THE EFFECTS OF THE COMPUTER-BASED INSTRUCTION ON THE ACHIEVEMENT AND PROBLEM SOLVING SKILLS OF THE SCIENCE AND TECHNOLOGY STUDENTS

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ABSTRACT
This study aims to investigate the effects of the computer-based instruction on the achievements and problem solving skills of the science and technology students. This is a study based on the pre-test/post-test control group design. The participants of the study consist of 52 students; 26 in the experimental group, 26 in the control group. The achievements test on "the world, the sun and the moon" and the Problem Solving Inventory for children were used to collect data. The experimental group received the computer-based science and technology instruction three hours a week during three weeks. In the analyses of data, the independent groups t-test was used at the outset of the study to find out the whether the levels of the two groups were equivalent in terms of their achievements and problem solving skills and the Kolmogorov-Smirnov single sample test to find out whether the data follow a normal distribution and finally, the covariance analysis (ANCOVA) to evaluate the efficacy of the experimental process. The result of the study reveals that there is a statistically significant increase in the achievements and problem solving skills of the students in the experimental group that received the computer-based science and technology instruction.
Keywords: Computer-based instruction (CBI), the Science and Technology Course, learning packet, achievement, problem solving skills, primary education

INTRODUCTION

Great emphasis is placed on the computer-based science and technology laboratories as well as ordinary science laboratories in the educational curricula of the developed countries. One of the aims of the science and technology course is to train individuals capable of keeping up the fast developing and changing science world and capable of utilizing the recent technological discoveries in every field. Researchers have been interested in revealing the effects of the computer-based instruction, which began to be used with the invention of the computer, which is one of the most important technological devices of the time.

As a result of the rapid development of the information and communication technology, the use of computers in education has become inevitable. The use of technology in education provides the students with a more suitable environment to learn, serves to create interest and a learning centred-atmosphere, and helps increase the students' motivation. The use of technology in this way plays an important role in the teaching and learning process (İşman, Baytekin, Balkan, Horzum, & Kıyıcı, 2002). In parallel with the technological advances; technological devices, particularly computers began to be used in educational environments to develop audio-visual materials such as animation and simulation, which resulted in the development of the computer-based instruction techniques.

The best example of the integration of science and technology is the Computer-Based Instruction technique. The use of computers in the teaching and learning activities is defined as Computer-Based Instruction (CBI). CBI is the use of computers in the teaching and learning activities (Brophy, 1999). CBI enables the students to learn by self-evaluating and reflecting on their learning process. CBI motivates children to learn better by providing them with the immediate feedback and reinforcement and by creating an exciting and interesting game-like atmosphere. The studies in the field reveal that the students' achievements increase when the CBI technique is provided as a supplement to the classroom education. CBI is more effective on less successful children. The reason for this is that the computer-based instruction enables the children to progress at their own pace and provides them with appropriate alternative ways of learning by individualizing the learning process (Senemoğlu, 2003). The most familiar function of the science education is to teach the children the science concepts in a meaningful way and enable them to lean how they can make use of these concepts in their daily lives (Çepni, Taş, & Köse, 2006).

The computer based teaching has had an impact on the development of the educational technology to a great extent in the 21. Century and this has resulted in the production of the software for the computer-based instruction. The primary purpose of the educational software is to solve the learning problems in the science courses encountered by the primary school students, to increase their motivation and achievements and to protect them against the negative effects of the rote-memory based educational system.

There are software-supported educational products designed to be used in the computer-based and computer-supported teaching practices. These are the products that the teachers use as complementary materials for taking notes about their students and observations; making tables; developing materials; doing calculations, and preparing simple educational software. The educational software is used as a teaching material in the teaching of a part of a subject or the whole subject (Alkan, Deryakulu, & Şimşek, 1995; İşman, 2005).

According to Alessi & Trollip (2005), it is possible to divide educational software into five different types such as tutorial, drill and practice, simulation, educational games and hypermedia type. For effective and productive teaching, these techniques should be used with some classroom activities. These are: presentation, demonstration, practice and evaluation of learning (Özmen, 2004). The use of computer technology enables learners be active in the learning process, to construct knowledge, to develop problem solving skills and to discover alternative solutions (Özmen, 2008).

The presentation of teaching materials by means of the computer technology helps students to process and develop information, to find alternative solutions, to take an active part in the learning process and to develop their problem solving skills. Most of the scientific and technological advances are realized by the people whose problem solving skills have been developed. In addition, these advances give rise to positive changes in the lives of people owing to the ways and techniques developed by means of the power of the problem solving skills. The use the problem solving skills is inevitable at every stage of our daily lives. As a result of the advances in today's technology and computer devices, it's getting indispensable to use this new technology in the solution of educational problems. The education and technology play an important role in the education of humans. Although the education and technology are different concepts, the use of both resulted in the emergence of a new discipline, the educational technology. Owing to the educational technology, the teaching and learning activities become enjoyable. Students learn willingly, by playing and enjoying during these activities (İşman, 2005).

Among the primary and secondary school students, girls use computer 5 hours a week for the play purpose whereas boys spend 13 hours a week for the same purpose (Christakis, Ebel, Rivara, & Zimmerman, 2004). The use of computer in teaching and learning environments is very important as the children like it very much and can continue playing with it without ever getting bored. In our time, it is evident that visual materials such as TV and computer are utilized in every field. And it is also evident that computer attract students very much. The use of the audio-visual devices and animations with instructional materials results in the enjoyable and productive learning process. In this way, the learning process can become enjoyable and interesting for students as a result of abolishing traditional classroom learning activities.

Technological developments give rise to new teaching and learning facilities. In our time, human beings keep on searching to find out how to use computer in educational activities in a more productive way rather than searching to reveal whether the use of computer in teaching and learning activities is effective (Kara & Yakar 2008). Educational technologies, especially computers play an important role in concretizing abstract concepts, which are difficult for children to learn, by means of animations (Akpınar, 2005).

The computer-based Instruction makes teaching techniques far more effective than those of the traditional teaching methods as it is used for presenting information, testing and evaluation and providing feedback. It makes a contribution to the individualization of education. It motivates students and gets them to take an active part in the learning process. It helps to develop creativity and problem solving skills, identity and self-reliance in learners. CBI provides drawings, graphics, animation, music and plenty materials for the students to proceed at their own pace and in line with their individual differences. It serves to control lots of variables having an impact on learning, which cannot be controlled by means of traditional educational techniques (Kaşlı, 2000; Chang, 2002).

Liao (2007) found out that CBI had a positive effect on individuals by comparing 52 research studies carried out in Taiwan in his meta-analysis study. Senteni (2004) also found out that CBI enabled the students to increase their motivation and achievements and to develop positive attitudes. According to research studies in literature, the use of computer-based education increases students' attitudes and achievements significantly (Berger, Lu, Belzer, & Voss, 1994; Geban, 1995). There is a lot of research on CBI both in Turkey and in the world. Different results have been arrived at in these studies. Some of these studies reveal that CBI serves to establish more effective learning situations than traditional teaching methods which involve teacher presentation, question and answer techniques, and discussions etc (Boblck, 1972; Hughes, 1974; Cavin & Lagouski, 1978; Choi & Gennaro, 1987; Niewiec & Walberg, 1987; Huonsell & Hill, 1989; Jedege, Okebukola, & Ajevole, 1991; Geban, Ertepınar, Yılmaz, Altın, & Şahbaz, 1994; Crook, 1994; Child, 1995; Brophy, 1999; Gance, 2002; Çekbaş,

Yakar, Yıldırım, & Savran 2003; Yenice, 2003; Carter, 2004; Moodly, 2004; Preciado, 2004; Li & Edmonds, 2005; Brooks, 2005; Bryan, 2006; Çepni, Taş, & Köse, 2006; Wilder, 2006; Başer, 2006; Chang, Sung & Lin, 2006; Liao, 2007; Ragasa, 2008; Hançer & Yalçın, 2009; Lin, 2009). It has been found out that CBI serves to develop meta-cognitive skills in students and helps them to learn in a meaningful way instead of rote-memory learning as well as it enables them to increase their achievements (Renshaw & Taylor, 2000). According to some studies there is no significant difference between the CBI and traditional teaching methods (Bayraktar, 2001; Alacapınar, 2003; Çetin, 2007).

This study, which aims to test the effects of the use of the CBI technology, is thought to be important as it will contribute to the wide use of educational software which triggers active participation and enables students to make their own meaning. The research, which was carried out to this end, is considered to make the science and technology education more enjoyable, productive and functional. This study is important as its results serve to complete the other studies done on CBI in Turkey and to provide a basis for further studies.

Theoretical Background of the Study

With the use computers in education, a lot of terms have come into and gone out of use in education (Owusu, Monney, Appiah, & Wilmot, 2010). The overlapping terms related to the uses of computer and associated technologies in science education are categorized into three by Bybee, Poewll, & Trowbridge (2008) as follows: learning about computers, learning with computers and learning through computers.

1. Learning about computers involves the knowledge of computers at various levels such as knowing the uses of the computer and the names of the various parts, knowing how to use the keyboard and computer packages and so on (Owusu et al., 2010). According to Tabassum (2004), the knowledge of computers may be thought of as a continuum which ranges from skills in and awareness of computers at lower level to programming at higher level.

2. Learning with computers, students use computers as a tool in data acquisition, analysis, communication with other people, information retrieval and myriad other ways (Owusu et al., 2010). Learners use computers to get information and do their homework.

3. The term 'learning through computers' involves the use of computer as an aid for the teacher to do his/her presentations, and / or to get the learners to practise and drill. Computers are used to enhance interactive activities, to provide immediate feedback, to facilitate the retention and to enable the learners at diverse levels to work at own their pace.

This study involves mainly learning through computer as well as learning about computer. The theoretical basis of the study derives from the operant conditioning by Skinner as described by Owusu et al. (2010) in their study. Operant conditioning is a type conditioning in which a learner achieves some outcome by producing an action, which is called the operant. If the operant is followed by something pleasant, the outcome is positively reinforced but if it is followed by the removal something unpleasant, the outcome is negatively reinforced. The theory that was influential during the heyday of the Audio-Lingual method which lost favour 1960s was revived after the introduction of the use computers into education. Skinner's reinforcement theory is central to computerized learning; especially drill and practice and tutorial learning (Tabassum, 2004). In these computer facilitated learning, students' behaviours are reinforced by being permitted to proceed to the next frame when they get the right answer (Bigge & Shermis, 2004). Tabassum (2004) indicates that Skinner illustrated how to develop programmed learning sequence which is being used directly to design tutorial modules. According to Owusu et al. (2010), "the use of computer-assisted instruction especially in tutorials mode is supported mostly by the behaviourist view of learning. This is due to the principle of practice and reinforcement. Therefore, the developers of tutorials mostly incorporate this theory of learning in their programme".

The study makes use of the operant conditioning deriving from the practices of Skinner's behaviourism. The materials and activities are presented in graded steps. Learners have the opportunity to be active in the learning process and receive immediate feedback and work at their own pace.

Purpose of the Research

The basic aim of this study is to investigate the effects of the computer-based instruction on the achievements and problem solving skills of the science and technology students.

The Research Question of the Research:
The main research question of the study is stated as follows: "Does the computer-based science and technology instruction have any effects on the achievements and their problem solving skills of the students?"

Sub-questions of the research:
The study aims to answer the following sub research questions.

1. Is there a significant difference between the means of the post-test achievements scores corrected according to the pre-test achievements scores of the control group taught according to the traditional method and the experimental group taught according to the computer-based science and technology program?
2. Is there a significant difference between the means of the problem solving post-test scores corrected with respect to the pre-test scores of the control group taught according to the traditional method and the experimental group taught according to the computer-based science and technology program?

Limitations
The study is restricted to the topics, "Earth, Sun and Moon" in the study field of "Earth and Universe" of the science and technology course and to the 52 fifth graders studying in a primary school at Buca-İzmir in the 2008-2009 school year. Only "the learning package" was used in the process of teaching the experimental group.

METHOD
Research Design
The pre-test/post-test control group design (PPGD) was used in this study. The pre-test/post-test control group design is a mixed design, which is widely used. A mixed design is a factorial design widely used in social sciences, especially in education and psychology. The pre test-post test control group design as one of the mixed designs is one of the most widely used experimental designs. In PPGD, in order to determine the effectiveness of the experimental process, whether the variation between two groups is significantly different is tested by means of the "t" or "F" test Büyüköztürk, 2010).

Table 1 The pre test-post test control group model

Groups	Pre Test	Process	Post Test
E_1	0_1	X	0_2
E_2	0_3	-	0_4

(Balcı, 2007)

As can be seen in Table 1, notations are: E_1=Experimental group, E_2=Control Group, O_1, O_2 = Pre-test and Post-test (Experimental group) scores, O_2, O_4 = Pre-test and Post-test (Control group) scores, X=Process that stands for the experimental variable of the computer based science and technology program.

Participants
The participants of the study were 53 fourth year pupils in a primary school in Buca/İzmir in the 2008-2009 school year. Those 53 pupils were put into two groups by lot and later 26 were placed in the experimental group and 27 in the control group by lot again. As one of the participants did not attend the classes regularly and did not take the pre-test, they were excluded from the research in the data analysis process. In order to avoid the effects of the gender variable, male and female pupils were assigned to the groups equally.

Data Collection Instruments
The Problem Solving Inventory for children with the Cronbach's Alpha reliability coefficient of .85 was used as a data collection instrument prepared by Serin, Bulut Serin and Saygılı (2010). This Problem Solving Inventory serves to test the self-perception levels and behaviour of the primary school students about the problem solving skills. The scale is a five grade likert type scale rating from 1 to 5 and consisting of 25 items that can be administered to primary school pupils between the ages of 7-12. The points range from 24 to 120. High scores represent the pupils' positive perception of their problem solving skills, whereas low scores represent the negative perception of their problem solving skills.

In order to determine the primary school pupils' comprehension levels of the topics "Earth, Sun and Moon in the science and technology course, an achievements test of 25 items was designed. Before designing the achievements test, the behavioural objectives were determined by means of the content analysis. With the help of experts in the field, it was determined that that there were 25 types of critical behaviour to be tested. 75 questions were prepared to test these behaviours. The tentative form was administered to a group of 200 fifth year pupils of

another primary school. The results of the administration were analysed with the TAP program (The Transition Assistance Program). 25 questions that test critical behaviours were included in the final test. On the basis of the item analysis, the achievements test was prepared with the item difficulty ranging from .25 to .90. The test was finalized with the KR-20 reliability as .72.

Contents of the Program Applied

The research was conducted in the "Earth, Sun and Moon" unit which aims to enable students to become familiar with the relative shapes and dimensions of Earth, Sun and Moon, to establish a connection between the movements of Earth and Moon and to acquire information about the results of this relationship and about their effects on daily life. The difficulty of finding quality software and supporting teaching programs is an important factor that impairs the success of computer based instruction. For these reasons, the computer based software pertaining to "Earth, Sun and Moon" was prepared by consulting science and technology teachers and experts. This program was used in order to deal with the issue of quality software. The "Adobe Photoshop" program was used in preparing the graphics. The "learning package" applied to the experiment group was prepared by using the Macromedia Flash 8 program. The reason for the preference of this program is that it offers a better visual medium, as the shapes produced remain clear, the files created are very small in dimension and the files can be disseminated on the internet. The contents of each subject were presented systematically in accordance with predetermined, specific aims in the software. The visual aids used in the software were suitable for the age and educational level of the children. The software contained documentaries and activities related to the subjects. Furthermore, the student could direct his learning process and evaluate his learning; the software had a dynamic structure that enabled the student to see if the answers s/he gave to the questions were correct or not. Apart from this, using this software the student could play various educational games related to the subject when s/he went on the internet through the software. The internet based "teaching package" which was applied to the experiment group made it possible to have interactive lessons using media like the internet, video, slides, CD's, sound, animation and the like. In the program, first topics were presented. They were enriched with visual material and made attractive with animation. The colors used in the software were interesting for the student but not distractive or tiring for the eye. The design of the interface was simple and easy to understand, which made it easy to direct the student. When the student entered the program, s/he encountered an introductory screen which showed all the subjects to be studied throughout the unit. In order to enhance interaction, there were return buttons throughout the program with which the student could go to the main menu or to a previous page. Again, throughout the program, the subjects were presented with rich visual animations. The written material on the screen was minimal but sufficient to summarize the subject. The students studied the subjects with their teacher but also reviewed the subject as much as they wanted. After they studied the subject with their teacher on their own computers, they did the interactive exercises on the screen at the end of each lesson.

Figure 1 Introduction page of the software

When the student entered the program, s/he heard the following (Figure 1): “Hello! Welcome to our program. In this program you can reinforce what you have learned in the exercise section which we prepared for you if you want to learn about Earth, Sun and Moon. Should you be bored, don’t worry. You can always come back to the main page from where you are after you have had fun as much as you want in the games section which we prepared for you. What is more, don’t forget to get support from the help button in places you have difficulty. Now, the program is waiting for you. Cruise and have fun to your heart’s content”.

Figure 2: Let us get to know our world

On the page in Figure 2 was the following audio explanation: “I am Earth. Welcome to my page. If you click on the how am I button, you can reach the place which contains information about me. You can see how I revolve around the sun together with the moon when you click the come along with me button. If you click the where am I button, you can learn how much the distance is between me and the sun and the moon. Finally, if you click the watch video button, you can watch a very beautiful video about me”.

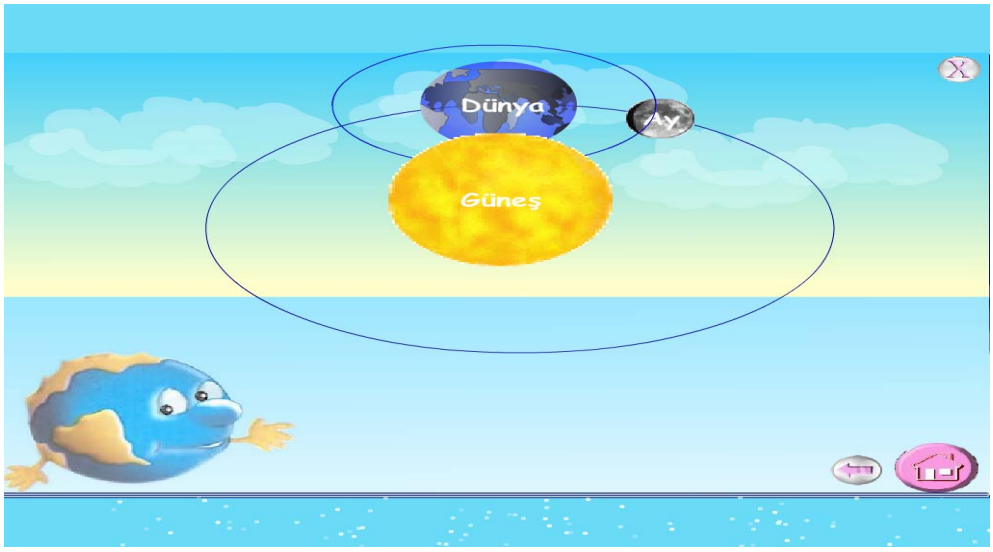

Figure 3: Let us get to know Earth (Where am I?)

Figure 4: Let us get to know the Sun

The page on Figure 4 said, “Hello! I am the sun. Welcome to my page. If you click the how am I button, you can reach the part which covers information related to me. You will love the video about me if you click the “would you like to watch a video” button. When you click the “where am I” button, you can see how far away I am from Earth and the moon”.

Figure 5 Let us get to know the Moon

On the page in Figure 5, the student could hear the following: “Hello! I am the moon. Welcome to my page. If you click the “how am I” button, you can reach the part which covers information related to me. You will love the video about me if you click the “would you like to watch a video” button. When you click the “where am I” button, you can see how far away I am from the sun and Earth”. If you click the “phases of the moon” button, you can learn about my phases”.

Figure 6 Assessment Section.

This section said, “Welcome to the assessment section. Here you can begin answering the true/false, fill in the blanks and the test questions we have prepared for you by clicking the forward button below”.

Figure 7 Shall we exercise? (a)

As can be seen in Figure 7, if the student answered correctly, the voice said, “Congratulations! You can pass on to the next question” together with a smiling face. The student had to give a correct answer in order to be able to answer the next question.

Figure 8 Shall we exercise? (b)

In the "Shall we exercise" section in Figure 8 where the matching questions were, the student could pass on to the other questions when s/he matched the pairs correctly.

Figure 9 Clues to be taken if wrong answers are given.

If the student could not find the correct answer, up came the page where Figure 9 is and if the student so wished, s/he could take the clue to find the correct answer.

Figure 10 Shall we play?

As can be seen in Figure 10, the "Shall We Play?" section comprised "follow the mouse", "find Earth", "shall we watch an animation?" and "photograph album" activities.

Figure 11 Shall we play? (Let Us Find Earth)

As can be seen in Figure 11, when the student clicked the red button to reach the information on how to play the "Find Earth" game, s/he saw the following text: "There are some planets and the sun in our game. What you have to do is to find Earth among these planets. When you find Earth, it stops. If you have stopped it, a little surprise will be awaiting you in the blue button on the game page. Don't be a spoiling sport or click the button before you find Earth. Don't forget that none of the planets will stop if you click the wrong one. OK! Have fun! Find Earth and the surprise is yours".

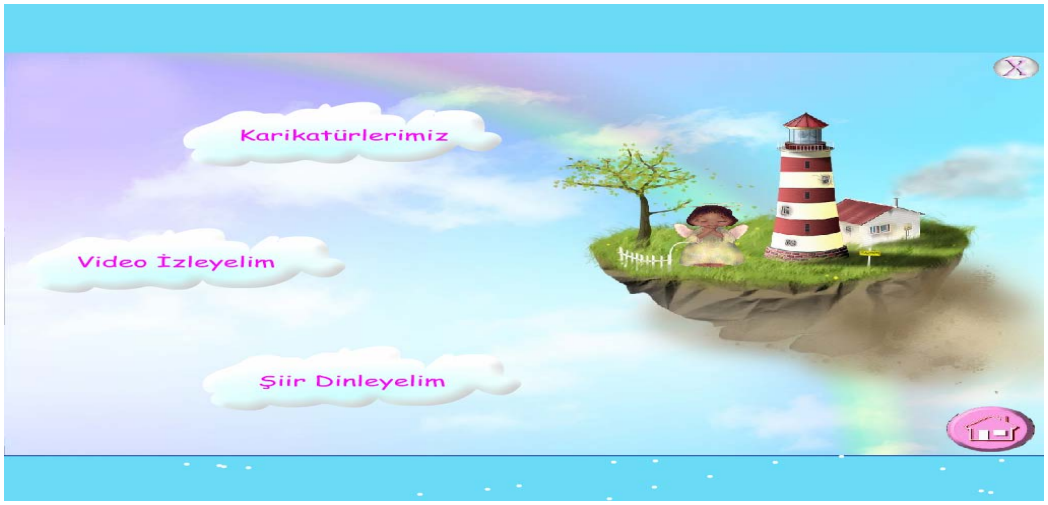

Figure 12 Ready to have fun?

The section "Ready to Have fun?" on the page in Figure 12 comprised "our comic strips", "shall we watch a video?" and "shall we listen to a poem?" activities.

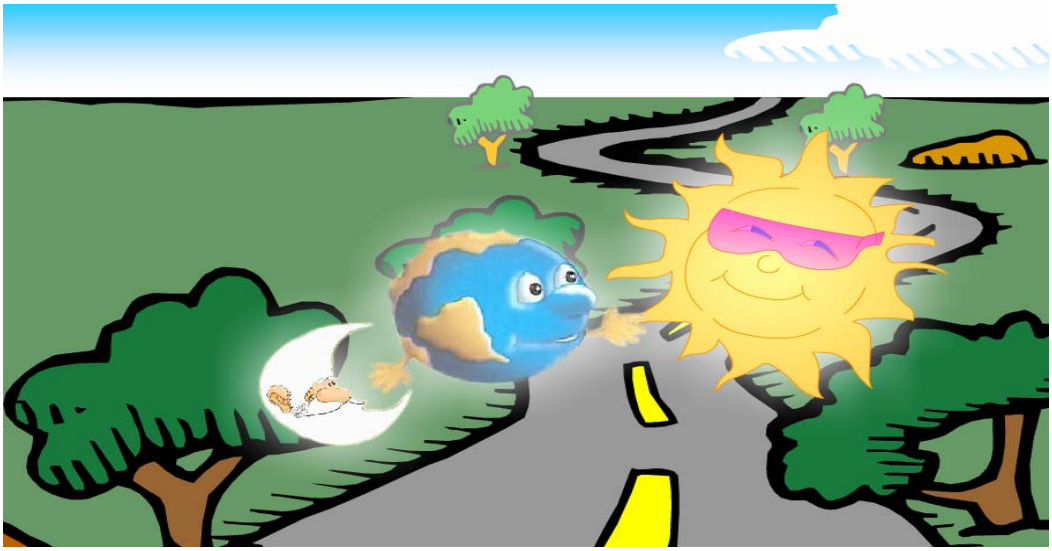

Figure 13 Exit page of the software.

The Experimental Process and Collecting Data

The "computer-based science and technology teaching program" was applied to the experimental group and not to the control group. The t-test results of the pre-test points related to the achievements and problem solving skills of the experimental and control groups are given in Table 2. As can be seen in Table 2 there was not a statistically significant difference between the pre-test means of the experimental and control groups. Accordingly, it can be said that there is no significant difference between the "Earth, Sun and Moon Achievements Test" and "Problem Solving Inventory for Children" pre-test means of the experimental and control groups. In this case, it can be assumed that the levels of the achievements and problem solving skills of the control and experimental groups were equivalent before the experiment began.

Tablo 2 The t-test results of the "achievements and problem solving skills" pre-test scores of the experimental and control groups

Measurements	Groups	N	$\bar{x}$	s.d.	df	t	p
Achievements Pre-test	Experimental	26	24.000	7.244	50	.076	.940
	Control	26	23.846	8.117			
Problem Solving Skill Pre-test	Experimental	26	72.230	13.360	50	.072	.943
	Control	26	72.538	15.687			

For the experimental group the white board was not used while studying the "Earth, Sun and Moon" unit in the science and technology class. Instead, the interactive computer-based "learning package" consisting of educational games that could be played when connected to the internet, which was prepared with the Macromedia Flash 8 program.

The control and experimental groups were balanced gender wise. Furthermore, care was taken that the individuals in control and experimental groups did not interact with each other. Six sessions of teaching-time was allocated equally to both groups (12 hours). At the end of the three-week computer based science and technology program, the experimental and control groups were again administered the "Earth, Sun and Moon Achievements Test" and the "Problem Solving Inventory for Children" on the same date.

Analysis of Data

In the analysis of data, the Kolmogorov-Simirnov single sample test was used to see if the data were suitable for normal distribution and the "independent groups t-test" was used to test the equivalence of the achievements and problem solving skills of the experimental and control groups at the beginning of the study. At the end of the experimental process, in order to test the effectiveness of the experimental process the co-variance analysis technique (ANCOVA) was used to see whether there was a significant difference between the post-test score averages which were corrected according to the pre-test results of the experimental and control groups (Bonate, 2000; Büyüköztürk, 2006). The significance level was taken as .05 in the study.

Findings

Kolmogorov-Simirnov Z was used to find out whether the scores of the dependent variables followed a normal distribution within each subgroup and whether the variances were equal in order to measure whether there was a significant difference between the means of the pre test and post test results of the control and experimental groups' achievements and problem solving skills by means of ANCOVA.

As is seen in Table 3 and Table 4, the measurements related to the experimental and control groups follow a normal distribution and the variances are equal. In addition, when studied the correlations between the measurements related to the groups, it can be seen that there is a correlation at .49 (the lowest) between the pre test and post test scores of the experimental group's problem solving skills and there is a correlation at .52 (the highest) between the pre test and post test scores of the experimental group's problem solving skill. All of the correlations are significant at the .05 level. The results can provide evidence for the fact that there is a linear correlation between the pre and post test scores. With respect to these results, the covariance analysis was used to determine whether there was a significant difference between the means of the corrected post test scores according to the control and experimental groups' achievements and problem solving skills.

Table 3 Descriptive statistics of experimental and control groups and normality test results with Kolmogorov-Simirnov Z

Groups	Measurements	N	$\bar{x}$	s.d.	KS-Z	p
Experimental	Achievements Pre-test	26	24.000	7.244	.981	.291
	Achievements Post-test	26	66.461	10.187	.858	.454
	Problem Solving Skills Pre-test	26	72.692	13.768	1.074	.199
	Problem Solving Skills Post-test	26	83.576	15.150	.986	.285
Control	Achievements Pre-test	26	23.846	8.117	.823	.507
	Achievements Post-test	26	58.307	8.629	.780	.577
	Problem Solving Skills Pre-test	26	72.538	15.687	1.222	.101
	Problem Solving Skills Post-test	26	71.730	14.387	.964	.311

Table 4 Test results of homogeneity related to the variance measurements of experimental and control groups

	Levene Statistics	Sd 1	Sd 2	p
Achievements Pre-test	.686	1	50	.412
Achievements Post-test	1.369	1	50	.248
Problem Solving Skills Pre-test	1.615	1	50	.210
Problem Solving Skills Post-test	.747	1	50	.392

The following is the first sub research question:

"Is there a significant difference between the means of the post test achievements scores corrected with respect to the pre-test achievements scores of the control group taught according to the traditional method and the experimental group taught according to the computer-based science and technology program?" As is seen in

Table 4, there is a statistically significant difference between the means of the post test achievements scores of the pupils in the control and the experimental groups corrected according to the pre test ($F_{(1,49)}$=10.312; p<.05). It can be seen that there is a significant difference between the means of the achievements post test scores ($\bar{x}_{Experimental}$ =66.433; $\bar{x}_{Control}$=58.336) corrected according to the pre test in favour of the experimental group. It has been found out that the program (computer-based science and technology teaching package) used with the experimental group had an effect on the success in the science and technology course according to the research findings. When the eta-square values of the dependent variable are examined, it will be seen that the amount of effect is high and the 17.4 % of the variations in the achievements post tests can be accounted for due to being in different process groups.

The following is the second sub research question:
"Is there a significant difference between the means of the problem solving post test scores corrected with respect to the pre test scores of the control group taught according to the traditional method and the experimental group taught according to the computer-based science and technology program?" As is seen in Table 4, there is a statistically significant difference between the means of the problem solving post test scores corrected with respect to the pre test scores of the control group taught according to the traditional method and the experimental group taught according to the computer-based science and technology program ($F_{(1,49)}$=22.891; p<.05).). It can be seen that there is a significant difference in favour of the experimental group between the means of the problem solving post test scores ($\bar{x}_{Experimental}$=86.361; $\bar{x}_{Control}$ =74.524) corrected according to the pre test. It has been found out that the program (computer-based science and technology teaching package) used with the experimental group had an effect on the problem solving skills in the science and technology course according to the research findings. When the eta-square values of the dependent variable are examined, it will be seen that the amount of effect is high and the 31.8 % of the variances in the achievements post tests can be attributed to being in different process groups.

It can be stated that the F values and significance levels related to the models are significant both from the perspective of the achievements post test scores and from the perspective of the problem solving post test scores and the 23.9 % of the variances in the achievements post tests can be attributed to being in different process groups whereas the 58.7 % of the variances in the achievements post tests can be attributed to being in different process groups.

Table 5 The Achievements and problem solving skills of the pupils in the experimental and control groups, pre test, post test, corrected means, values of standard deviations

Dependent Variable	Groups	N	PRETEST		POSTTEST		CORRECTED MEAN	
			$\bar{x}$	s.d.	$\bar{x}$	s.d.	$\bar{x}$	s.d.
Achievements	Experimental	26	24.000	7.244	66.461	10.187	66.433	1.783
	Control	26	23.846	8.117	58.307	8.629	58.336	1.783
Problem Solving Skills	Experimental	26	72.230	13.360	86.269	13.183	86.361	1.749
	Control	26	72.538	15.687	74.615	11.548	74.524	1.749

Table 4 The Analysis results of ANCOVA about the differences between the means of the post-test scores of the achievements and the problem solving skills corrected according to pre-test scores

Dependent Variable	Source	Sum of Squares	df	Mean Square	F-Value	p-value	Eta Squared
Achievements	Model	1271.120	2	635.560	7.691**	.001	.239
	Pre-test (reg.)	406.813	1	406.813	4.923**	.031	.091
	Grup	852.169	1	852.169	10.312**	.002	.174
	Error	4049.187	49	82.636			
	Total	5320.308	51				
Problem Solving Skills	Model	5545.964	2	2772.982	34.850**	.000	.587
	Pre-test (reg.)	3780.406	1	3780.406	47.511**	.000	.492
	Grup	1821.422	1	1821.422	22.891**	.000	.318
	Error	3898.863	49	79.569			
	Total	9444.827	51				

**p<.05

DISCUSSIONS AND SUGGESTIONS

The fundamental aim of this study was to investigate the effects of the computer-based Instruction on the achievements and problem solving skills on the science and technology students. To this end, the scores obtained from the "Earth, Sun and Moon" Achievements Test and "the Problem Solving Inventory for Children" administered to the experimental and control groups were compared. It was revealed that the findings obtained from the results of the pre and post tests administered at the end of the computer-based science and technology instruction program revealed that there was a significant difference between the achievements and problem solving post test scores corrected according to the pre test scores of the experimental and control groups. It was found out the use of the computer and the teaching package with the materials such as videos, slides, CD's, sounds and animations in the science and technology course makes it possible to have an interactive lesson. Moreover, the presentations of topics by means of rich visual materials increase the achievements of the students. It can also be stated that the use of CBI has positive effects on the learners' problem solving skills. The high eta-square values obtained from the study indicate that the group and pre test variables can provide an explanation for the variances in the scores of the post test. The results of the research indicate that the use of the interactive learning package assists the learners in increasing their achievements and developing their problem solving skills in the fifth year science and technology course.

The significant increase in learners' achievements in this study can also be seen in Olgun's study entitled "The effect of the computer assisted instruction given to 6th grade primary school students on the students' attitude toward science and their metacognitive skills and their achievement" showed that computer-assisted science instruction positively affected the attitude of the students toward science and their metacognitive skills; in Demirer's study entitled "The effect of the computer assisted teaching method and the traditional teaching method on students' academic achievement and their attitude toward science and the permanence of the acquired behaviors", determined that the CAT method significantly affected the attitude of the students; in Tekmen's study entitled "The effect of computer assisted instruction given in the physics lesson in the 9th grade on the achievement of the students, their attitude toward the lesson and its retention", Tekmen (2006) determined that the effect of the CAT method on the attitude of the students was significantly higher in comparison to the traditional methods; Pektaş (2008), in his study entitled "The effect of the constructivist approach and computer-assisted instruction on students' achievement and attitude in biology" determined that the attitude of the experimental and control groups toward biology and the computer differed significantly in the positive direction; Tavukcu (2008), in her study entitled "The effect of a computer-assisted instruction environment in science instruction on the students' academic achievement, scientific process skills, and the use of the computer" determined that computer-assisted instruction positively affected the attitude toward the computer; Pilli (2008) found that there was a significant difference in the attitude of the students toward computer-assisted learning in favor of the experimental group in his study entitled "The effects of computer-assisted instruction on the achievement, attitudes and retention of 4th grade mathematics course"; Yıldız (2009), in her study entitled "The effect of computer-assisted instruction on the attitude and achievement of 8th grade primary school children in the subjects of geometric objects' surface areas and their volume", reached the conclusion that computer-assisted instruction positively affected the attitudes of the students, and in the experimental study entitled "The effect web-based science instruction on students' achievement and attitude" Şengel & Özden (2009) determined that web-based 7th grade science instruction had a statistically significant effect on the students' attitude toward science. In this study it was also determined that the attitude of primary school 6th grade students toward science and the computer differed significantly in favor of the experimental group.

The findings are in agreement with the results obtained by Geban, Aşkar, & Özkan (1992), Geban et al. (1994), Dinçer (1995), Demircioğlu & Geban (1996), Meyveci (1997), İbiş (1999), Sezgin (2002), Feyzioğlu (2002), Sezgin & Köymen (2002), Akçay (2002), Bayraktar (2002), Bozkuş (2002), Yiğit (2003), Yiğit & Akdeniz (2003), Akçay, Tüysüz, & Feyzioğlu (2003), Çekbaş et al. (2003), Carter (2004), Bussell (2004), Kert (2004), Kıyıcı & Yumuşak (2005), Akgün (2005), Yakar (2005), Başaran (2005), Atam (2006), Olgun (2006), Karataş (2006), Aydoğdu (2006), Demirer (2006), Gönen, Kocakaya & İnan (2006), Bodur (2006), Tekmen (2006), Saka & Akdeniz (2006), Keleş (2007), Akpınar & Ergin (2007), Liao (2007), Sarıçayır (2007), Kara & Kahraman (2008), Akıllı (2008), Kara, Kahraman, & Baştürk (2008), Yakışan (2008), Özel (2008), Pektaş (2008), Pilli (2008), Tavukcu (2008), Birgin, Kutluca, & Gürbüz (2008), Imhanlahimi & Imhanlahimi (2008), Özmen (2008), Teyfur (2009), Yıldız (2009), Karaçöp, Doymuş, Doğan, & Koç (2009), Doğan (2010), Güneş & Çelikler (2010), Emrahoğlu & Sağlıker (2010). On the other hand, the findings of this research partially or completely contradict the results of the studies carried out by Bayraktar (2001), Güler & Sağlam (2002), Alacapınar (2003), Çetin (2007), and Owusu et al. (2010).

Finally, the suggestions deriving from the findings of this research can be presented as follows: This study is limited to the study of "Earth, Sun, Moon" in the science and technology course. Similar research can be carried

out on different topics in different classes. Quantitative and qualitative studies can be carried out on the achievements and problem solving skills of high achievers and low achievers in the other school subjects. The duration of this research was limited to three weeks. In another study, more time should be spared to find out the effectiveness of the experiment. Qualitative studies can be carried with the students who have weak problem solving skills and with those who have strong problem solving skills. Considering the effectiveness of the teaching package used with the experimental group, teachers can be asked to take part in-service training and can be taught how to use the programs such as Macromedia Flash, Macromedia Authorware, Adobe Photoshop. They can be encouraged to develop the computer-based science and technology software. Similar research can be conducted in different primary and secondary classes.

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