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Student Views With Regard To Probsol Learning Environmenta

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Abstract

The aim of this study is to assess learner views with regard to ProbSol learning environment prepared according to problem solving steps for the teaching of “applications related to equations and inequalities”. In line with this aim, the study was carried out with 15 volunteered 9th graders who are taught with ProbSol. The study is a case study, which is one of the qualitative research paradigms, and a semi-structured interview form with 8 open-ended questions developed by the researchers was used. Data obtained from semi-structured interview form were analyzed with content analysis method. In general, the views of the participants with regard to ProbSol environment were mostly positive.

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1. Introduction

The role of instructional technology in mathematics education specified by NCTM as technology is an essential tool for teaching and learning mathematics enhancing student's learning (NCTM, 2000). On the contrary the idea of learning from technology, this is a new approach to learning with technology (Baki & Guveli, 2008). As a result of this approach, many educators indicated that the use of instructional technologies in the classroom improves teaching and learning (Baki, 2002; Baki & Guveli, 2008; Chang, 2002; Dogan, 2009; Gursul & Keser, 2009; Liao, 2007; Sedlacek, 2009; Yildiz, Guven & Koparan, 2010).

Mathematics as a system is an abstract notion which is composed of structures and connections and which

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include sequential abstractions and generalizations made up of these structures and connections. It is known that students find mathematics difficult and unpleasant as it is difficult to acquire abstract notions (Baykul, 2001). Some research reports have shown that with the implementation of the computer in education of mathematics, mathematics teaching becomes lovable and fun. That is to say other words, instructional technologies for the students develop a positive attitude towards mathematics, increase interest and provide benefits such as reducing a fear (Dogan, 2009; Ozusaglam, 2007; Ozyurt et al, 2012).

In the traditional classroom, teacher is the one who delivers the lecturer content and controls the whole instructional process and the students listen to the lecture. Learners play a little part in their learning process and the learning mode tends to be passive. Addressing the issue of the passivity of students within traditional classroom settings has led to the development of student centered learning environments and using constructivist learning approaches (Neo et al, 2013). Therefore, along with the rapid development of the technology, researchers have focused on personalized virtual learning environments (Chen, 2011; Keles et al, 2009; Ozyurt et al, 2012; Seters et al, 2012; Srisawasdi, Srikasee & Panjaburee, 2012).

Virtual learning environments are best at achieving learning effectiveness when they adapt to the needs of individual learners (Park & Hannafin, 1993). Virtual learning environments should be able to identify learning needs and personalize solutions that foster successful learning and performance. Therefore personalized virtual learning environments are defined as those virtual learning environments that provide a set of personalization functionalities, such as personalized learning plans, learning materials and tests, and initiating interactions with the learner by providing advice, necessary instant messages, etc. personalized virtual learning environments are becoming more promising for achieving e-learning effectiveness due to their individual e-learning supports (Xu & Wang, 2006).

1.1. Problem solving

In Turkey, like many other countries, problem solving is one of major aspect in mathematics curriculum (Kayan & Cakiroglu, 2008; Tambychik & Meerah, 2010). Mathematics problem solving is not a topic but a process underlie the whole mathematics curriculums which contextually helped concepts and skills to be learned. Many mathematics skills were involved in problem-solving (Ibrahim, 1997).

Problem solving not only means finding the result of a mathematics question but also means facing with new conditions and finding flexible, effective and elegant solutions for these conditions (Gail, 1996). Therefore students' engagement in problem-solving activities helps them to acquire useful attitudes such as thinking, flexibility, creativity, and productivity which are very important to real life (Goffin & Tull, 1985).

Numerous problem-solving models have been proposed (Bransford & Stein, 1993; Good & Brophy, 1995; Hohn & Frey, 2002; Polya, 1973; Sternberg, 2003). All of them aim at helping students develop or improve their problem-solving skills through the execution of numerous steps of the problem-solving process. In this way it is expected that students' actions can be oriented to the direction of finding the right or best solution of a problem (Lazakidou & Retalis, 2010). A well-known problem solving model is the Polya's 4 steps model. Four steps which form the strategy of Polya (1973) called "**heuristics**" are (1) understanding the problem, (2) devising a plan, (3) carrying out the plan and (4) looking back. When these steps are considered, it is seen that a suitable plan shall be conducted for the solution of a problem. In fact devising a plan in the process of problem solving is to develop the suitable strategy. The more suitable strategies individuals develop for the solution the more successful he will be in the process of problem-solving (Ozdogan, Seyitoglu & Guven, 2011).

The purpose of this study is to develop a learning environment (named ProbSol) that is based on the four problem solving steps mentioned by Polya (1973). Besides, ProbSol was applied in real classroom environment and students' opinions were taken and evaluated.

2. Method

This study was conducted with the case study method, which is one of the qualitative study methods, in order to evaluate students' opinions about ProbSol learning environment prepared according to problem solving steps for the teaching of "applications related to equations and inequalities". Case study is a method, which investigates the case that is studied within its own life framework and which is used in the cases when there are no distinctive borders between the case and the environment it happens within and there are more than one evidence or data source (Yin, 1984).

2.1. Probsol learning environment

ProbSol learning environment is designed according to Problem solving steps in line with the learning achievement that “the students use equations and inequalities to model real life or real life like situations and problem solving”. ProbSol features 42 learning objects. Real life like problem scenarios were written for each of these learning objects and these scenarios were prepared based on Polya (1973) problem solving steps.

The learning objects in ProbSol were prepared with expert support. The aim in presenting the content of the ProbSol system with expert support is to present the content to the students in flexible way based on their performance not a fixed way. That is, the expert system embedded in the content decides in which cases the students will receive clues and solution supports in the learning objects. Thanks to this structure, students working on the same learning object can face different questions and solution support depending on their learning skills and performances. This indicates that ProbSol system helps individual learning. ProbSol is based on net technology. The developed system can be reached via <http://www.probsolvingwebmat.com>.

2.2. Participants

This study was conducted with 15 ninth grade students during fall semester of the 2014-2015 educational year in order to evaluate the students' opinions about ProbSol learning environment prepared according to problem solving steps. Students participating in the study used the developed ProbSol learning environment in the lecture environment were selected from among 70 ninth grade students based on the principle of voluntariness. 10 of the students were girls while 5 of them were boys.

2.3. Collection of data

Research data was collected with the semi-structured interview form made of 8 open-ended questions in order to investigate students' opinions about ProbSol learning environment. Open-ended questions in the interview form were prepared in order to collect the data appropriate for the purpose of the study and opinions of the experts were obtained about the subject.

The questions in the interview form were specified below:

1. How do you think learning by using problem solving steps by means of ProbSol affects your learning process?
2. How did receiving support for solutions and clues from ProbSol affect your learning when you answered the problems within the activities wrong?
3. Did ProbSol made an effect over your attitude against mathematics?
4. How did the activities, clues and solution support prepared according to the problem solving steps of ProbSol affect the process of discovering mathematical relations?
5. Would you like to learn other subjects of mathematics with a system similar to ProbSol?
6. Do you think it is possible to learn without a teacher using ProbSol?
7. What do you think about learning the relevant subject with the help of ProbSol or a teacher?
8. Do you have any other remarks?

2.4. Data analysis

Answers given by the students to the questions in the interview form were investigated in detail while analysing students' opinions about ProbSol learning environment at the first step. At the end of the investigations, three students who gave conflicted answers to the questions were excluded from the evaluation. At the second step, answers given by students to every question in the interview form were classified according to similarities and divided into themes. Reliability and validity of the study was ensured at the third step. Yildirim and Simsek (2011) expressed that reporting in detail how the data and results were obtained in qualitative studies was an important criterion for validity. Accordingly, data collection and the process of analysis were explained in detail in this study. Data collected from the interview form was analysed firstly by the researchers and then by a professor, who is an

expert in this area, in order to ensure the reliability of the study.

3. Finding

In this section, qualitative data obtained from the interview form are firstly organized as themes and sub-themes and then details of each theme and sub-theme are discussed. The themes and sub-themes obtained from 15 students are given in Table 1.

Table 1. Themes and sub-themes obtained from 15 students.

Themes	Sub Themes
Learning with ProbSol	Permanent Learning Facilitation of Learning Learning fast Learning with Fun Reinforcement
Interest in Lessons	Active Participation Attention Effort Curiosity
Structure of ProbSol	Discovery Grasping the Logic Using Problem Solving Strategies Applying Problem Solving Steps
Choice	Learning with a Teacher Learning with ProbSol Learning with Both ProbSol and a Teacher
Attitude Against Mathematics	Changing the Negative Attitude Reinforcing the Positive Attitude Not Changing the Negative Attitude Not Changing the Positive Attitude Gaining Self-confidence against Mathematics
Need	Teaching a Subject Help

Details regarding findings about themes and sub-themes presented in Table 1 are given in the tables below. "Learning with ProbSol", which is the first theme obtained from the interview form, along with sub-themes and the repetition frequency of these sub-themes are given in Table 2.

Table 2. "Learning with ProbSol" Theme

Theme	Sub Themes	Repetition Frequency of Sub-themes
Learning with ProbSol	Permanent Learning	12
	Facilitation of Learning	11
	Learning fast	5
	Learning with Fun	6
	Reinforcement	3

As it is seen in Table 2 sub-themes regarding "Learning with ProbSol" include "Permanent Learning", "Facilitation of Learning", "Learning fast", and "Learning with Fun" and "Reinforcement". Repetition frequency of these sub-themes was determined to be 12, 11, 5, 6 and 3, respectively. All of these sub-themes present positive opinions about the ProbSol learning environment. The students' opinions regarding each sub-theme are given below.

Students' opinions regarding "Permanent Learning" sub-theme

"I can visualize the problem by using animations. Thanks to this, I do not forget what I learn." (S2)

"I do not forget things since we learn by our own efforts. I understand better." (S9)

Students' opinions regarding "Facilitation of Learning" sub-theme

"Animations make it easier for me to understand and reason. I learn more easily." (S13)

"I learn more easily by using clues and animations." (S5)

Students' opinions regarding "Learning fast" sub-theme

"I progress faster and by understanding thanks to ProbSol." (S8)

“ProbSol shows us what we need to do and how we need to apply the steps when solving a problem. Thus, we learn faster.” (S13)

Students' opinions regarding “Learning with Fun” sub-theme

“Lessons were boring. But now I am having fun. Now, I look forward to mathematics lessons.” (S9)

“We learn by having fun thanks to videos and input screens.” (S3)

Students' opinions regarding “Reinforcement” sub-theme

“We can reinforce at home even if we learned a subject insufficiently at school” (S10)

“We are having opportunities to watch again and again at home. I understand it better when I watch it at home.” (S11)

Table 3. “Interest in Lessons” Theme

Theme	Sub Themes	Repetition Frequency of Sub-themes
Interest in Lessons	Active Participation	10
	Attention	6
	Effort	9
	Curiosity	5

As it is seen in Table 3, sub-themes regarding “Interest in Lessons” include “Active Participation”, “Attention”, “Effort” and “Curiosity”. Repetition frequency of these sub-themes was determined to be 10, 6, 9 and 5, respectively. All of these sub-themes present positive opinions about the ProbSol learning environment. Students' opinions regarding each sub-theme are given below.

Students' opinions regarding “Active Participation” sub-theme

“Before now, our teacher used to speak and we used to write down what he said. Now, we are also making an effort to solve the problems.” (S2)

“We do everything and discover everything there is to be discovered. This ensures everyone to participate in the lessons actively. (S4)

Students' opinions regarding “Attention” sub-theme

“Sometimes we cannot focus completely on the blackboard or the teacher. But I think we focus better on this application.” (S14)

“We could lose our focus during the lessons but I am more attentive while working with ProbSol.” (S4)

Students' opinions regarding “Effort” sub-theme

“It does not let us give up when we could not solve the problems. We need to make effort to answer a question.” (S12)

“This individual study is better for me. We are making an effort to learn.” (S6)

Students' opinions regarding “Curiosity” sub-theme

“It does not interest me when the teacher presents us the information readily. But ProbSol arouses curiosity in me.” (S2)

“Input Screen of ProbSol arouses curiosity in me. I am curious about the input screen of the next problem.” (S5)

Table 4. “Structure of ProbSol” Theme

Theme	Sub Themes	Repetition Frequency of Sub-themes
Structure of ProbSol	Discovery	7
	Grasping the Logic	6
	Using Problem Solving Strategies	3
	Applying Problem Solving Steps	4

As it is seen in Table 4, sub-themes regarding “Structure of ProbSol” include “Discovery”, “Grasping the Logic”, “Using Problem Solving Strategies” and “Applying Problem Solving Steps”. Repetition frequency of these sub-themes was determined to be 7, 6, 3 and 4, respectively. All of these sub-themes present positive opinions about the ProbSol learning environment. Students' opinions regarding each sub-theme are given below.

Students' opinions regarding “Discovery” sub-theme

“Clues and solution support provided step-by-step made it easier for me to discover the rules.” (S8)

“It does not give me the rules even if I find the answer to the problem. It wants me to discover the rules. ProbSol makes us discover the rules.” (S9)

Students' opinions regarding “Grasping the Logic” sub-theme

“It made mathematics easier for me. It taught us about its logic. I learned better thanks to problems, clues and solution support.” (S13)

“It teaches me by means of animations when I cannot solve a problem. Thus I am able understand the relations between the given values of the problem. After that I can solve the other problem by using the same logic.” (S5)

Students' opinions regarding "Using Problem Solving Strategies" sub-theme

“ProbSol affected my learning positively. Now, I know how I will approach a problem and which steps I will use. I solve a problem sometimes by creating a table, drawing a figure sometimes by creating an equation. I learned what I will do from now on.” (S4)

Students' opinions regarding "Using Problem Solving Steps" sub-theme

“Sometimes I can read a program wrongly. Now I follow the rules regarding problem solving steps and try to create an equation by writing given and demanded values.” (S2)

Table 5. “Choice” Theme

Theme	Sub Themes	Repetition Frequency of Sub-themes
Choice	Learning with a Teacher	2
	Learning with ProbSol	4
	Learning with Both ProbSol and a Teacher	9

As it is seen in Table 5, sub-themes regarding “Choice” theme include “Learning with a Teacher”, “Learning with ProbSol” and “Learning with Both ProbSol and a Teacher”. Repetition frequency of these sub-themes was determined to be 2, 4 and 9, respectively. When the opinions of students, who participated in the study, regarding their choices of learning “Learning with ProbSol”, which represent positive opinions, and “Learning with Both ProbSol and a Teacher”, which indirectly represented positive opinions, were determined. In addition to that, “Learning with a Teacher” theme was also determined.

Students' opinions regarding “Learning with a Teacher” sub-theme

“Programs such as ProbSol are informative and we surely are learning some things but it is better if a teacher teaches a subject.” (S15)

“ProbSol cannot teach as well as a teacher does. I prefer to learn with a teacher.” (S7)

Students' opinions regarding “Learning with ProbSol” sub-theme

“It is more efficient and fun to learn with ProbSol. I prefer to learn with ProbSol.” (S8)

“It is easier and more fun to learn with ProbSol.” (S6)

Students' opinions regarding “Learning with Both ProbSol and a Teacher” sub-theme

“I think it will be more useful to learn with help of both ProbSol and a teacher.” (S5)

“It will be better for us to learn with a teacher in the classroom. Our teacher can help us when we cannot understand something or we have difficulties understanding something, however, we may not get the same response from this program and similar programs.” (S3)

Table 6. “Attitude against Mathematics” Theme

Theme	Sub Themes	Repetition Frequency of Sub-themes
Attitude Against Mathematics	Changing the Negative Attitude	4
	Reinforcing the Positive Attitude	5
	Not Changing the Negative Attitude	2
	Not Changing the Positive Attitude	4
	Gaining Self-confidence against Mathematics	3

As it is seen in Table 6, sub-themes regarding “Attitude Against Mathematics” include “Changing the Negative Attitude”, “Reinforcing the Positive Attitude”, “Not Changing the Negative Attitude”, “Not Changing the Positive Attitude” and “Gaining Self-confidence in Mathematics”. Repetition frequency of these sub-themes was determined to be 4, 5, 2, 4 and 3, respectively. While "Changing the Negative Attitude", "Reinforcing the Positive Attitude" and "Gaining Self-confidence Against Mathematics" sub-themes among these themes represent the positive options about ProbSol learning environment "Not Changing the Negative Attitude" and "Not Changing the Positive Attitude" sub-themes represent negative opinions about ProbSol learning environment. Students' opinions regarding each sub-theme are given below.

Students' opinions regarding “Changing the Negative Attitude” sub-theme

“Mathematics is a subject that is not liked by many people but it became entertaining for me this way.” (S3)

“Mathematics is a subject with which I have difficulties but now it became easier with ProbSol.” (S8)

Students' opinions regarding “Reinforcing the Positive Attitude” sub-theme

“Mathematics became more fun this way. Now I look forward to mathematics lessons.” (S2)

“Mathematics was the most favorite subject of mine but now I am even more interested in the subject.” (S10)

Students' opinions regarding “Not Changing the Negative Attitude” sub-theme

“Mathematics is mathematics for me. I think I will never like it.” (S1)

Students' opinions regarding “Not Changing the Positive Attitude” sub-theme

“I always liked mathematics and I still like it. There is no difference.” (S7)

“I always liked mathematics. I still love mathematics. Nothing changed.” (S11)

Students' opinions regarding “Gaining Self-confidence against Mathematics” sub-theme

“Learning with ProbSol helps person gain self-confidence.” (S5)

“I always failed at mathematics. But now I think I can succeed.” (S3)

Table 7. “Need” Theme

Theme	Sub Themes	Repetition Frequency of Sub-themes
Need	Teaching a Subject	5
	Help	2

As it is seen in Table 7, sub-themes regarding “Need” theme include “Teaching a Subject” and “Help”. Repetition frequency of these sub-themes was determined to be 5 and 2, respectively. All of these sub-themes present negative opinions about the ProbSol learning environment. Students' opinions regarding each sub-theme are given below.

Students' opinions regarding “Teaching a Subject” sub-theme

“I think a teacher should teach a subject shortly before start to use ProbSol. Or ProbSol should have a summary section at the beginning.” (S1)

“There should be a teaching section at the beginning. It is difficult to learn a new subject without our teacher teaching it.” (S11)

Students' opinions regarding “Help” sub-theme

“I have difficulties understanding a subject on my own without getting help or someone teaching it to me. It has always been like this for years.” (S7)

“Even if ProbSol provides clues to solve problems, I cannot manage it on my own without getting any help. I always need the help of a teacher.” (S15)

4. Discussion and Conclusion

The aim of this study is to assess students' views with regard to ProbSol learning environment prepared according to problem solving steps. When the opinions of students who took part in the study with regard to learning ProbSol were examined, it was seen that students had positive opinions with their learning experience.

When the views of the students, who took part in the study, with regard to their experience learning with ProbSol are examined, it was seen that most of the students were of the opinion that they actively took part in the lesson when learning with ProbSol, their attention was not distracted and learning with ProbSol was fun. Besides, participants stated that they learnt easily and their learning was more permanent. ProbSol does not directly give the answer and helps solving the problem by giving clues at each problem solving step. When the views of the student in this study were generally examined, it was seen that the views that ProbSol learning environment played positive role in the students' learning stood out. This result is supported with the conclusions of other studies that computer assisted learning environments had positive effects on the learning process of students (Bartsch & Cobern, 2003; Chang, 2003; Chang, Sung & Lin, 2006; Chittaro & Ranon, 2007; Dasedemir & Doymus, 2012; Gurbuz, 2008; Kay & Kletschin, 2012; Kelly & Jones, 2007; Keles et al, 2009; Lewalter, 2003; Lin, 2009; Lowe, 2003; Wang, 2011; Zangyuan, 2006).

When the attitudes of the students who took part in the study towards mathematics are examined, it is seen that 4 of the 6 students who had negative attitudes towards mathematics changed their attitudes to positive after instruction

with ProbSol and the attitudes of 5 students out of 9 students who had positive attitudes towards mathematics were reinforced after instruction with ProbSol. Besides, it is seen that three students also gained self-confidence towards mathematics. When generally examined, it can be said that the attitudes of the students taught with ProbSol about mathematics changed positively. In similar studies, it was concluded that computer assisted learning environments influenced students' attitudes towards the course positively (Arikan, 2006; Ozyurt et al, 2012).

While some of the participants are of the opinion that they can learn on their own using ProbSol, some of them want summary of the topics to be added at the beginning of ProbSol or want a teacher to teach the topics first. This can be attributed to the learning strategies that students transfer from their traditional learning experiences. Besides, most of the participants emphasized that such software would be more effective when used together with teachers rather than alone. Participants stated the reason for this as the inability of the software to answer all questions in students' minds. This result, which provides clues for the understanding of web-based distant education, was also found in other studies in the literature (Demirli, 2002; Ozyurt et al, 2012; Saban, Ozer & Tumer, 2010).

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