The learning style inventory ,which consists of 59 articles and which is 3-Likert-Type scaled, includes three modes of learning called 'visual learning style', 'auditory learning style' and kinesthetic learning style'. According to the result of the study, it was seen that approximately half of the students learned visually. By observing the influence of the gender on the learning styles of the students, it was found out that, in visual learning, girls had obvious higher averages rather than boys in statistical terms. In addition, it was also noted that, neither the departments of the students nor the common effect of the gender nor the department doesn't affect the learning styles.

Keywords: *learning, Investigation, learning styles*

INTRODUCTION

People, use learning every day as it is the period of processing the data. The purpose of people using learning is to manage and adopt the conditions which result in different learning styles (Brown, 2009). Thus, here it is seen that individuals might differ in learning styles. When we ask the meaning of learning styles, we can easily notice that it is not a brand new topic in education and can be encountered in the studies that took place in the last 20 years. It has been observed by lots of different researchers and has always been one of the topics that has been taken into consideration within the framework of learning (Huston and Cohen, 1995, as cited in Brown et al. 2009; Ballone and Czerniak, 2001). 'Learning Style' was described as the path which individuals prefer in order to adopt the new data and strategies that they process for active learning. In other words, learning styles are conceptual, cognitive, behavioral patterns which are exposed to time and duties (Guild, 1994, as cited in Ballone and Czerniak,2001).

Experts defined the learning styles in various ways as they made their assessments in different orientations. Due to this, learning styles have different definitions and classifications (Yılmaz – Soylu ve Akkoyunlu, 2002). For example, the learning styles of Gregoric consist of four dimensions that include concrete-consecutive,abstract-consecutive, concrete-random and abstract-random (Guild and Garger, 1985, as cited in Ballone and Czerniak, 2001).

In the learning styles of Kolb, there are also four styles. These are: accommodator,diverger,converger and assimilator (Can, 2011; Yılmaz-Soylu ve Akkoyunlu, 2002). In the learning styles of Felder ve Soloman four different learning styles exist and these are the active-reflective scale, the sensing /intuitive scale,the visual/verbal scale and the sequential /global Scale (Samancı and Keskin, 2007). Vester mentioned three learning styles in his book called 'Think-Learn-Forget' which was published in 1975. According to Vester, there are auditive, visual and haptic learning styles (Beck, 2005). The McVay Lych Learning Styles Invantory which was used in this study consists of three dimensions called visual, auditory and kinesthetic. When these dimensions are observed;

- In visual learning students learn through seeing. Visual learners prefer visual aids like pictures, figures and tables (Mills et al.. 2010).

- In auditory learning,students learn through hearing. They tend to prefer verbal and written materials (Mills et al., 2010).

- In kinesthetic learning, students learn as they perform.

Learning styles are not stable. Students might adopt different styles depending on their subject and their learning environment (Pritchard, 2009, as cited in Alharbi et al., 2011). For example, some students might have one or two of the learning styles like visual , auditory and kinesthetic while others might have all of them.

Determining the learning styles of students is of vital importance in order to collect data about their preferances. It creates awareness for the student. This awareness provides the learner to gain knowledge during his effort to learn and also acts as a motive for the learner to use the gained. knowledge (Federico 2000, as cited in Brown et al., 2009). Learning styles not only creates awareness for the students but they can also be used to inform them about their strengths and weaknesses. Being cognizant of their strengths and weaknesses might trigger them to be more motivated to learn (Coffield et al., 2004). Starting from this point, the target was to determine different learning styles among the university students that are registered to different departments. Consequently, the research was based on the preparatory school students since they vary in terms of departments.

In this study, it was aimed to determine the learning styles of the students who study at a private university's prep school in Northern Cyprus. In addition, it was also aimed to see the impact of their genders and their departments on their learning styles, these two elements (their genders and departments) were assessed both mutually and separately. The data obtained from this study is thought to be useful for the studies that are done on learning strategies and also to be beneficial for educational activities which are oriented on university students. The answers to the following questions were sought:

- What are the style of prep students like?

- Does gender has an impact on learning styles of these students?

- Do the departments of the students affect learning modes?

- Do the genders and the departments of the students have a mutual effect on students' learning styles?

Revealing the learning problems of the students, finding out the preferances of them, helping students find out the suitable learning methods and contributing the studies conducted on this subject can be accepted as the benefits of observing learning strategies

MATERIALS AND METHOD

The study group consists of 120 students (62 girls and 58 boys) who study at a prep school of a private university in the Northern Cyprus. The mean values of age of these students who were chosen randomly is 19.5 (Sd. 1.3). The reason why these prep students were chosen is that they would continue to study different departments after completing their prep year. Thus, it was a great opportunity to see varied learning strategies. The departments that these students would proceed are given below:

Nutirition and Dietetics (20 students)

Faculty of Pharmacy (17 students)

Nursing (33 students)

Business Management (29 students)

Faculty of Engineering. (21 students)

Maggie Mcvay Lynch Learning Strategy Inventory was used in this study. Maggie McVay Lynch Inventory was adapted into Turkish by Dağhan and Akkoyunlu in 2011. This 3 Likert- type- scaled inventory's actual form has 60 items. However, the adaptation of it contains 59 items. Inventory is made up of three dimensions and these are: 1. Visual learnning style (21 items), 2. Auditory Learning Style (19 items), 3. Kinesthetic Learning Style (19 items). For the reliability of this research, Cronbach Alpha value was calculated and the reliability of this study was found .80, where

as the Turkish adaptation's reliability was .95.

The reliability of the learning strategies are given below:

- Visual Learning : .68
- Auditory Learning : .56
- Kinesthetic Learning: .58

While evaluating the data, frequency, mean, standard deviation and percentage techniques were used. T test, one-way ANOVA and two-way ANOVA tecniques were used while assessing the separate and mutual effect of the genders and the departments on learning styles of the students. For the normalcy, the assumptions were controlled. As the kurtosis and skewness were between -1 and +1, the distribution was accepted as normal. (skewness:.138; kurtosis: .95)

RESULTS

In this part, the data collected from the analyses are given under the headings of 'The Distribution Of The Learning Styles of Students', 'The Effect Of Gender On the Learning Styles, 'The Effect of Departments on The Learning Styles', and 'The Mutual Effect Of the Gender and Departments On Learning Styles'.

The Distribution Of The Learning Styles of Students

Table 1. shows the distribution of the learning styles of students.

Table 1. Percentages for the learning styles of students

	Visual	Auditory	Kinesthetic	Visual-Kinesthetic	Total
f	55	25	39	1	120
%	41.7	18.9	29.5	0.8	100

According to Table 1, the most common learning styles is visual. About half of the students (41.7 %) have visual learning style. The following learning style is Kinesthetic (29.5%). The 18.9 % of the students use auditory learning mode.

The Effect of Gender on Learning Styles

Table 2 presents the results of t test analysis.

Table 2. The comparision of gender differences on learning strategies

		f	$\overline{X}$	Sd.	t	p*
Visual Learning Style	Women	62	2.34	0.27	2.55	.01
	Men	58	2.22	0.28		
Auditory Learning Style	Women	62	2.22	0.26	.99	.32
	Men	58	2.18	0.24		
Kinesthetic Learning Style	Women	62	2.22	0.25	.33	.74
	Men	**58**	**2.20**	**0.24**		

*.05

The average of women are higher than men in terms of visual, auditory and kinesthetic learning styles. However, the most important difference on average is on visual learning. To put it another way, a crucial difference on visual learning which is beneficial for women was found. ($t_{(118)}$=2.55, p>0.05).

The Effect of Departments on The Learning Strategies

Table 3 illustrates the results of one-way varyans analysis (one-way ANOVA) tecnique.

Tablo 3. The Comparison of Students according to their departments

Variants	Group Type	f	$\bar{x}$	Sd.
Visual Learning Style	Nutrition and Dietetics	20	2.32	.22
	Pharmacy	17	2.30	.24
	Nursing	33	2.30	.30
	Engineering	21	2.23	.28
	Business Administration	29	2.25	.33
Auditory Learning Style	Nutrition and Dietetics	20	2.24	.21
	Pharmacy	17	2.19	.26
	Nursing	33	2.20	.28
	Engineering	21	2.24	.27
	Business Administration	29	2.15	.21
Kinesthetic Learning Style	Nutrition	20	2.13	.24
	Pharmacy	17	2.25	.19
	Nursing	33	2.25	.24
	Engineering	21	2.22	.23
	Business Administration	29	2.18	.29
	One-Way ANOVA			
Visual Learning Style	SS*=.130;	MS*=.003;	$F^*_{4\text{-}115}$=.400;	p*=.81
Auditory Learning Style	SS*=.140;	MS*=.580;	$F^*_{4\text{-}115}$=.580;	p*=.68
Kinesthetic Learning Style	SS*=.240;	MS*=1.00;	$F^*_{4\text{-}115}$=1.00;	p*=.41

* SS: Sum of Squares; MS: Mean Square; F values; p: significance

When Table 3 was observed, it was seen that the departments of the students do not have considerable effect on the learning strategies. According to this study, the students of Nutrition and Dietetics, Pharmacy, Nursing and Business Administration have visual learning style, whereas the ones who would study at Engineering have auditory learning style.

The Mutual effec Of the Gender and Departments On Learning Styles

Table 4. shows two way varyans analysis (two way-ANOVA) whether the departments and gender of students have an influence on the learning styles of students.

Table 4: The mutual effect of the gender and departments on Learning Styles

		Women			Men		
Variants	Department	f	$\bar{x}$	Sd.	f	$\bar{x}$	Sd.
Visual Learning Style	Nutirition and Dietetics	16	2.31	.24	4	2.39	.14
	Pharmacy	10	2.37	.24	7	2.20	.21
	Nursing	26	2.35	.27	7	2.12	.35
	Engineering	2	2.15	.36	19	2.24	.28
	Business Administration	8	2.40	.41	21	2.20	.29
Auditory Learning Style	Nutirition and Dietetics	16	2.25	.22	4	2.21	.16
	Pharmacy	10	2.17	.26	7	2.21	.30
	Nursing	26	2.22	.30	7	2.14	.21
	Engineering	2	2.33	.17	19	2.23	.28
	Business Administration	8	2.21	.24	21	2.13	.21
Kinesthetic Learning Style	Nutrition and Dietetics	16	2.09	.24	4	2.29	.13
	Pharmacy	10	2.27	23	7	2.21	.14
	Nursing	26	2.28	.22	7	2.16	.29
	Engineering	2	2.47	.07	19	2.19	.23
	Business Administration	8	2.11	.32	21	2.20	.24
	Two -Way ANOVA						
Visual Learning Style	SS*=.330;	MS*=.082;	$F^*_{9\text{-}110}$=1.054;	p*=.38			
Auditory Learning Style	SS*=.047;	MS*=.012;	$F^*_{9\text{-}110}$=.183;	p*=.95			
Kinesthetic Learning Style	SS*=.414;	MS*=.104;	$F^*_{9\text{-}110}$=1.724;	p*=.15			

* SS: Sum of Squares; MS: Mean Square; F values; p: significance

Having observed Table 4, it was seen that the common effect of the gender and the departments of the students is not significant. The highest average value is from the women students of Engineering faculty and it is in Kinesthetic Learning Style ($\overline{X}$=2.47). The lowest average is the women students from Nutrition and Dietetics in Kinesthetic Learning Style ($\overline{X}$=2.09)

CONCLUSIONS AND DISCUSSION

In this study, it was aimed to determine the learning styles of the students who study at the Preparatory School. In addition, it was also aimed to see the effect of their genders and their departments on their learning styles, these two elements (their genders and departments) were assessed both mutually and separately. The most prevalent learning style adopted by the students who participated in this study is visual learning. MacCarter (2008) mentioned in his research that the most dominant learning style is visual learning. Visual learners form mental images with the things they learn and keep them in their mind (Dunn and Dunn, 2003, as cited in Pender and Tekavčič, 2009; Pender, Tekavčič and Dimovski, 2008). Among the learning styles ,such as visual, auditory and kinesthetic , one or two of them are normally dominant (Pender and Tekavčič, 2009). Some students have a preferance among these learning styles because the learning style is a consistent path in which students respond to the stimuluses and use it*.

When the crucial importance of the gender on the learning modes was observed, it was seen that gender had no effect on the students who learned by auditory learning and by performance. However, the influence of gender is significant on visual learners. It was seen that this effect was beneficial for girls. This result is similar to another study in which some other learning styles were observed (Can, 2011; Deniz, 2011). On the other hand, it brings out a contrast when it is compared with another study concerning the learning styles of students (Oktar-Ergün, 2010).

When the relation between the student's departments and the learning strategies were observed, it was seen that the difference in terms of departments does not have an important effect on learning strategies. Some studies also support this result (Özen and Eren 2009); while others do not (Kahyaoğlu, 2011).

As it was also stated in Samancı and Keskin's study in 2007, the common effect of the gender and the department does not have a noteworthy influence on the learning styles of the students. As a result of these findings, it can be noted that the departments of the students do not have an effect upon the learning styles of the students.

REFERENCES

Alharbi, A., Paul, D. Heskens, F. and Hannaford, M. (2011). " An Investigation into the Learning Styles and Self Regulated Strategies for Computer Science Students. *Hobart Tasmania Australia*, 4-7 December.

Ballone, L. M. and Czerniak, C. M. (2001). "Teacher's Beliefs About Accommodating Students's Styles In Science Classess. *Electronic Journal of Science Education*, Vol. 6, No. 2, December/

Brown. T., Zogni. M., Williams, B., Sim, J. vd. (2009). „Are learning preferences of health science students predictive of their attitudes towards e-learning?". *Australasian Journal of Educational Techonogy*, 25(4), 524-543.

Beck, H. (2005). „Lernstile und Lerntypen". *Lernen lehren*. http://synpaed.de/3_Lernen/PDF/3_Lernstile.pdf.

Can, Ş. (2011). „Sınıf Öğretmeni Adaylarının Öğrenme Stilleri ile Bazı Değişkenler Arasındaki İlişkinin Araştırılması". *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 41:70-82.

Coffield, F., Moseley, D. Hall, E. ve Ecclestone, K. (2004). Learning styles and pedagogy in post-16 learning. Learning and Skills Devolopment Agency.

Dağhan, G. and Akkoyunlu, B. (2011). Maggie Mcvay Lynch Öğrenme Stili Envanterinin Türkçe'ye Uyarlanma Çalışması. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 40: 117-126.

Deniz, J. (2011). Müzik Öğretmeni Adaylarının Öğrenme Stilleri. *2nd International Conference on New Trends in Education and Their Implications*, Antalya, www.iconte.org.

Kahyaoğlu, M. (2011). Öğretmen Adaylarının Öğrenme Stilleri İle Çevre Eğitimi Öz-Yeterlikleri Arasındaki İlişki. Eğitim Bilimleri Araştırmaları Dergisi – *Journal of Educational Sciences Research*, Cilt 1, Sayı 2.

MacCarter, K. M. (2008). The Effect of auditory stimulation on learners with different learning styles. Capella University, Doctor of Philosophy.

Mills, J., Ayre, M., Hands, D., and Carden, P. (2010). Learning About Learning Styles: Can It İmprove Engineering Education? *Mountain R*.

Oktar-Ergür, D. (2010). "Hazırlık Sınıfı Öğrencilerinin Kişisel Özelliklerinin Öğrenme Stillerine Etkisi ve Öğrenme Süreçlerine Yansıması". *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 39: 173-184.

Penger, S. and Tekavčič, M. (2009). Testıng Dunn & Dunn's And Honey & Mumford's Learnıng Style Theorıes: The Case Of The Slovenıan Hıgher Educatıon System. *Management*, Vol. 14, 2009, 2, pp. 1-20.

Penger, S., Tekavčič, M. and Dimovski, V. (2008). Comparison, Validation And Implications Of Learning Style Theories In Higher Education In Slovenia: An Experiential And Theoretical Case. *International Business & Economics Research Journal*, Volume 7, Number 12.

Samancı, N. K. and Keskin, M. Ö. (2007). "Felder ve Solomon Öğrenme Stili İndeksi: Türkçeye Uyarlanması ve Geçerlik-Güvenirlik Çalışması". *Ahi Evren Kırşehir Eğitim Fakültesi Dergisi, (KEDAF)*, Cilt 8, Sayı 2, 34-54.

Yılmaz-Soylu and Akkoyunlu, B. (2002). The Effect Learning Styles On Achievement In Different Learning Environments". *The Turkish Online Journal of Educational Technology*.

* http://www.itslifejimbutnotasweknowit.org.uk/files/LearningStyles.pdf. : Duckett and Tatarkowski, "Learning styles and their application for effective learning".

The Relationship between Elementary Teacher Candidates' Attitudes towards Problem Based Learning and Problem Solving Skills

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ABSTRACT

The purpose of this research is to determine the relation between elementary teacher candidates' problem solving skills and attitudes towards problem based learning. Furthermore this research intend to determine if there is a significant difference in elementary teacher candidates' problem solving skills and the attitudes towards problem based learning according to the variables of gender and their education program, or not. The research was carried out with a total of 199 third and fourth grade teacher candidates (100 female, 99 male) from Elementary Department of Faculty of Education at Siirt University in Turkey. It was used the "Problem Solving Inventory" which was developed by Heppner and Peterson (1982) and translated into Turkish by Şahin, Şahin and Heppner (1993) to determine the problem-solving skills of the teacher candidates' and the "Problem-Based Learning Attitude Scale" which was developed by Turan and Demirel (2010) was used to determine their attitudes towards problem-based learning. In our research, it was calculated that the Cronbach alpha reliability coefficient of problem solving skills as .78 and the scale of attitudes towards problem based learning as .93. As a result of this research, the problem solving skills (M=87.91) and the attitudes towards problem based learning mean score (M=68.15) of elementary teacher candidates' were found as medium level. It was found that there is no significant and negative relation between the elementary teacher candidates' problem solving skills and attitudes towards problem based learning (r= -.54; p>0.05).

Keywords: *Attitudes, problem, problem-solving skills, problem based learning;*

INTRODUCTION

In our day individuals are spending their energy and most of their time on problem solving and decision making progresses because of even more complicating social structure, technological developments, political, social and economical problems. D'Zurilla (1971) determines the term problem as a situation, where the individual experiences difficulties on answering internal and external missions. According to King (1981) the term problem is a situation that leads to doubt uncertainty. Morgan (1999) claims that the problem is a conflicting situation, where the individual encounters some obstacles on the way to his target. Semerci (2001) defines the problem as a situation, which the individual is unable to solve with his present reactions. According to Karasar (2004) every situation, that disturbs the individual physically and mentally and where indecision and more than one solution exists. Accordingly, a solution requires the use of the most complicated mental skills. In other words. Problem solution is an activity made for revealing the "unknown" in a systematic and analytic way, where the start point is the "known". Heppner (1982) uses problem solving as a synonym of dealing with problems. Aksu (1998) describes problem solution as a progress of winning the difficulties encountered in the way of a purpose. Problem solution is a quite complicated progress, that

covers the cognitive skills, but also affective and behavioral features. Saygılı (2000) approaches the affective factors on problem solving as; individual factors (intelligence, motivation, foreknowledge-installation, function hesitation) and sociological factors (socio-economic, level and sociological development of child, child raising applications and manners of families, physical conditions of school and class size). Problem solving is closely related to psychological harmony(Bepner & Anderson 1985), confidence (Erden & Akman, 1995), communication skills and decision making styles (Hunsakler and Alessandra 1980), academical and social self-respect (McCobe, Balnkstein & Mills, 1999) of the individual. The lack in problem solving skills may cause in young people to results like aggression (Dodge & Feldman 1990), behavior disorders (Joffe et. al. 1990) drug use (Platt, Scura & Hannon, 1973; Korkut, 2002). Problem solving depends on the type and complication of problem. While some problems can be solved logically, some requires emotional maturity. In order for a situation to be considered as a problem, the individual must ponder upon it and perceive it as a problem (Morgan, 1995). According to Gagne, the purpose of training programs should be to teach to students own to solve the possible problems both on their branch and on real life (Yapıcı & Yapıcı, 2006; Karataş & Güven, 2003; Çalışkan, Selçuk & Erol, 2006; Polat & Tümkaya, 2010). The education mentality of today expects from students to extract distinctive meanings from their experiences and to structure what they learned with distinctive strategies by proceeding them (Açıkgöz, 2007). Problem Based Education is an approach, that aims to have students gain the skills of learning with self-governance, independent studying, questioning and problem solving, is an approach that provides the students to self-research and learn whenever they encounter similar situations during their lifetime. This approach is based upon from real situations forming problem situations and scenarios. Learners, under the guidance and management of the teacher, learn to discover, analyze, solve the problem and to gather the required data to learn both individually and in groups. Problem Based Education plays an effective role in revealing the before learned dates of student, providing the learning to happen and obtaining the permanent data by organizing and giving meaning to the data. Teacher are the main source t help the students to improve their problem solving skills. This situation provides the students with opportunities of problem solving, and helps them to raise as good problem solvers in future. In this situation teachers' understanding, belief and approaches problem solving is important. Therefore it is believed that revealing teacher candidates' skills of problem solving and approaches problem solving is important.

Purpose of these studies is to determine teacher candidates' problem solving skills and problem based learning oriented approaches. In pursuance of this purpose answers for following questions were sought:

1. What kind of relation is there between teacher candidates' problem solving skills and problem based learning oriented approaches?

2. Is there any difference between teacher candidates' problem solving skills and problem based learning oriented approaches, based upon gender and the program they study in?

METHOD

Participants

The study was conducted in the spring of 2009-2010 academic year at Siirt University in Turkey. Participants were 199 candidates of teachers who were attending at primary class and sciences education departments in faculty of education.

Data Collection

A descriptive survey research design was used in this study. As a mean of data collection; person information forms developed by the researcher and problem solving inventory which is developed by Heppner & Petersen (1982) and adapted to Turkish by Sahin, Sahin & Heppner (1993) and the attitude scale towards problem based learning which is developed by Turan & Demirel (2010) are used. Problem solving inventory aims to measure the reactions against the problems, individuals face in lifetime how they perceive their own problem solving skills. From 35 items, attained by positive and negative formulas in the scale 32 of them are taken into evaluation. Items have answers suitable for six point gradation. Confidence in problem solving skill, self control and approach avoidance subscale take place. High points indicate how low isperception of problem solving skill (Şahin, Şahin & Heppner, 1993). The results obtained from the studies of adaptation, validity and reliability show that the scale can be used for research in spite of some restrictions (Taylan, 1990, Savaşır & Şahin 1997). Content of the inventory is consisting of 35 items as a six pints Likert scale. Some of the items are positive while some are negative. Scale shows the scores relating to the total scores of problem solving skill perception and subscales. Given answers are scored from 1 to 6. During the scoring 9th, 22nd,

29th items are excluded; therefore scoring is made out of 32 items. Items numbers 1, 2, 3, 4, 11, 13, 14, 15, 17, 21, 25, 26, 30 and 34 are scored adversely. The range of the inventory scores is between 32 and 192. Highest scores obtained from the scale indicated that individuals percept themselves inadequate in problem solving. Oppositely if the scores are low then it is the sign of positive perception of problem solving skill. The Cronbach alpha coefficient of reliability of the original scale was calculates as .88. In this study made by us the Cronbach alpha coefficient of reliability of the scale was calculates as .78. The attitude scale towards problem based learning was developed by Turan & Özdemir (2010) and consists of 20 items in 5 points likert type. Cronbach alpha coefficient of the scale was indicated as .95. in our study, the Cronbach alpha coefficient of reliability of problem based learning attitude scale was found as .93.

Data Analysis

SPSS 16.00 statistic program is used for the analysis during the analysis arithmetic means and standard deviations of the problem solving skills and attitudes towards problem based learning level scores are calculated. t-test are applied in order to find whether the differences between the arithmetic means are relevant or not and Pearson Moment Correlation Coefficient was used. The significance levels for the statistical analyses is accepted as $p< .05$.

RESULTS

Findings of the study that aims to determine of relationship between the problem solving skills and the attitude towards problem based learning are given below.

Table 1. Pearson Moment Correlation Coefficient results about the problem solving skills and the attitude towards problem based learning of elementary teacher candidates.

		Problem solving skills
The attitudes towards problem based learning	r	-.054
	p	.448*
	N	199

As seen in Table-1, it is determined that there is a no meaningful relation in negative direction between the problem solving skills and the attitudes towards problem based learning of the teacher candidates ($r= -.054$; $p> .05$),

Table 2. Arithmetic mean and standard deviation of teacher candidates' problem solving skills and the attitudes towards problem based learning

	N	Minimum	Maksimum	$\overline{X}$	SS
Problem solving skills	199	55.00	128.00	87.91	15.65
The attitudes towards problem based learning	199	20.00	100.00	68.15	20.64

As seen in Table-1, the mean of the teacher candidates' problem solving skills 87.91; mean of the attitudes towards problem based learning 68.15. Accordingly, it is seen that the mean of the teacher candidates' problem solving skills and the attitudes towards problem based learning are the medium level.

Table3. t-test results of teacher candidates' problem solving skills and the attitude towards problem based learning according to gender

	Gender	N	$\overline{X}$	SS	t	p
Problem solving skills	Female	100	85.99	15.11	-1.75	.081*
	Male	99	89.85	16.02		
The attitudes towards problem based learning	Female	100	69.73	20.65	1.08	.281*
	Male	99	66.56	20.62		

* $p> .05$

As seen in Table-3, the mean of male teacher candidates' problem solving skills (89.85) was higher than female teacher candidates (85.99). This means female teacher candidates' problem solving skills are higher than male ones. The mean of female teacher candidates' attitudes towards problem based learning (69.73) was higher than male teacher candidates (66.56). This means of female teacher candidates' attitudes towards problem based learning was positive than male teacher candidates. It was determined that problem solving skills and attitudes towards problem based learning of the teacher candidates show no meaningful difference in the dimension of gender ($p> .05$).

Table 4. t-test results of teacher candidates' problem solving skills and the attitude towards problem based learning according to department

	Department	N	$\overline{X}$	SS	t	p
Problem solving skills	Elementary class	123	89.91	16.11	.862	.390*
	Elementary science	76	87.73	14.39		
The attitudes towards problem based learning	Elementary class	123	68.22	18.69	.280	.780*
	Elementary science	76	67.27	22.15		

* p> .05

As seen in Table-3, the mean of elementary class teacher candidates' problem solving skills (89.91) was higher than elementary science teacher candidates (87.73). This means elementary science teacher candidates' problem solving skills are higher than elementary class teacher candidates. The mean of elementary class teacher candidates' attitudes towards problem based learning (68.22) was higher than elementary science teacher candidates (67.27). This means of elementary class teacher candidates' attitudes towards problem based learning was positive than the elementary science teacher candidates. It was determined that problem solving skills and the attitudes towards problem based learning of the elementary teacher candidates show no meaningful difference in the dimension of department (p> .05).

CONCLUSION AND DISCUSSION

In the study, no statistically meaningful relation in negative direction between teacher candidates' problem solving skills and problem based learning oriented approaches was found. In a similar study made by Serin (2004) it is indicated that there is a meaningful relation in negative direction between the problem solving skills and the approaches for the sciences of the students of Faculty of Education, while there is a statistically meaningless relation in negative direction between problem solving skills and sciences successes of the students. Kocabaş et. al. (2006) stated in a study, that there is a highly meaningful relation between the problem solving skills and the approaches for the program of Class Teaching Master Students, while there was no meaningful relation found for Doctorate Students. In our study, teachers' s and teacher candidates' skills of problem solving and their approaches to problem based education was determined as mid-level. Saracaloğlu, Yenice & Karasakaloğlu (2010) have indicated that class teacher candidates' skill level of problem solving is sufficient. İnel, Evrekli & Türkmen (2011) have stated that class teacher candidates' skill level of problem solving is high. Aslan (2007)stated that Turkish lesson teacher candidates' skill level of problem solving is sufficient. It was determined that teacher candidates' problem solving skills and problem based learning oriented approaches do not differ in regard to gender variables, that female teacher candidates' problem solving skills and problem based learning oriented approaches are higher than male ones. In similar studies, besides the studies that show there is no meaningful difference for teacher candidates' skills of problem solving in regards to the gender (Çam, 1995; Kasap, 1997; Erdem, 2001; Güven & Akyüz, 2001; Serin, 2001; Özkütük et.al., 2003), there is also some studies that contradict (Korkut, 2002). Study of different subjects might have caused to current situation. There is no statistical meaningful difference confirmed between teacher candidates' study program, problem solving skills and problem based learning oriented approaches. As conclusion, problem solving skills and approaches for problem based education of teacher candidates must be determined and time must be taken for improving the problem solving skills and problem based education oriented approaches of low level teacher candidates. If needed, training programs should be prepared in a fitting way with the purpose of improvement of problem solving skills and problem based education activities.

REFERENCES

Açıkgöz, K.Ü. (2007). *Başarmak Elimizde*, İzmir: Biliş.

Aksu, M. (1998). Problem çözme becerilerinin geliştirilmesi. *Problem Çözme Yöntemleri Sempozyumu Kitabı*, Ankara: O.D.T.Ü.

Aslan, C. (2007). Research on self-perceptions of pre-service turkish language teachers in turkey with regard to problem solving skills. *International Journal of Human and Social Sciences*, 2:4 249-255.

Çalışkan, S., Selçuk, G.S., & Erol, M. (2006). Fizik öğretmen adaylarının problem çözme davranışlarının değerlendirilmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*. 30 73-81

Çam, S. (1995). Oğretmen adaylarının ego durumları ile problem çözme becerisi algısı ilişkisinin incelenmesi, *Psikolojik Danışma ve Rehberlik Dergisi*, 6 (2), 37-42.

Dodge, K.A., & Feldman (1990). Issues in social cognition and sosiometric statüs. İn S.A. Asher & J.D.Coide (Eds) *Peer Rejection in childhood*. New York Cambridge University Press.

D'Zurilla, T.J., & Goldfried, M.R. (1971). Problem solving and behavior modification. *Journal of Abnormal Psychology*, 18, 407–426.

Erdem, Y. (2001). Yüksekokul ve sağlık meslek lisesi mezunu hemşirelerin problem çözme becerileri. *Yeni Tıp Dergisi,* 18(1): 11-13.

Erden, M., Akman, Y. (1995). *Eğitim Psikolojisi Gelişim-Öğrenme- Öğretme*. Ankara: Arkadaş Yayınevi.

Güven, A., & Akyüz, M.Y. (2001). Öğretmen adaylarının iletişim ve problem çözme becerilerine ilişkin görüşleri. *Ege Eğitim Dergisi,* l: 13-22.

Heppner, P.P., & Petersen, C.H. (1982). The development and implications of a personal problem-solving inventory, *Journal of Counselling Psychology*, 29 (1), 66-75.

Hunsaker, P.L., & Alessandra A.J. (1980). *The art of meaning people*. Prentice Hall İnc. Englewod Cliffs New Jersey.

İnel, D., Evrekli, E., Türkmen, L. (2011). Sınıf öğretmen adaylarının problem çözme becerilerinin araştırılması, *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi* 29 (1): 167-178.

Joffe, R.D., Dobson, K.S., Fine, S., Marriage, K., & Glenn, H. (1990). Social problem-solving in depressed, conduct-disordered and normal adolescents. *Journal of Abnormal Child Psychology*, 18(5): 565-575.

Kasap, Z. (1997). *İlköğretim 4. Sınıf Öğrencilerinin Sosyo-Ekonomik Düzeye Göre Problem Çözme Başarısı İle Problem Çözme Tutumu Arasındaki İlişki*. Yayımlanmamış Yüksek Lisans Tezi. Marmara Üniversitesi Eğitim Bilimleri Enstitüsü. İstanbul.

Karasar, N. (2004). *Araştırmalarda Rapor Hazırlama*. Nobel Yayın Dağıtım. 12. Baskı. Ankara.

Karataş, İ., & Güven., B. (2003). Problem çözme davranışlarının değerlendirilmesinde kullanılan yöntemler: klinik mülakatın potansiyeli. *İlköğretim-Online* 2(2), 2-9.

King, L.T. (1981). *Problem Solving In a Project Environment*. A Wily- Interscience Publication. Toronto.

Kocabaş, A., Selçinoğlu, E., & Kırmızı F.S. (2006). Sınıf öğretmenliği lisansüstü öğrencilerinin programa yönelik tutumlarına ve problem çözme becerilerine ilişkin görüşlerinin karşılaştırılması. *Eğitim ve Bilim*, 31 (142) 26-34.

Korkut, F. (2002). Lise öğrencilerinin problem çözme becerileri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 22, 177–184.

McCabe R., Balnkstcin K.R.., & Mills *LS*. (1999). Interpersonal sensity and social problem solving: relations with academic and social self esteem depressive symptoms and academic performance, *Cognitive Therapy and Research* 23(6) 587-604

Morgan, C.T. (1999), *Psikolojiye Giriş,(* Çev. H. Arıcı ve Ark.), Ankara: Meteksan Yayınları.

Plucker, J.A. (1999). How to use problem based learning in the classroom (Book Plucker 1999). *Roeper Plucker*, 22(1), 69-70.

Polat, R. H., & Tümkaya, S. (2010). An investigation of the students of primary school problem solving abilities depending on need for cognition. *Elementary Education Online,* 9(1), 346– 360.

Özkütük, N., Silkü, H.A., Orgun, F., & Yalçınkaya, M., (2003). Öğretmen Adaylarının Problem Çözme Becerileri. *Ege Eğitim Dergisi,* 2: 1-9.

Özdemir, S.T. (2003). Tıp eğitimi ve yetişkin öğrenmesi. *Uludağ Üniversitesi Tıp Fakültesi Dergisi*, 29 (2), 25-28.

Saygılı, H. (2000). *Problem Çözeme Becerileri ile Sosyal ve Kişisel Uyum Arasındaki İlişkinin İncelenmesi*. Yayımlanmamış Yüksek Lisans Tezi. Atatürk Üniversitesi Sosyal Bilimler enstitüsü. Erzurum.

Semerci, N. (2001) Yaratıcılık, kritik düşünme ve problem çözme, *Çağdaş Eğitim*, 271.

Serin, O. (2001). Lisans ve Lisansüstü düzeyindeki Fen grubu öğrencilerinin problemçözme becerileri, fene ve bilgisayara yönelik tutumları ile başarı arasındaki ilişki. Dokuz Eylül Üniversitesi Eğitim Bilimleri Doktora tezi, İzmir.

Serin, O. (2004). Öğretmen Adaylarının Problem Çözme Becerisi ve Fene Yönelik Tutum İle Başarıları Arasındaki İlişki, XIII. Ulusal Eğitim Bilimleri Kurultayı (6-9 Temmuz 2004), İnönü Üniversitesi, Eğitim Fakültesi, Malatya.

Şahin, N. H., Şahin, N., & Heppner P. (1993). Psychometric properties of the problem solving ınventory in A Group of Turkish University Students, *Cognitive Therapy and Research*, 17 (3), 379-385.

Turan S., & Demirel Ö. (2010). Probleme Dayalı Öğrenmeye İlişkin Tutum Ölçeği Geçerlik ve Güvenirlik Çalışması. *Eğitim ve Bilim* 1-12.

Yapıcı, Ş., & Yapıcı, M. (2006). Çocukta Bilişsel Gelişim. *Bilim, Eğitim ve Düşünce Dergisi*, 6(1), 1-3.