

Prospective Mathematics Teachers' Views about Using Flash Animations in Mathematics Lessons

Esra Bukova-Güzel, Berna Cantürk-Günhan

Abstract—The purpose of the study is to determine secondary prospective mathematics teachers' views related to using flash animations in mathematics lessons and to reveal how the sample presentations towards different mathematical concepts altered their views. This is a case study involving three secondary prospective mathematics teachers from a state university in Turkey. The data gathered from two semi-structural interviews. Findings revealed that these animations help understand mathematics meaningfully, relate mathematics and real world, visualization, and comprehend the importance of mathematics. The analysis of the data indicated that the sample presentations enhanced participants' views about using flash animations in mathematics lessons.

Keywords—Instructional technology, animations, prospective mathematics teachers.

I. INTRODUCTION

IN Turkey, primary and secondary mathematics curriculums have been revised. This revision was based on the philosophy of constructivism which proposes that learners need to build their own understandings of new ideas. Constructivism also suggests that new knowledge is not passively received by the student through textbook activities and lectures, or by simply asking students to memorize rote facts. Students learn more effectively if they have experience applying ideas to new situations. From this perspective, using technology is of great important. Some researchers express that using technology in mathematics learning environment support constructivism [2, 3, 4, 5, 6]. They explain some reasons as follows;

- providing different representations of mathematical concepts;
- acquiring knowledge by making experiments;
- relating real life with mathematical concepts;
- developing or enhancing students' conceptual knowledge;
- supplying individual and cooperative studies to learners;
- presenting concrete representations of abstract mathematical concepts.
- constructing meaningful learning;
- motivating;
- becoming lessons more interesting;

Esra Bukova-Güzel is with Dokuz Eylul University, Faculty of Education, Department of Science and Mathematics Education, Izmir, Turkey. (corresponding author to provide phone: +90 232 420 48 82; e-mail: esra.bukova@deu.edu.tr).

Berna Cantürk-Günhan is with Dokuz Eylul University, Faculty of Education, Department of Primary Education, Izmir, Turkey. (corresponding author to provide phone: +90 232 420 48 82; e-mail: berna.gunhan@deu.edu.tr).

- providing an active learning environment;
- improving learners' creativity;
- having positive attitudes towards mathematics
- supplying visualization.

In light of these reasons, mathematics teachers should integrate technology into mathematics learning. If it is wanted that mathematics teachers use computer-based presentations in their lessons, they are supported and encouraged using computer-based presentations during their teacher training years. Hereby, prospective mathematics teachers should develop and use the computer-based presentations in their future lessons. There are many forms of computer-based presentations. Animations may also use as computer-based presentations. Animations can be used to provide information that aids in understanding dynamic processes and summarizing major concepts, and can help students to construct mental models with which to organize new knowledge [7]. From this explanation, it is seen that animations can affect students in positive way while constructing mathematical concepts if teachers use them effectively. Therefore, this study focuses on the prospective mathematics teachers' views about animations which prepared by using Macromedia Flash.

The purpose of this study is to determine the secondary prospective mathematics teachers' views related to using Flash animations in mathematics lessons and to reveal how the sample presentations towards different mathematical concepts altered their views.

II. THEORITICAL FRAMEWORK

Technology has tremendous potential for enhancing mathematics instruction; it can be used to strengthen student learning and to assist in developing mathematical concepts [8]. As the National Council of Teachers of Mathematics (NCTM) that is a public voice of mathematics education, supporting teachers to ensure equitable mathematics learning of the highest quality for all students through vision, leadership, professional development, and research [16] - highlights in its standards; technology can facilitate mathematical problem solving, developing deep understanding of mathematics, communication, reasoning, proof; moreover, technology can provide students with opportunities to explore different representations of mathematical ideas, support them in making connections both within and outside of mathematics, and allow student to focus on decision making, reflection [9]. Because of the technology's these effects to the learning, teacher must use the computer-based presentations in their classroom.

In a recent study, it has been argued that most prospective teachers identified technology as important in mathematics education to assist in the development of concepts but were uncomfortable discussing the specific uses of technology for instruction due to lack of knowledge [10]. Many prospective teachers feel that they are not prepared to teach using technology after they graduate [11]. If teachers want to use and integrate technology to their learning environment, they will have a great role. Especially, new teachers are expected to enter the educational field with knowledge not only in their content areas, but of technology as well [12].

III. METHODS

The case study design was used in this study involving three secondary prospective mathematics teachers at Dokuz Eylül University in Izmir, Turkey. This study was realized in one week as two sections during 2006-2007 academic years. In the first section some of the prepared flash animations were shown to the participants approximately in one hour and after that in the second sections discussions about these presentations were made by the participants in one hour.

The data gathered from two semi-structural interviews containing pre-interview and post-interview. The study consisted of the three phases. The pre-interview was realized with three secondary prospective mathematics teachers in the beginning of the study. The purpose of this pre-interview was to determine participants' views about using flash animations in constructing mathematical concepts. After that, the flash animations prepared by the researcher were introduced to the participants. When the all presentations were made it was discussed with the participants about them. Finally, the post-interview was carried out with the participants. The purpose of this post-interview was to determine how the participants' views altered about using flash animations in constructing mathematical concepts after the presentations in other words, whether their thought changed or not.

A. Participants

The purposeful sampling method was used when the participants were selected. There were three participants in this study from the Faculty of Education. Their ages ranged from 20 to 22 years old. The participants were educated for being secondary school mathematics teachers. They completed the courses about mathematics content knowledge, general pedagogical knowledge, pedagogical content knowledge, integration technology into mathematics education, and school experience. Three participants showed differences about knowing and using computer and software programs. The first participant named Y who has limited knowledge and experiences of the computer and software programs, the second participant named Z has more knowledge and experiences of the computer and software programs, and the third participant named B who had much knowledge and experiences of the computer programs and software. Additionally, no one knows Flash program, Z is the most successful students in our mathematics education program in terms of mathematics content knowledge, general pedagogical knowledge, and pedagogical content knowledge. B has average achievement

about mathematical content knowledge, general pedagogical knowledge and pedagogical content knowledge and Y is the lowest achievement -but enough for graduating our mathematics education program- in terms of this knowledge.

B. Instruments

The qualitative method was used to collect the data in this study. The data gathered from two semi-structural interviews containing the pre-interview and the post-interview. In these interviews, two open-ended questions were asked to the participants and the interview guide was used in this stage. The open-ended questions were related on the following areas: "How the flash animations affect mathematics lessons and constructing mathematical concepts", and "Can you use or want to use these kinds of tools in your future class-in professional life? Why?". These questions were asked to the participants both the pre-interview and the post-interview. All the interviews were recorded by the audio-recorder and analyzed later.

C. Materials

In this study, the Flash animations were used as a material to examine prospective mathematics teachers' views about Flash animations and whether their views changed when they confronted with the different examples and discussed about these materials or not. While the presentations about some mathematical concepts were developing the principles of constructivism were used. On the other words, these presentations were suitable for constructivist learning environment. All the presentations were constructed by taking into account the critical points of mathematical concepts in question.

The Flash animations were mainly used to sample the real world applications of mathematical concepts in this study. These representations were important to integrate the real world with the mathematical concept. It also provided to construct mathematical knowledge, procedures, and concepts by using mathematical models. It was intended that these materials should be interesting, emphasize the critical points of the concepts, and allow meaningful learning.

Nine presentations were presented about the flash animations such as limit concept, function concept, induction, and factorization. Some of the examples were given in Figure 1, 2, 3, 4, 5, 6. For example, in Figure 1 and Figure2, it was aimed to construct the function concept as a machine exactly the loom as a machine, the fiber as an input, and the carpet as an out-put.

Figure 3, 4, 5, 6 were constructed to show the critical points of the limit concept such as approaching, approximate value, domain of function (the existences of the limits of a functions at a points which are not necessary to be an element of the domain especially in Figure, 4, 5, 6 with burning pizza house), the relationship between limit concept and the real world. It was given a scenario with the figure, 4, 5, and 6. This scenario was started this sentence "by taking into account movement of the cars in the entire situation, can they meet? Why? Try to draw their movement on a graph. For this reason, you can think that the cars are two points moved on a curve and the road is a curve. Be careful, they are point on a curve and you make these move

on a curve. You can also think that the Math Pizza Restaurant is a point on the curve.” In Figure 4 the cars move to the same Math Pizza Restaurant, and so they meet. In Figure 5, the cars move to the different Math Pizza Restaurant, so they did not meet. Finally, in Figure 6 it was considered the restaurant as a point on a curve; it showed the point was not defined. The cars move to the same restaurant. However, when they arrived at the restaurant, the restaurant had been burned but still they could meet.

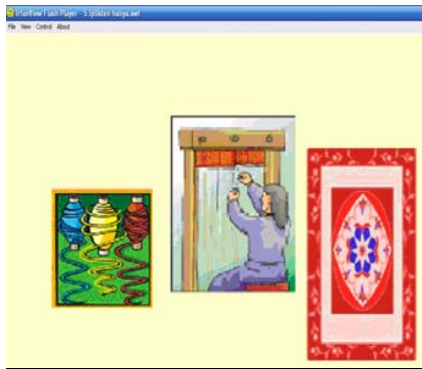


Fig.1 Flash animations about function concept

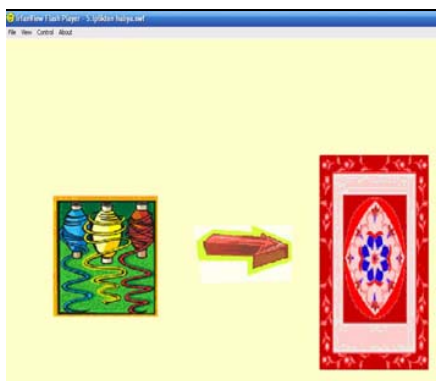


Fig. 2 Flash animations about function concept



Fig. 3 Flash animations about approaching



Fig. 4 Flash animations about limit concept



Fig. 5 Flash animations about limit concept

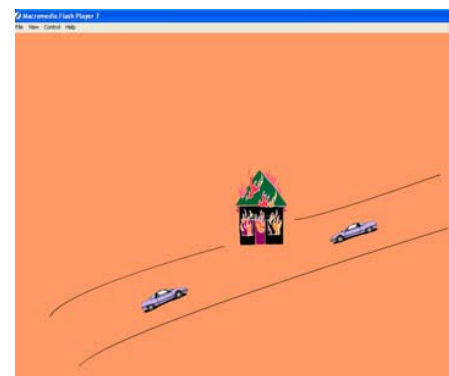


Fig. 6 Flash animations about limit concept

D. Procedure

The researchers investigated the learning tools in literature. Then the presentations were organized by the researchers. These are flash animations, dynamic graphics, Geometry Sketchpad activities, video-clips, spreadsheets, and power-point representations, etc. In this article, only the case of flash animations was used.

The application was carried out within one week. The participants were interviewed in the beginning of the study. The interviews, which form the majority of the material, are characterized by reflective conversations. The length of the interviews varied between 20 and 25 minutes. Before each

interview took place, the participants were informed of the purpose of the interview. All of the interviews were tape-recorded with the permission of the participants.

E. Data Analysis

The interviews were recorded with the audio-taped. The data were transcribed verbatim. Evaluation was guided by the ideas of qualitative content analysis [13]. It could try to evaluate the differences between the pre-interview and the post-interview.

IV. RESULTS AND DISCUSSIONS

In this section, three cases were presented by comparing in terms of the pre- and the post interviews and each other.

A. The Case of Y

In the pre-interview Y said nearly nothing about the questions "How the flash animations affect mathematics lessons and constructing mathematical concepts", "Can you use or want to use these kinds of tools in your future class? Why?". Y stated that animations (not only flash animations) were important for mathematics learning and added that Y never saw flash animations in preparing any mathematical concept. Y also remarked that was not able to prepare computer based materials because of the lack of technology knowledge. Y said very general sentences like;

Using flash animations contribute mathematics learning and saving of time in mathematics lessons.

In the post-interview, it was seen that Y's views changed completely. When Y responded the questions Y looked very exciting and said that was very happy for seeing these presentations. It can be understood Y's following speaking;

I like all the presentations. I never see before this kind of application. I saw only power point presentations. It changed my point of view. Participating of this study became the good experience for me. Before then, I had no idea about flash animations.

In the pre-interview, Y could not say advantages of using flash animations in mathematics lessons but after the sample flash animations Y stated many advantages. Y pointed out that these kinds of flash animations can relate the real world to the mathematical concepts, emphasize the critical points of the concept, provide for students to think creatively, block to constitute misconceptions about the mathematical concepts, and give an opportunity for exploring and discovering phenomena. Additionally Y specified that they can also lead students to deeply thinking about mathematical concepts and make lesson interesting. And finally, after this explanation Y said the followings:

I really want to use flash animations in my future mathematics lessons. However, my knowledge about preparing flash animations does not allow this. We must be educated in our mathematics education program about using computer and software programs like this.

B. The Case of Z

In the pre-interview, Z stated that flash animations provided many benefits to mathematics lessons. Z explained that flash animations could represent mathematical concepts more concretely by making visualization, relate real world and mathematical concepts, facilitate retention of the learning, provide students' motivation, advance students' mathematical thinking, enhance students' reasoning skills. Z was able to prepare some computer based materials using software programs such as Geometer' Sketchpad, MathCAD, and Derive etc. on the other hand, Z was not able to prepare flash animations because of limited knowledge and experiences about this program.

In the post-interview-in addition to Z's pre-interview speaking- Z emphasized that using flash animations in mathematics lessons could sophisticate students' intuitive thinking, provide for students to think creatively, give an opportunity for exploring and discovering, occur active learning, associate among the mathematical concept, block to constitute misconceptions about the mathematical concepts, emphasize the critical points of the concept, become lessons more interesting. Furthermore, Z remarked the following sentences:

Samples about flash animations affected me very much. They were interesting because they were very new applications for me. They could gain different viewpoint to students. These animations could draw students' attention. When students realized that they could understand mathematical concepts they attended lessons more. By using flash animations mathematics lessons become suitable for constructivist principles. Teachers could make an effort for students to think intuitively about mathematical concepts. For example, instead of saying what the limit is teachers ask questions so they could direct students to reach the meaning of limit. However, it was very hard to perform these kinds of lessons in considering Turkey's basic facilities such as lack of technical structure in class, lack of teachers' knowledge about computer-even some teachers did not know how computer started-, teachers' beliefs about computer and computer-based materials. Teachers' content knowledge and pedagogical content knowledge are also important. I mean if teacher's knowledge about limit concept is not adequate he or she will not design the animations very well. He or she imagines very carefully reflecting the critical points of limit. I want to use flash animations but I do not prepare for now. I think cooperation is made with mathematics teachers and computer programmers. Mathematics teachers use content knowledge, learners' knowledge, pedagogical content knowledge and others use software programs' knowledge.

C. The Case of B

In the pre-interview, B explained that flash animations may represent abstract mathematical concepts in a concrete way, provide visualization, and also relate the real world to the mathematical concepts, supply for students to interpret and generalize about mathematical concepts. B represented that B's knowledge and experiences about computer and software programs was very good but not in Flash programs.

After the sample presentations, B stated that want to improve about this animations. He expressed these sentences:

I like all the animations, especially, about limit concept because I have always trouble with the limit concept. Whoever watches the animations about the limit concept apprehend that the limit concept is an approaching, an approximate value, relationship between limit concept and the real world, and the limit of a function at a point which is not necessary to be an element of the domain exist. I should use flash animations in my professional life. Because of this, I will develop myself about this issue.

In the post-interview-in addition to B's pre-interview speaking- B stated that using flash animations in mathematics lessons could advance students' mathematical thinking, occur active learning, associate among the mathematical concept, emphasize the critical points of the concept. Besides, B expressed the following sentences:

When flash animations like these can use students learn by doing, making, thinking and relating. Because they are motivated students they must be used especially in difficult mathematical concept, and concepts which students never relate real world. It is very essential for students to understand the importance of mathematics. For example, constructing the correlation between the limit concept and the real world can assist for learning the limit concept meaningfully. Generally, it is thought that technology can be used as a computational tool but these representations exactly show opposite view. On the other words, it is showed technology can be used to visualize, explore, relate, generalize and analyze mathematical concepts and ideas.

V. DISCUSSION AND IMPLICATIONS

This study reports the views of the mathematics students' teachers concerning using flash animations in mathematics lessons. It is thought that this study provides an important contribution to prior research and researches about integrating technology into mathematics education. All the participants agreed with the statement that flash animations should be used in a mathematics classroom. The results from the three interviewed present a development of views of using flash animations in mathematics education. The pre-interviews and post-interviews of the participants were examined and it has seen that important changes occurred on the participants' thoughts, especially, in the case of Y.

This study indicated the importance of integration technology into mathematics learning with application of the flash animations. The prospective mathematics teachers believe that technology is important for mathematics learning. All the participants touched on mathematics teacher's training. In this perspective, mathematics teacher education program should value of technology integration in mathematics learning. But it is not enough mathematics content knowledge and pedagogical content knowledge is also taken into account. Consequently it is handled technological pedagogical content knowledge (TPCK) which framework builds on Shulman's idea of Pedagogical Content Knowledge and is the complex interplay of three primary forms of knowledge: Content, Pedagogy, and Technology [14].

This study has shown many benefits of using flash animations. The prospective mathematics teachers indicated likely benefits in terms of their experiences. It was seen from their views that these animations help understand

mathematics meaningfully, relate mathematics and real world, visualization, and comprehend the importance of mathematics. It was taken into account that the transition from concrete examples to the abstract concept is the most demanding step in mathematics learning [15], using flash animations is seen as an important beginning.

REFERENCES

- [1] J. M. Mills, "A theoretical framework for teaching statistics," *Teaching Statistics*, vol. 25, no.2, pp. 56-58, March 2003.
- [2] S. Durmuş, "Constructivist approaches to mathematics education," *Journal of Educational Sciences: Theory & Practice*, vol. 1, no. 1, pp. 91-107, Jun. 2001.
- [3] E. Bukova Güzel, and H. Alkan, "Sampling of constructivist learning with learning activities developed in mathematics teaching," presented at the 6th National Science and Mathematics Education Conference, Istanbul, September, 9-11, 2004.
- [4] McDonalds, . (2005, Dec. 03). Using multiple intelligence activities to introduce limits [Online]. Available: <http://www.math.montana.edu/mathed/distance/capstone/mcdonald/index.html>.
- [5] E. Bukova, "The development of new curriculum to overcome students' difficulties in perceiving the concept of limit and constructing the relationship between the concept of limit and the other mathematical concepts," doctoral thesis, Dept. Math. Edu., Dokuz Eylul Univ., Izmir, Turkey, 2006.
- [6] G. Kersaint, "Toward technology integration in mathematics education: A technology-integration course planning assignment," *Contemporary Issues in Technology and Teacher Education*, vol. 7, no. 4, 2007.
- [7] M. J. Taylor, D. C. Pountney, and M. Baskett, "Using animation to support the teaching of computer game development techniques," *Computer & Education*. vol. 50, no. 4, pp. 1258-1268, May 2008.
- [8] T. Kurz, J. A. Middleton, and H. B. Yanik, "Preservice teachers' conceptions of mathematics-based software," presented at the International Group for the Psychology of Mathematics Education Conference PME-28, Bergen, Norway, July, 14-18, 2004.
- [9] M. Niess, (2006, Jan. 08). Preparing teachers to teach mathematics with technology [Online]. Available: <http://site.aace.org/pubs/foresite/MathematicsEd.pdf>.
- [10] K. B. Smith, and P. G. Shotsberger, (2006, Oct. 27). Web-based teacher education: Improving communication and professional knowledge in preservice and inservice teacher training [Online]. Available: http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/19/7c/a1.pdf
- [11] R. D. Carlson, and J. S. Gooden, "Mentoring pre-service teachers for technology skills acquisition," presented at the Society for Information Technology & Teacher Education International Conference, San Antonio, Feb. 28-March 4, 1999.
- [12] C. Ayas, "An examination of the relationship between the integration of technology into social studies and constructivist pedagogies," *The Turkish Online Journal of Educational Technology*, vol. 5, no. 1, pp. 14-25, Jan. 2006.
- [13] P. Mayring, (2006, Oct. 12). Qualitative Content Analysis [Online]. Available: <http://nbnresolving.de/urn:nbn:de:0114-fqs0002204>.
- [14] P. Mishra, and M. J. Koehler, "Technological Pedagogical Content Knowledge: A new framework for teacher knowledge," *Teachers College Record*, vol. 108, no. 6, pp.1017-1054, 2006.
- [15] M. E. Pesonen, (2003, Dec. 25). Experiments on using interactive web-based mathematics problem sets based on dynamic geometry applets [Online]. Available: <http://www.joensuu.fi/mathematics/MathDistEdu/Sortavala2003/ArticlePesonen6thConferenceFinal.pdf>
- [16] The National Council of Teachers of Mathematics. Available: <http://www.nctm.org/>

Esra Bukova-Güzel received her Ph.D. in mathematics education in 2006 at Dokuz Eylül University, Institute of Educational Sciences. She was born in İzmir, 1979. Her major fields of study are subject matter knowledge and pedagogical content knowledge of mathematics teachers, constructivist learning approach in mathematics teacher education, and mathematical modeling.

Berna Cantürk-Günhan received her Ph.D. in mathematics education in 2006 at Dokuz Eylül University, Institute of Educational Sciences. She was born in Denizli, 1975. Her major fields of study are problem-based learning, geometry teaching, and technology integration in mathematics learning, teacher education, and drama in mathematics education