Prospective Primary Mathematics Teachers' Opinions About The Use Of Computers In Teaching And Learning

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Abstract

The aim of this study is to examine the effect of a computer assisted mathematics instruction course, in which Excel and dynamic mathematics software are introduced, on prospective primary mathematics teachers' perceptions regarding the use of computers in mathematics. The sample of this study was composed of 41 volunteer prospective teachers studying at the department of primary school mathematics teaching. The research data was collected via a test composed of open-ended items. In view of the study, it has been observed that a computer assisted mathematics instruction course positively affects prospective primary mathematics teachers' perceptions regarding the use of computers. Furthermore, prospective teachers expressed that computers must be used in mathematics courses, since they provide visualisation, concretisation, knowledge retention and the opportunity to provide more examples, save time, draw more accurate shapes, increase interest in the course and facilitate learning.

Keywords: Computer assisted mathematics instruction, dynamic mathematics software, GeoGebra, Excel, prospective mathematics teacher

Introduction

With today's rapidly advancing technology, the incredible changes occurring in the world of information technology and the fact that technology is day by day becoming an integral part of our lives, educators are encouraged to integrate technology into their teaching methods. Apart from the fact that the use of technology in instruction is generally a requirement, mathematics instruction is a particularly suitable area where technological resources can be utilised (Öksüz and Ak, 2010). When information and communication technologies are mentioned in mathematics instruction, they specifically refer to the mathematics instruction that is performed using computer-based cognitive tools (Baki, 2008). Of the technology available, computers are the more strongly preferred and utilised instruments in education, as they have many different features. The role of computers in mathematics instruction and learning is becoming more and more important, to the point that they are regarded as an imperative factor that lays the foundation for the progress of mathematics education (Wiest, 2001). Baki (2002) defines computer assisted instruction, which emerged as a result of computer use in the learning-teaching process, as a method for utilising computers in the education-teaching process to allow students to discover their insufficiencies and performance levels through mutual interaction; to take responsibilty for their own learning by getting feedback; and become more interested in the courses with the help of graphs, sounds, animations and shapes.

Flores (2002) stated that although computers have astonishing capabilities, they are worthless if no quality software is available. Apart from the fact that the success of computer assisted mathematics instruction in learning-teaching processes depends on a range of variables, providing lesson software that is appropriate for educational aims and objectives is important in order for the method to succeed (Uşun, 2004). This being the case, software becomes one of the important elements of computer-assisted instruction.

Spreadsheets and dynamic software are among the programmes that are preferred in mathematics learning and teaching processes. Excel, which is Microsoft Office software, is the most common spreadsheet program, and many studies have been conducted using Excel in mathematics instruction (Baki and Öztekin, 2003; Çınar and Ardahan 2002; Kutluca and Birgin, 2007; Peker and Bağcı 2008). GeoGebra is one of the dynamic types of software. As multi-platform and open-source dynamic mathematics software, GeoGebra tries to combine ease-of-use of dynamic geometry software with the versatile possibilities

of computer algebra systems (Edwards and Jones, 2006; Hohenwarter, Hohenwarter, Kreis, and Lavicza, 2008; Hohenwarter, Hohenwarter, and Lavicza, 2008; Hohenwarter and Fuchs, 2005). The software simultaneously provides an algebraic, graphic and spreadsheet representation of mathematical objects. Any changes made to one of these aspects are directly reflected in the others. GeoGebra software provides important teaching and learning opportunities for teachers and students in calculus, geometry and algebra at every stage of learning, from elementary to higher education.

Karadag and McDougall (2009) state that GeoGebra users, whether students or teachers, can utilise this setting in order to elucidate, discover and model mathematical concepts and interactions between mathematical concepts or mathematics as a whole. With this software, students can discover mathematical concepts without having to spend a great deal of classroom time on drawing figures, objects or functions, and in addition they are able to dynamically associate the algebraic, graphic and numeric representations of these concepts (Haciomeroglu, Bu, Schoen, and Hohenwarter, 2009).

There are many different studies that put forth the importance of computers in mathematics education in the literature (Campbell and Martin, 2010; Choi-Koh, 1999; Kebritchi, Hirumi, and Bai, 2010; Liao, 2007; Lopez-Morteo and Lopez, 2007; Machin and Rivero, 2002; Schumann, 1993; Schumann, 1995; Vuong, He and Hui, 2010). It is very important to improve teachers' attitudes towards using computers in the classroom, as this may improve mathematics instruction and learning, though many prospective and in-service teachers are unfamiliar with the types of technology that are available to teachers (Lin, 2008). This being the case, to determine the degree to which prospective mathematics teachers perceive and create awareness of this importance is of some significance.

The aim of this study is to examine the effect of a computer assisted mathematics instruction course in which GeoGebra, which is a type of dynamic mathematics software, and an Excel software, are introduced on prospective primary mathematics teachers' perceptions regarding the use of computers in mathematics.

Method

Participants

The sample of this study was composed of 41 volunteer prospective teachers studying in the department of primary school mathematics teaching at a faculty of education in Turkey.

Data Collection Instrument

The research data was collected via a test (Appendix 1) composed of four open-ended questions prepared by the researcher in order to qualitatively determine prospective teachers' perceptions regarding the use of computers in mathematics education.

Procedure

Case study, which is one of the qualitative research methods, was used in this study. The study was conducted in a computer assisted mathematics instruction course, which was instructed by the researcher for two hours a week in the autumn semester (14 weeks) of the 2011-2012 academic year. Two programmes, namely MS Excel (6 weeks) and GeoGebra (8 weeks) were taught in the content of the course. Instruction has been firstly given during this period on how to use these programmes. Information was then given on how the materials were formed, which are related to mathematics subjects and which were

prepared using these programmes. A view of one of the materials, which was formed in Excel within the semester, is presented in Figure 1.

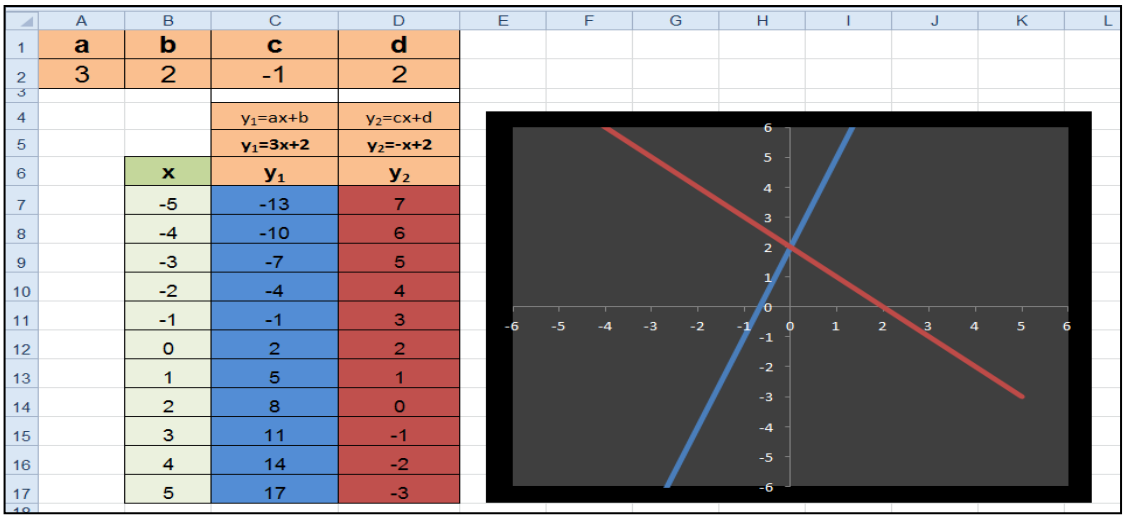

Figure 1: The view of one of the Excel materials

The relation of two lines to each other can be examined in the material, the image of which is presented in Figure 1. Notwithstanding the change of a, b, c and d coefficients in the line equations within this material, its change in its graph can also be dynamically observed. An image of one of the GeoGebra materials, which has been submitted in the scope of the study, is presented in Figure 2.

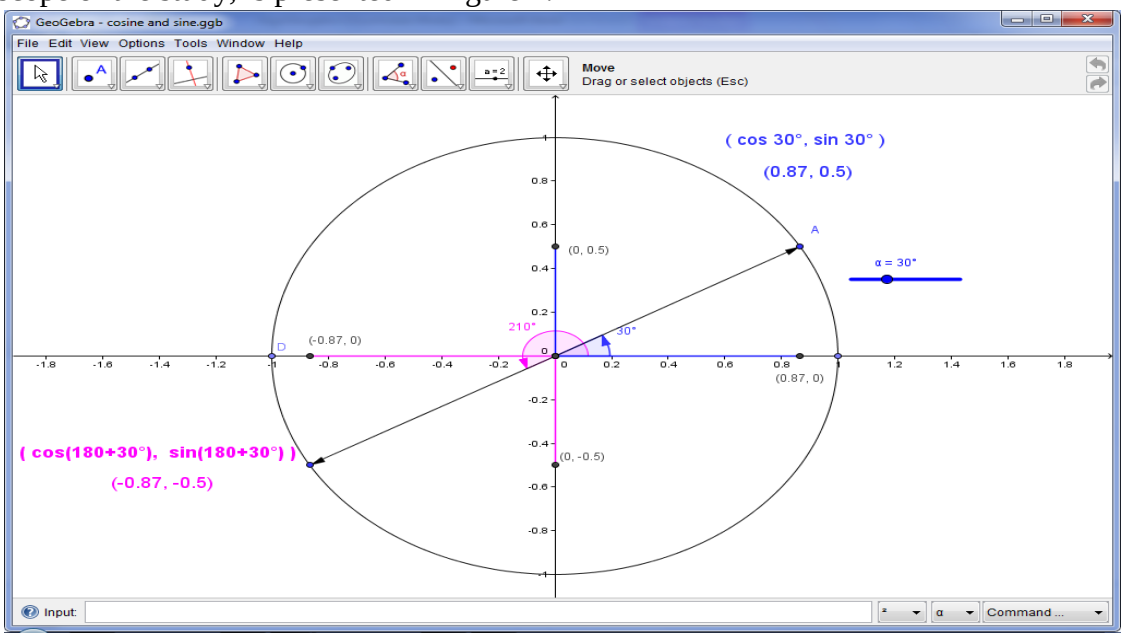

Figure 2: The view of one of the GeoGebra materials

In Figure 2, α being an acute angle, the view of the GeoGebra file prepared in order to indicate to what sine and cosine of the 180+α degree angle equal in terms of sine and cosine of α is given. In this material, α angle can be changed as connected to a slide. Despite this, the value of sine and cosine of 180+α can be dynamically seen.

Furthermore, emphasis was put on how to form a technology-assisted course environment by using Excel or GeoGebra, which is a dynamic programme. The Formed data collection instrument was applied at the end of the semester. In the study, prospective teachers are asked to elucidate the change in their perceptions regarding the use of computers in mathematics instruction. For that reason, the data was obtained with the test that was only applied at the end of the study. Prospective teachers were particularly asked not to write their names on the data collection instrument used in the study.

Data Analysis

Both content analysis and descriptive analysis were conducted in order to analyse the obtained qualitative data. The answers given to each question in the scale by the prospective teachers were individually coded, categorised and presented via tables and figures that contain frequencies and percentages. Categories expressed by at least two people were featured in these tables and figures. Furthermore, sample references from prospective teachers, who were coded in a range from PT1 to PT41, were featured in relation to the formed categories.

Results

The effects of the course on prospective primary mathematics teachers' perceptions regarding the use of computers in mathematics were examined via the data obtained from the test, which was composed of open-ended questions. The obtained findings were presented as two sub-headings, namely "The use of computers in mathematics courses" and "The contribution of computers to teaching and learning".

The Use of Computers in Mathematics Courses

Prospective teachers were asked the question "Is it necessary to use computers in mathematics courses? If so, why?". Thirty-six prospective teachers expressed the opinion that it is necessary to use computers. Their answers on the necessity of using computers are presented in Table 1.

Table 1: *Opinions on why it is necessary to use computers in mathematics courses*

Categories	f (%)
Providing convenience of visualization.	19 (46%)
Providing knowledge retention.	13 (32%)
Facilitating learning.	12 (29%)
Providing convenience of concretisation.	9 (22%)
Providing the opportunity to give more examples.	9 (22%)
Increasing interest in the course.	7 (17%)
Saving time.	5 (12%)
Enabling drawing more accurate shapes.	2 (5%)

PT22, who emphasised visualisation and giving more examples, answered the question as follows:

"Yes, I think it is necessary to use computers. That is because visualisation must be provided and many examples must be solved in order for many subjects to be understood well in mathematics lessons. That is why computers must be used in the courses."

PT15, who mentioned the contributions towards attention, exemplification, visualisation and comprehensibility, answered the question as follows:

"I think it is necessary to use computers in mathematics lessons because instructing in mathematics via computers, instead of classical methods, makes courses more interesting and comprehensible. The use of computers provides ease and comprehensibility, especially in subjects where plenty of examples must be given and visuality is important."

PT28, who mentioned saving time, answered the question as follows:

"Excessive loss of time may occur while solving appropriate examples in teaching some subjects in mathematics courses. Computers assist in saving time."

The analysis of the answers given by the prospective teachers to the question "Can you compare your opinions on the necessity of using computers in mathematics courses before taking the course with your current opinions?" are presented in Figure 3.

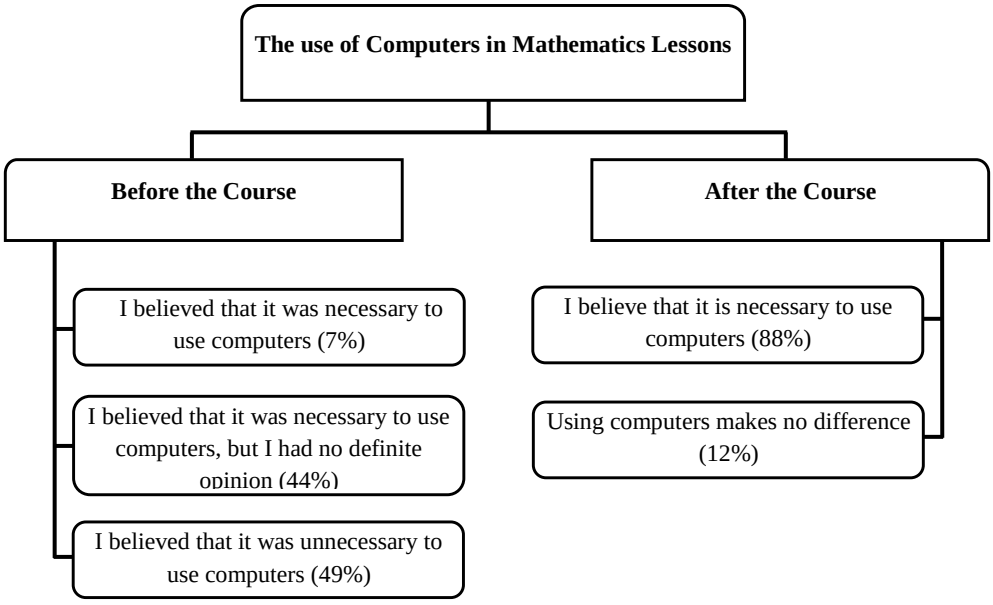

Figure 3: Opinions on the necessity of using computers in mathematics courses

Fifteen of the 20 prospective teachers, who had believed that it was unnecessary to use computers in mathematics courses before taking the course, stated that their opinions had completely changed by the end of the semester. That is to say, they stated that computers must be used in mathematics. The remaining five prospective teachers expressed the opinion that using computers makes no difference. Among the prospective teachers who stated that their opinions had completely changed, PT17 answered the question as follows:

"Before taking this course, I had no idea that a computer programme could be used as a material while instructing courses. This was due to the fact that I had never heard of such programmes."

PT18, PT36 and PT38, who had believed that it was unnecessary to use computers in mathematics courses before taking the course, respectively stated the following:

"Before taking this course, I had believed that utilising computer support in mathematics courses would be a waste of time and would not be that useful. However, now I think that more effective and permanent learning can be achieved via computer support."

"Before the course, I had believed that it was just a matter of choice. This was due to the fact that I had not known how to render Excel as useful as this, and I had not even heard of GeoGebra."

"To be honest, I had believed that it was unnecessary and a waste of time. However, my opinion has completely changed, especially after having learnt GeoGebra. It is very useful and even helped me, the prospective teacher, to better understand the logic of many concepts when I saw them in the programme."

PT41, who stated that his opinions on the use of computers in mathematics solidified with this course, answered the question as follows:

"I had no definite opinions on this issue. My opinions are now much more definite. I most certainly agree that mathematics and computers are a perfect pair."

The Contribution of Computers to Teaching and Learning

Prospective teachers were asked the questions "In your opinion, can computers assist teachers in teaching activities? If so, how?" and "In your opinion, can computers contribute to learning? If so, how?". Nearly all of the prospective teachers who participated in the research stated that computers would both contribute to teachers in teaching activities and to learning. The answers given to these two questions are presented in Figure 4.

PT5, who expressed the opinion that computers can contribute to teachers in teaching activities in terms of visualisation and solving more examples, stated the following:

"Computers will definitely assist teachers. That is because a teacher can only give a limited number of examples over the course of an hour, and can draw very few of these examples on the blackboard. However, he/she can give plenty of examples and clearly visualise many concepts if he/she uses a programme that is created for such purposes."

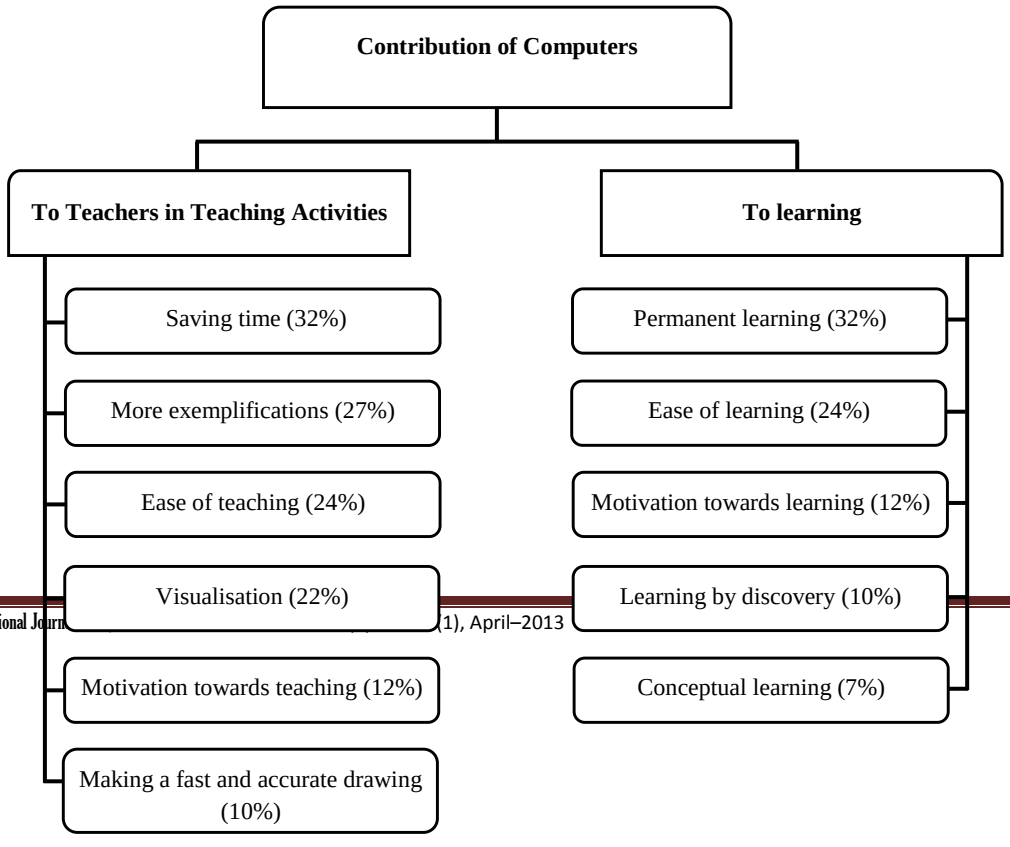

Figure 4: The contribution of computers to teachers and learning

PT18, who expressed the opinion that computers facilitate teaching and save time, stated the following:

"Thanks to computer programmes, students can directly see the concepts that their teacher was trying to explain by drawing them on the blackboard. As for the teachers, I believe that computers will save time and facilitate their job, provided that the preliminary work is done well."

PT27, who expressed the opinion that computers would contribute to giving more examples and saving time, stated the following:

"GeoGebra in particular can accelerate the work for teachers who have problems covering the curriculum in time. Computers would both enable students to see more examples and save time."

PT4, who expressed the opinion that computers would increase motivation towards learning and establish permanent learning, stated the following:

"Since computers capture the attention of students, their motivation level will be higher. Futhermore, permanent learning can be achieved thanks to these programmes."

Discussion and Suggestions

In this study, in which the effect of the computer assisted mathematics instruction course on prospective primary mathematics teachers' perceptions regarding the use of computers in mathematics was examined, 15 (37%) of the 20 (49%) prospective teachers who had believed that it was unnecessary to use computers in mathematics courses before taking this course stated that their opinions had completely changed by the end of the semester. That is to say, they stated that computers must be used in mathematics. The remaining five prospective teachers expressed the opinion that using computers makes no difference. Eighteen (44%) prospective teachers think that it is necessary to use computers in mathematics courses. These 18 prospective teachers stated that they had no definite opinion on this issue before taking the course, but their opinions on using computers in mathematics instruction became clearer after taking the course. The results show that this course, in which software that can be used in mathematics courses is taught, positively affects teachers' perceptions regarding the use of computers.

Prospective teachers emphasised the necessity of using computers in mathematics courses, since computers ensure visualisation, concretisation and knowledge retention, and facilitate learning. Furthermore, they expressed the opinion that computers would contribute to teachers in teaching activities in terms of saving time, giving more examples and facilitating teaching. They expressed the opinion that computers would contribute to learning in terms of retention, facilitating learning, motivation and conceptual learning. These contributions, which were stated by the prospective teachers, are among the most important reasons for using computer-based environments in mathematics instruction as stated in the studies of Aktümen and Kaçar (2008), Baki (2000), Baki and Çakıroğlu (2010), Corbalan, Paas and Cuypers (2010), Lu (2008) and Seo and Woo (2010).

Although there are many technological facilities today, these facilities are not adequately utilised in schools. This is because teachers instruct courses via traditional methods, and this falls short in terms of achieving the goals intended for education. It is understood from this study that, unquestionably, teachers cannot be expected to embrace something of which they have no idea, and are bound to regard it as necessary. For this reason, the education researchers may carry out more studies in the field of mathematics education, regarding the subject of computer assisted mathematics instruction, and consequently may focus the attentions of the teachers and educators on this subject. Although the use of Excel and only one of the dynamic software packages was examined in this study, a positive change was observed in prospective teachers' perceptions about using computer in mathematics. Therefore, teachers should be provided with in-service training courses about Excel and dynamic software such as GeoGebra. Besides, pre-service teachers should definitely be provided with computer assisted mathematics instruction during their undergraduate studies; and they should be assisted in designing events that they may apply in their teaching careers.

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Appendix 1. The Data Collection Instrument

Is it necessary to use computers in mathematics courses? If so, why?

"Can you compare your opinions on the necessity of using computers in mathematics courses before taking the course with your current opinions?"

In your opinion, can computers assist teachers in teaching activities? If so, how?"

"In your opinion, can computers contribute to learning? If so, how?"