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The Effect of Computer Assisted Instruction on Achievement and Attitude of Primary School Students

Zeynep Yıldız[1] and Mine Aktaş[2]

[1]Yıldız Technical University, Faculty of Education, Department of Elementary Education, Turkey; [2]Gazi University, Gazi Faculty of Education, Department of Elementary Education, Turkey

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ABSTRACT

The purpose of this study is to determine the effects of using computer assisted teaching method. The model of the study is experimental design. A sample of 46 students was randomly selected and assigned into experimental and control groups. While the lessons of the experimental group were taught with computer based teaching method, the lessons of the control group students were taught with classical teaching methods. The data were obtained by using mathematical achievement test and by using mathematics attitude scale. Data were analyzed using independent t-tests at a .05 level of significance. According to results, the mathematical achievements of all students increased after this process; however the improvement of the experimental group students is higher than control group students. Besides, the average scores of experimental group students obtained from mathematics attitude scale after the teaching process is significantly higher than their scores obtained before the teaching process.

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Keywords:
Computer Assisted Teaching, Geometry, Mathematics Education.

Introduction

Today, the increased importance of technology in every part of life and the need to increase the success in education cleared the way for using technological facilities in the field of education. According to Kriek and Stols (2010), technology can be used to strengthen student learning. Bester & Brand (2013) stated that students can explore new information, construct new knowledge and link theories into practice with the helping of technology-rich learning environments. Technology in education also provides more interactive learning so students can use multi-modalities resulting with long-term attention and concentration. According to Vural (2005), using computers in every part of education caused massive changes in the classical system and structure of education. The changes that happen together with the rapid development of computers in recent years resulted with the use of computers in order to increase the quality of teaching and learning activities. In this way, computer based teaching approach has appeared.

Computer based teaching approach has been accepted as an approach in which self-learning principles are combined with computer technologies (Bayraktar, 1988). Vural (2005) who explained computer based teaching approach as an approach in which computers are used as teaching instruments and a teaching method with the computers in which learning is actualized by self-learning. Also expressed that, it can be defined as a type of education in which students proceed according to their own speed interactively by using

[1] Corresponding author's address: Yıldız Teknik Üniversitesi, Eğitim Fakültesi, Oda no: A-312, Esenler, İstanbul
Telephone: 00 90 212 383 48 56
Fax: 00 90 212 383 4808
e-mail: zeynepyildiz.2005@hotmail.com
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a course software which was prepared by taking into consideration of all the reactions that can students give in front of a computer. Computer based teaching can also be defined as a teaching approach in which the computer technologies and self-learning principles are combined. Computers are used as environments in which learning occurs and as a teaching approach and as a process which strengthens teaching process, student motivation and which students can use according to their own learning speed (Tuğba, 1999, p.58; transfer from Pesen, 2003, p.46). According to Baki (2002), computer based teaching approach is a method of using computers during teaching and learning process in order to ensure that students are more interested in lessons with the help of graphics, sound, animation and figures. So that they can control their own learning with feedbacks they received and they can realize their own deficiencies through interaction and they can recognize their own performances.

According to the approach which is adopted today and in which computers are evaluated as an learning instrument in the hands of children, students can use software that are presented to them interactively in an environment where computer based learning approach is carried out. In this way, they can solve problems step by step, they facilitate by taking feedback to their correct answers, if they give incorrect answers they can get the correct answers by taking the clues that help them to find the correct answer and by learning from their mistakes. So, in computer based teaching which is carried out in this way, computers used by students play the role of bridge to emphasize students' knowledge and skills (Baki, 2002).

According to results of the research which was carried out by Jenks and Springer, they stated that computer based teaching is at least as effective as classical teaching but classical teaching should not be thrown aside for computer based teaching. They also expressed that the researches for finding the ways of making computer based teaching more effective should be carried out. According to Demirel (2007), computer based teaching should be used as an instrument which strengths and fulfils the system, it shouldn't be used as an instrument for replacing teacher in teaching and learning process. While teaching with computer based teaching approach, teachers can use computers at different levels according to the facilities that they have or according to the features of the subjects. The ways of using computers can be stated as in the following:

1. An opportunity can be created for absent students or for students who did not understand the subject.
2. It can be used at evaluation process after the teacher taught the subject.
3. After the teacher has taught the subject in the classroom, computers can be used during practice, application and evaluation activities.
4. While the subject is taught by using computers, computers can be used by teacher for counseling or for controlling students.

In this research, computer based teaching approach was applied as it was stated at the last item. This research focuses on effects of using computers as an interactive learning environment. In the process which computers are being used in mathematics education, it is important to determine that how students are being effected in terms of mathematical achievement and attitude toward mathematics . The purpose of this research is to determine the effect of using computer based teaching approach on academic achievement of 8th grade primary school students. In addition to that, it was aimed determine the effect on their attitudes toward mathematics. Thus, it is thought the research will be beneficial for educators because it will give some perspectives about using computer assisted education method in mathematics education. In the direction of this purpose, research questions in this study are like following.

1. Is there any significant difference between control and experimental group students' average pre-test scores?
2. Is there any significant difference between average pre-test and post test scores of experimental group students?
3. Is there any significant difference between average pre-test and post-test scores of control group students?
4. Is there any significant difference between control and experimental group students' average post-test scores?

5. Is there any significant difference between average attitude test scores which was implemented before and after teaching?

Method

In this research, the experimental method which is one of the quantitative research methods was used. According to Kaplan (1998) experimental method is changing the external environment or creating various research situations by combining the subjects that has expected characteristics. In this study the effect of using computer based teaching on the academic achievement and the attitude of 8th grade primary students during teaching the subject of surface area and volume of geometric objects have been investigated. Two different 8th grades have been selected as the subject of the research. One of these classes has been taught by using classical method while the other class has been taught by using computer based teaching. Also, the academic achievements and attitudes of students have been analyzed before and after teaching.

To investigate the effect of teaching method on mathematical achievement, pretest – posttest control group design has been used. Mathematical achievement test was used as pretest and posttest to investigate mathematical achievement of both experimental and control grpup students. In addition to that, one sample pretest – posttest design has been used to investigate the effect of computer assited learning method on attitude. Mathematical attitude scale was used as pretest and posttest to investigate attitudes of experimental group students only.

This research was carried out with 8th grade students from a public school. 46 students from two different classes were studied. All the students were studying at the same school and these two classes were chosen randomly. Equivalence of two different groups was analyzed by comparing mathematics achievement pre-test scores. After understanding groups are equivalent, one of them was determined as the control group and the other one was determined as the experimental group randomly. The number of students in control and experimental groups was shown in Table 1 based on their gender.

Table 1. Numbers of the students in study group

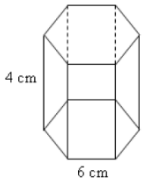
	Female	Male	Total
Experimental Group	14	9	23
Control Group	12	11	23
Total	26	20	46

It is understood that the average of mathematics achievement of these selected classes were close to each other after interviewing with teachers who were familiar with these classrooms and comparing the average scores stated at the previous years of the report cards of those students. Also, it was seen that the average scores of achievement test which was carried out before teaching of two groups were close to each other.

Mathematical Achievement Test

In order to measure the mathematical achievement of the students, mathematical achievement test was used. The mathematical achievement test had 25 multiple choice questions and was prepared by the researcher. Questions were about the subject of "Surface area and volume of geometric objects" in Geometry. The test piloted with 96 students and reliability coefficient of the test was obtained as .72. There is a few sample questions below from the test.

Sample Question 1:



The operations to find the volume of the above hexagonal prism are below in sequence. The length of one edge is 6 cm and the height of this prism is 4 cm.

In which operation is there any mistake?

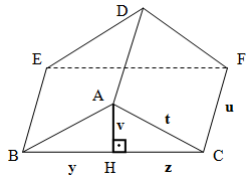
A) The area of a equilateral triangle of which the length of one edge is 6 cm = $\frac{6^2.\sqrt{3}}{4} = 9\sqrt{3}$ cm^2

B) The base area of hexagonal prism is = $9\sqrt{3}\,.6 = 54\sqrt{3}$ cm^2

C) The volume of hexagonal prism is = Base Area . Hight

D) The volume of hexagonal prism is = $9\sqrt{3}\,.4 = 36\sqrt{3}$ cm^3

Sample Question 2:



Some lengths of the right triangular prism above are like following:

|BH| = y, |HC| = z, |AH| = v, |AC| = t and |FC| = u

Accordingly, which is the volume formula of this right triangular prism?

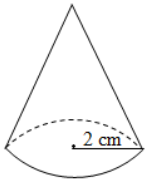
A) $[v.(y+z)].u$

B) $\frac{[(y+z).v]}{2}.u$

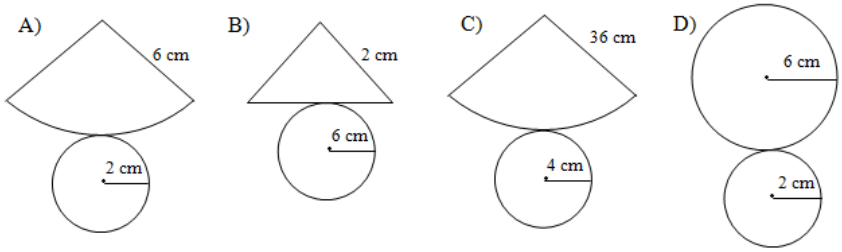
C) $2.(t.u)+(y+z).u$

D $(y+z).v+(2t+y+z).u$

Sample Question 3:



The length of base radius is 2 cm and lateral area is 36 cm^2 of the right cone above. Which one is the development of this right cone? ($\pi = 3$)



Mathematical Attitude Scale

In order to determine the attitudes of students towards the mathematics, a mathematical attitude scale (Askar, 1986) was used. This scale had 20 items which provide understanding the students' point of views about the mathematics. 10 of the 20 items are positive expressive and other 10 items are negative expressive. Mathematical Attitude Scale was a Likert type Scale with 5 choices. For each item, students had 5 options to choose which are absolutely appropriate, appropriate, neutral, slightly inappropriate and absolutely inappropriate. Positive items were scored respectively 4, 3, 2, 1, 0 and negative items were scored respectively 0, 1, 2, 3, 4. The scale had been piloted and the alpha internal consistency reliability coefficient had been found as 0.96. In addition to that according to pilot study results, the scale was one dimensional. The items in the scale were like below:

1. Math class is a chore for me
2. Math class annoys me
3. Mathematics terrifies me
4. I like mathematics.
5. Mathematics is the most feared course of all the courses
6. Mathematics is interesting to me
7. Mathematics is a course which I like.
8. I don't feel comfortable when attending mathematics classes
9. School life would be more enjoying if math lessons weren't exist
10. The most charmless course is mathematics in my all courses
11. I am afraid to mathematics exam
12. Time flows very slowly in mathematics course
13. I enjoy making discussions about mathematics with my friends
14. I wish to have more class hours devoted to mathematics
15. I get bored while studying mathematics
16. I don't get tired of studying mathematics for years
17. I study mathematics more fondly as compared with the other courses
18. Mathematics lessons are enjoying to me
19. Mathematics class is a fun course.
20. I'd like to spend most of my working time in mathematics

Computer Assisted Education Material

The teaching was carried out with computer assisted approach to the experimental group students during 20 hours. In this process, the instructor was the researcher and she used a computer assisted education material. The content of this material consisted of interactive lecturing, problems with their solutions, activities, visuals, animations and tests. This content was existed according to 12 goals of the subject of surface area and volume of geometric objects in the 8th grade primary curriculum. The material was developed by the researcher by using Microsoft Office Power Point. Before using the material in the teaching process, it was shown to different experts to be evaluated. According to their opinions, required changes and corrections were made on the material.

Computer assisted education material has 9 sections which were surface area of right prisms, volume of right prisms, surface area of right pyramids, volume of right pyramids, surface area of a right circular cone, volume of a right circular cone, surface area of the sphere, volume of the sphere and overall test. There is

'Title of the subject' (), 'exit' () and 'help' () buttons on every page at the bottom part of each page. When the button of 'title of the subject' is clicked, 'getting attention' parts can be seen on the first page of each subject. Visuals related with subject were put in this part and the aim was to provide students to have an opinion, think and making comments about the content of the subject by asking questions related with this visuals. Thus the attention of students can be gathered on the subject with these introduction parts of subjects. 'Getting attention' page at the beginning of the 'surface area of a right cone' subject was given in Figure 1.

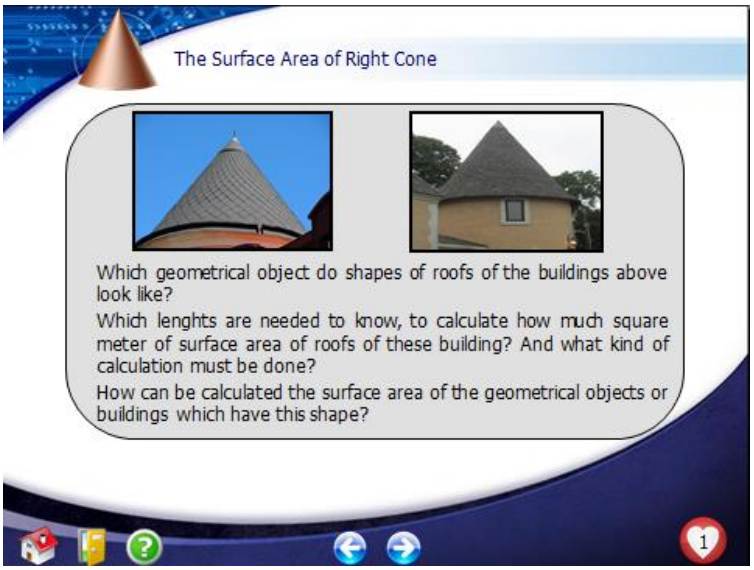


Figure 1. The page of 'getting attention' at the beginning of the subject of 'Surface area of a right cone'

When clicked on one of the subject titles, there is a part on the second page of each subject, aiming to notify students about the target. In this part, there are some information like which subject will be taught, what kind of operations will be carried out related with the learning of the subject, what kind of problems will be solved, the content of the part and etc. While preparing the material, the lecturing part is enriched by using photographs and pictures from daily life in order to help students to have a better understanding. Photographs already taken and photographs which were taken by the researcher were added on the related parts in the material. The aim of this is both taking the attention of the students and learning the subject in depth. Besides, in order to take students' attention on pictures and photographs used in the material were shown in a TV screen and added on to related pages. Figure 2 and Figure 3 shows the page consisting of photographs from daily life related with the subject of 'surface area of a pyramid' and 'volume of sphere'.

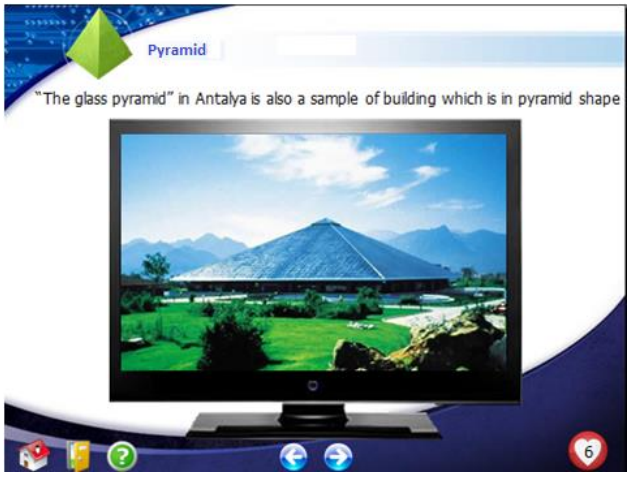


Figure 2. A page which is related with subject of 'Surface area of a pyramid'

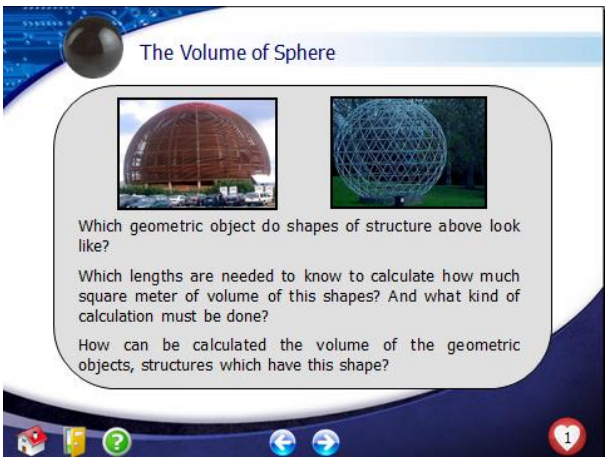


Figure 3. A page which is related with subject of 'The volume of sphere'

The subject of "Surface area and volume of geometrical objects" consists of 3-dimensional geometrical objects. For this reason, animations have been added into the related parts of the material when necessary. These animations were used to provide an analysis of these objects in every aspect. In addition to that animations also were used to provide understanding of 3-dimensional objects' developments. While animations were added to the material, they were placed on a laptop screen for being more attractive.

Activities were also added to teaching period by considering the fact that, students can learn permanently if they use tangible materials which were produced by them. In the pages related with activities, firstly there is a page in which equipments are given, then a page explaining how the activity should be done and at the last part there are questions related to activities. The questions are multiple choice questions and students cannot proceed to next question without finding the correct answer. When students give an incorrect answer, they will see a page which includes a 'back' button and a link which provides to come back to the subject which is thought that students have lack of knowledge. This page also includes a feedback which is explaining the possible reason of incorrect answer or a clue which directs students to the correct answer. Figure 4, Figure 5 and Figure 6 shows the page consisting of photographs from daily life related with the subject of 'surface area of a sphere'.

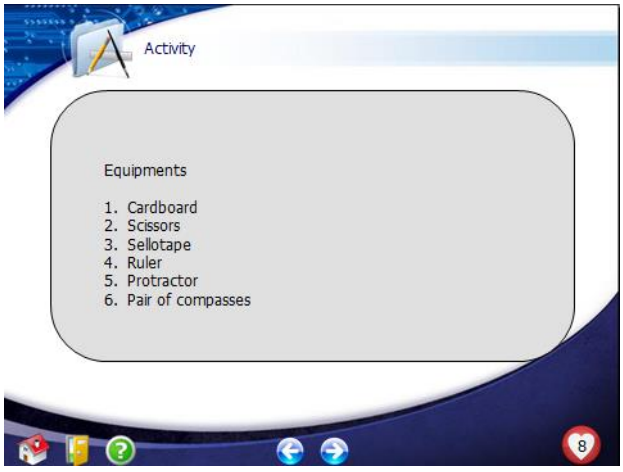


Figure 4. An equipments page from an activity related with subject of 'The surface area of sphere'

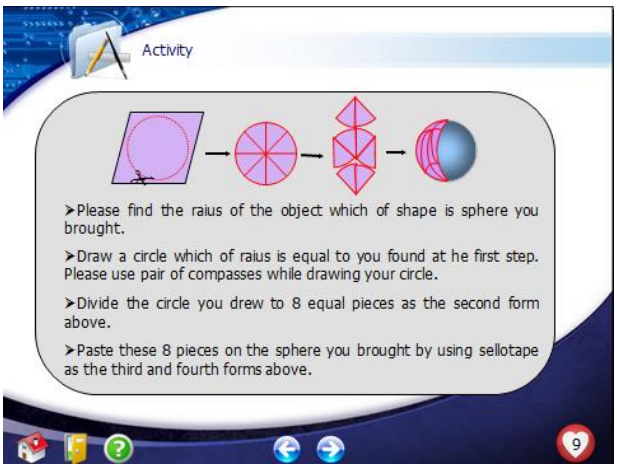


Figure 5. A steps page from an activity related with subject of 'The surface area of sphere'

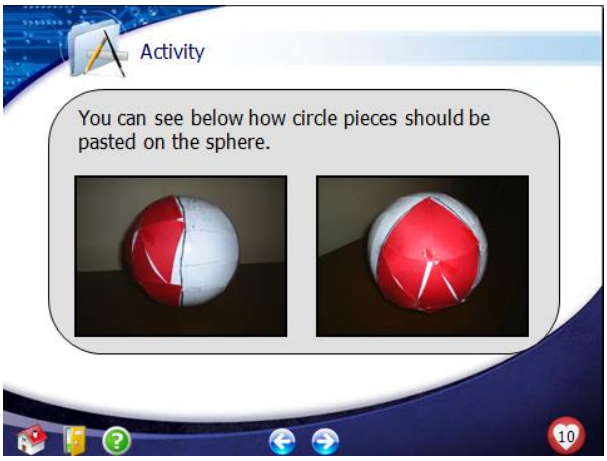


Figure 6. A steps page from an activity related with subject of 'The surface area of sphere'

After giving basic information about the subject and making related activities, sample questions with solutions were also placed to the material to practice and to provide a consolidation of the subject. These questions were multiple choice questions having four alternatives. Solutions of these questions could be seen when the 'solution' button is clicked. Also a feedback is given to students when it is clicked on each four alternative choices. Students who can find the correct answer can proceed to next question by clicking the 'next' button or can check the solution of the question by clicking 'Solution' button if they want. Students who could not find the correct answer have three choices which are turning back to the question by clicking the 'Back' button, turning back to lecture page about subject by clicking the "here" button or has the opportunity of seeing the solution by clicking "Solution" button.

Each page number is shown at the lower right of corner with ( ) image. While students progress with their own speeds they can know the page number of the subject by looking that image. At the end of the each lesson, some pages have "Recall ( )" button so that students can turn back to previous or earlier subjects. Thus it is intended students to recall necessary information for learning the subject or for solving the questions. In this way, it is also intended to teach the subject in a more comfortable and understandable way. In order to avoid the loss of the students' time and to show the practical ways of some solutions, "shortcut ( )" button was placed in some parts of the material. So, it is indented students to learn some methods which they can save time while solving problems and it is also intended students to have a better enhancement by using different solutions. In Figure 3, there is a shortcut page related with the subject of "surface areas of triangle right prism".

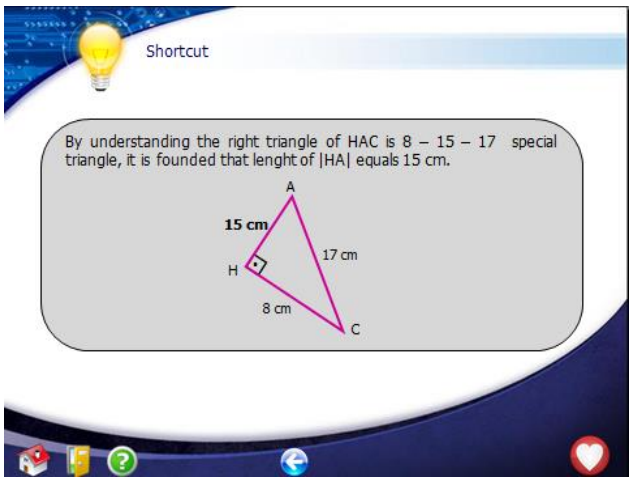


Figure 7. A shortcut" page related with the subject of "surface areas of triangle right prism

"Warning (⚠)" button is used for underlying some parts which are important. When this button is clicked, pages that have special explanations related with the subject and with some important points that students need to pay attention are coming to the screen.

Looking at the overall content of the material, the subject of triangle right prism and the surface area of triangle right prism consist of 40 pages, the subject of volume of triangle right prism consists of 17 pages, the subject of surface area of right pyramid consists of 31 pages, the subject of volume of right prism consists of 11 pages, the subject of surface area of right cone consists of 34 pages, the subject of volume of right cone consists of 15 pages, the subject of surface area of sphere 21 pages and the subject of volume of sphere consists of 15 pages. At the end there is a multiple choice test with 20 questions which were proposed to solve in 40 minutes.

Implementation

Pre-test was applied to the experimental and control group students in the same day at the same hour before one week of teaching. In this way, equivalence of two selected classes has been analyzed in terms of mathematical achievement and the level of knowledge of students before teaching the subject. Also mathematics attitude scale has been applied in order to analyze the attitudes of experimental group students towards mathematics before the teaching. The lessons of experimental and control group students were carried out by the researcher throughout the teaching period. Teaching process was carried out by the researcher because the computer assisted education material has been developed by the researcher, the content of this material is known by the researcher and the necessity of providing the same content to both groups.

The information about computer-assisted teaching was provided to experimental group students. The students of experimental group were told that the subject of surface area and volume of geometric objects was going to be taught by using computer-assisted teaching and how the lessons are going to be carried out was explained. Additionally, the material was shown and how the students were going to use the material was explained to the students.

During the 20-hour period in which computer-assisted teaching method was carried out, 23 students in the experimental group were placed in correspondence with a computer in the computer laboratory. Students progressed at the subjects themselves by using the material. Students decided themselves about what they will take notes to their notebook. The researcher took the role of guidance as the teacher of the lesson, and provided assistance to the students about how to use the material or for clarifying the subject if necessary. After the teaching period had finished, mathematical achievement test which had been used as pre-test was carried out as post-test. So, the effect of computer-assisted teaching was analyzed by comparing the results obtained with the pre-test results. The mathematical attitude test was also implemented to the experimental group students. The results of this test were compared with the results of the pre-test results and the effect of teaching on students' mathematical attitudes was analyzed.

During the 20-hour period in which classical teaching method was carried out 23 students in the control group were trained. In this process teacher-centered education was applied. Blackboard, pencil-notebook were used as teaching material. By using this kind of materials and in the direction of textbook, students were trained.

Data Analysis

In order to calculate the reliability of the mathematical achievement test which was prepared by the researcher, item analysis was carried out by using an ITEMAN analyzing program. To analyze of the quantitative data collected during the research, t-test for two independent samples was performed. For that purpose, SPSS program was used to see whether there is a significant difference between two groups. The significance of the difference between the average scores of groups interpreted as .05.

Results

Whether there is a significant difference between pre-test and post-test mathematical achievement average score of experimental group and control group students was analyzed by using t test for independent samples. These values were shown in Table 2.

Table 2. The analysis of the difference between pre-test and post-test mathematical achievement scores of the students in experimental group and control group

Group	Test	N	$\overline{X}$	S	t	Sd	p
Experimental Group	Pre-test	23	6.21	2,25	10,948	22	0,000
	Post-test	23	16.65	4,55			
Control Group	Pre-test	23	6.91	2,57	12,322	22	0,000
	Post-test	23	13.47	3,28			

Looking at the results obtained, while the mathematical achievement pre-test average score of experimental group students was found as ($\overline{X}$=6.21), the mathematical achievement post-test average score was found as ($\overline{X}$=16.65). Experimental group students' average score obtained from mathematical achievement post-test is higher than the average score of pre-test. According to the t test result which was carried out to understand whether there is a significant difference between mathematical achievement pre-test and mathematical achievement post-test results of experimental group students, it is found that there is a significant difference between these scores [$t_{(22)}$ =10,948; p< .05]. According to this result, a significant increase was seen during teaching period at the mathematical achievement levels of experimental group students in the subject of surface area and volume of geometric objects.

Looking at the results obtained, the mathematical achievement pre-test average score of control group students was found as ($\overline{X}$=6.91) while the mathematical achievement post-test average score was found as ($\overline{X}$=13.47). Control group students' average score obtained from mathematical achievement post-test is higher than the average score of pre-test. According to the t test result which was carried out to understand whether there is a significant difference between mathematical achievement pre-test and mathematical achievement post-test results of control group students, it is found that there is a significant difference between these scores [$t_{(22)}$ =12,322; p< .05]. According to this result, during teaching period a significant increase was seen at the mathematical achievement levels of control group students in the subject of surface area and volume of geometric objects.

Whether there is a significant difference between the average scores of experimental and control group students in mathematical achievement test before and after teaching period (the average scores of pre-test and the average scores of post-test) were analyzed by using t test for independent samples and the findings are shown in Table 3.

Table 3. The analysis of the difference of mathematical achievement scores between experimental and control groups before and after the teaching

	Group	N	$\overline{X}$	S	t	Sd	p
Before teaching	Experimental Group Group	23	6.21	2,25	0,975	44	0,335
	Control Group	23	6.91	2,57			
After teaching	Experimental Group	23	16.65	4,55	2,708	44	0,010
	Control Group	23	13.47	3,28			

Looking at the values in the table, the control group students' average score obtained from mathematical achievement test before teaching period was calculated as ($\overline{X}$=6.91), while the experimental group students' average pre-test score was calculated as ($\overline{X}$=6.21). As seen, the average score of control group students from mathematical achievement test before teaching period is higher than experimental group students. According to the t test result which was carried out to understand whether there is a significant difference between pre-test average score of experimental and control group students, it is found that there is no significant difference between the average score of two groups [$t_{(44)}$=0,975; p> .05]. Depending on these findings, it can be said that mathematical achievement scores of experimental and control group students before teaching are equivalent to each other.

When looked at the results obtained, it is seen that, control group students' average score obtained from mathematical achievement test after teaching period was calculated as ($\overline{X}$=13.47) while experimental group students' average score from the same post-test was calculated as ($\overline{X}$=16.65). The average score of experimental group students from mathematical achievement test after teaching period is higher than control group students. According to the t test result which was carried out to understand whether there is a significant difference between post-test average score of experimental and control group students, it is found that there is a significant difference between the average score of two groups [$t_{(44)}$=2,708; p< .05]. Depending on these findings, it can be said that the difference between the mathematical achievement scores of experimental and control group students is in favor of experimental group students.

Whether there is a significant difference between scores obtained from the mathematical attitude test before and after teaching of experimental group students was analyzed by using t test for independent samples and the findings were shown in Table 5.

Table 4. The analyses of average scores obtained from the mathematical attitude test of students in experimental group

Experimental Group	N	$\overline{X}$	S	t	Sd	p
Before the teaching	23	56.47	12,85	2,753	22	0,012
After the teaching	23	65.08	17,33			

When looked at the results obtained, the mathematical attitude pre-test average score of experimental group students was found as ($\overline{X}$=56.47) while post-test average score was found as ($\overline{X}$=65.08). Experimental group students' post-test average score is higher than the pre-test average score. According to the t test result which was carried out to understand whether there is a significant difference between mathematical attitude pre-test and post-test average scores of experimental group students, it is found that there is a significant difference between these scores [$t_{(22)}$ =2,753; p< .05]. According to this result, a significant increase was seen during teaching period in terms of mathematical attitudes of experimental group students.

Discussion

In this part, findings collected through the analysis of the data gathered in the direction of research problems were explained and interpreted. The fact that there is no significant difference between the mathematical achievement pre-test average scores of experimental and control group students shows us these two groups were equivalent in terms of mathematical achievement. So, these groups can be compared

while evaluating the teaching processes that was applied two different methods. Besides, this result also provides to compare the pre-test and post-test average scores of two groups.

When the average scores of post-test and pre-test scores of experimental group students are compared, it was seen there is a significant difference in favor of post-test scores. This result shows us the fact that computer assisted teaching method increased the mathematical achievement of students in the subjects of surface area and volume of geometric objects. When the average scores of post-test and pre-test scores of control group students are compared, it was seen that there is a significant difference in favor of post-test scores. This result shows us the fact that classical teaching method increased the mathematical achievement of students in the subjects of surface area and volume of geometric objects. That means both teaching methods that were carried out during 5 weeks manage to increase the mathematical achievements of both groups significantly.

When the average scores of the groups obtained from the mathematical achievement test after the teaching are compared, experimental group students' average score was higher than control group students' average score. This result can be interpreted as computer assisted teaching method increases the mathematical achievement more. The results obtained are parallel with the studies which are Efendioğlu (2006), Forsythe (2007), Mayers (2009), Johnson (2008), Paino (2009) and Bester & Brand (2013). The fact that there is not a significant difference between the post-test average scores of experimental group students according to their gender can be interpreted as computer assisted teaching method equally increases the mathematical achievement of boys and girls.

The results obtained on the students' mathematics achievement shows that computer assisted education is one of the effective methods for improving mathematics achievement. There are several components at the base of the computer assisted education and these components provides active learning. This situation can be showed as a reason for improving the mathematical achievement.

The students are in position of active learning, they can proceed with the speed they preferred, they can study and take a break when they want and they can interest in technological tolls such as computer. It is thought that these kinds of reasons play a role for increasing the students' achievement. Abstract or concrete objects can be presented in different ways and types. This opportunity can provide deeply and effectively concept learning for students. Besides, computers can give some extra opportunities to students such as doing practise and repetitions in the amount of they need without peer pressure or criticism from their friends. Computer assisted learning also has some effects which make easier the learning by creating enjoyable learning environments by using some color, sound and animations (Arslan, 2003). Similarly, these components of computer assisted education develop more positive attitudes to the course with increasing sense of wonder and interest. Increasing the attitude towards mathematics of the students in the experimental group positively can be explained in this way.

When the average scores of experimental group students obtained mathematical attitude scale before and after teaching, it was found there is a significant difference in favor of the average scores after teaching. This finding can be interpreted as students who learnt the subjects (surface area and volume of geometric objects) with computer assisted teaching method have developed more positive attitudes towards mathematics. This result is in accordance with other researches which are Baki and Güveli (2004), Garcia and others (2005) with Kariuki and Burkette (2007).

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