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THE EFFECT OF COMPUTER-ASSISTED SCIENCE INSTRUCTION ATTITUDE TOWARDS SCIENCE AND THE COMPUTER

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ABSTRACT
The aim of the study was to investigate the effect of the use of the computer-assisted instruction (CAI) program prepared according to the constructivist approach in the primary school 6th grade level on students' attitude toward science and the computer. The randomized pretest-posttest control group design based on the split-pilot model was used. The study was conducted on 6th grade primary school children who were assigned to experimental and control groups in a primary school in Buca, İzmir, Turkey. In this study the "Attitude Scale toward Science" and the "Attitude Scale toward the Computer" were used as a means of collecting data. T-test, paired-samples t-test, Man-Whitney U test and Wilcoxon Signed-Rank test for paired sample were used for analyses. It was determined that computer-assisted science instruction based on the constructivist method positively affected the attitude of students toward science and the computer and that there was a statistically significant difference in favor of the experimental group.
Key Words: computer-assisted instruction, constructivism, science, computer, attitude, primary school pupil.

INTRODUCTION

Many theories have been proposed to explain the nature of the learning-teaching process. One of these is the theory called the constructivist learning theory, or constructivism. Developed by Wittrock and based on Ausabel's idea that the most important factor affecting learning is the student's knowledge at the time, the constructivist approach is a learning theory which aims to explain how students acquire new information by making use of their prior knowledge, how they form idiosyncratic knowledge and the nature of learning itself (Appleton, 1997). According to this theory, the student compares the newly acquired information with his prior knowledge, reconstructs it and thus gives it meaning to explain the world around him or her. In contrast to the traditional teaching method whereby the teacher is active and the students passive, this model maintains that the student has to be very active (Özmen, 2004). This theory emphasizes the fact that information is individually structured by each learner, that the student does not receive the information reaching him as it is, and that prior knowledge, personal characteristics and the learning atmosphere are of utmost importance.

Science teachers should employ a constructivist approach in their teaching and employ methods. If students perceive that the teacher is activating their prior knowledge, they will be more willing to combine the new information with the old (Stern, 1998). Previous attainments of students should be established. According to the constructivist theory every piece of information is constructed individually. Inasmuch as this individual information constructed by the learner is influenced by previous experience and prior knowledge of the learner, the prior knowledge of the learner should be taken into consideration and studies aiming to determine it should be conducted (Grayson, Anderson & Crossley, 2001).

Colleen (2001) determined the advantages and the effect of the combination of technology and constructivist-based curriculum on students. This study was conducted on a group of 30 students from the 5th grade for two years. The analyses carried out at end of the study revealed that the constructive-based curriculum could be successfully combined with technology. The presentation of teaching materials prepared according to the constructivist approach together with computer technology helps students to create their own knowledge, to develop it, to reach alternative solutions, to learn actively and to develop their problem solving skills. The use of the computer in all areas of learning and teaching is defined as Computer Assisted Instruction (CAI). CAI is a learning style whereby children can learn through computer programs, can monitor their learning and can evaluate themselves (Özmen, 2004).

By providing immediate feedback and creating a learning atmosphere with the use of striking and exciting displays, CAI motivates children to learn. Studies show that the success of children increases when CAI is integrated into the regular teaching system as a supplement. CAI is most effective on children with low success levels, the reason being that computer- assisted education allows the child to learn at his own pace and that it presents alternative learning strategies suitable to the level of the child by personalizing learning. Attitude is the learned tendency to react positively or negatively toward certain objects, situations, institutions, concepts or other people. Attitudes affect the success or the failure of the learning process. While positive attitudes enable students to be more successful, negative attitudes can render them unsuccessful (Gagne, Briggs & Wager, 1992). In fact, various other studies have also revealed that there is a significant correlation between attitude and success. Studies carried out to determine the correlation between attitude toward scientific subjects and success have revealed that a positive attitude toward science increases success and that forming a positive scientific attitude has an effect on the inclination toward science (Martinez, 2002). Liao (2007), in his meta-analysis study conducted in Taiwan in which he compared the results of his 52 different studies determined that computer-assisted instruction has a positive effect on individuals. Studies determined that CAI increased the motivation to learn and enabled individuals to develop a positive attitude. By surveying the literature in the field, it can be seen that the use of the computer in the science and technology classes significantly increases the success and positive attitude of students (İşman, Çağlar, Dabaj, Altınay, & Altınay, 2004; Taş, Köse & Çepni, 2006). Various studies contend that CAI provides a more effective learning atmosphere than do traditional teaching methods like lecturing, question-answer or discussion (Gance, 2002; Carter, 2004; Li & Edmonds, 2005; Aydoğdu, 2006; Hançer & Yalçın, 2007; Liao, 2007; Sarıçayır, 2007; Ragasa, 2008; Lin, 2009).

One of the basic aims of science and technology instruction is to raise individuals who are able to keep abreast with the ever-changing and developing field of science and who are capable of making use of the latest technological inventions in every field. As can be derived from reviewing the literature, it is believed that it will be beneficial to study the results of this new practice, i.e., the combination of computer-assisted instruction conducted with the use of the computer, one of the most developed technologies reported to provide students with a more effective learning atmosphere and the constructivist approach.

Subsequently with this idea, the "CAI based on the constructivist approach" method was developed and applied experimentally within the confines of the study. CAI based on the constructivist approach is a method which keeps the students alert by increasing their motivation and providing a personal learning environment due to its "constructivist approach principles" which claim that the individual construct information actively in his mind.

For this reason, it is necessary to develop and apply CAI material taking the constructivist approach into account. It is for this reason that CAI material was developed and applied in the teaching of "The Cell", a subject in the program of the Science and Technology lesson of 6th grade primary school children in Buca, İzmir.

It was deemed beneficial to investigate the effect of Science education based on the constructivist approach which enables the student to be active, which has an important place among contemporary methods and which supports the use of the computer on the attitude of students toward science and the computer. With this view in mind, an instruction method was developed and administered experimentally by defining a computer-assisted instruction method.

Purpose of the Research

The main purpose of the research was to determine the effectiveness of the computer-assisted science instruction method based on the constructivist approach on the attitude of primary school 6th grade students toward science and the computer.

The Statement of the Problem

Does computer-assisted instruction based on the constructivist approach have an effect on the attitudes of primary school 6th grade students toward science and the computer?

Hypotheses of the Research

In science instruction if an experimental group is given computer-assisted instruction based on the constructivist approach and a control group is given traditional instruction, then

$H_0$1. There is no significant difference between the pretest mean points of attitudes toward science and the computer.

$H_1$2. There is significant difference between the posttest mean points of attitudes toward science and the computer in favor of the control group.

$H_1$3. There is significant difference between the pretest-posttest (level of development) mean points of attitudes toward science and the computer in favor of the control group.

RESEARCH METHODOLOGY

Research Design

The research was an experimental study based on a split-pilot pretest-posttest model aiming to determine the effect of computer-assisted science instruction on the attitude of the students toward science and the computer. The study employed a randomly experimental design with a pretest-posttest group (PPCD). As Büyüköztürk (2006) states, PPCD is a widely used mixed design whereby the participants are measured by means of a pretest-posttest variable regarding the dependent variable. This is a powerful design which gives the researcher a high statistical power in the testing of the effect of the experimental process on the dependent variable, which makes it possible to interpret the findings in a cause and effect context and which is frequently used in behavioral sciences. There was compatibility between the technological facilities of required for computer-assisted instruction and the basic skills of the students to use the computer in the school where the study was conducted.

The Sample

Since an experimental design with a pre-test-posttest control group was employed in this research, instead of choosing a sample from a population, a work group was defined. As Büyüköztürk (2006) states, the suitability of the sample for the purpose is important in experimental research. The sample consisted of 6th grade primary school children who were assigned to experimental (N=22) and control (N=21) groups in a primary school in Buca, a district of İzmir, Turkey. Their lesson was Science and Technology and the topic, “the cell”.

Table 1. Demographic information about the research groups.

Groups	Gender	Frequency	Percent %
Experimental	Female	10	45.5
	Male	12	54.5
	Total	22	100.0
Control	Female	10	47.6
	Male	11	52.4
	Total	21	100.0

Data Collection Instruments

In this study the "Attitude Scale toward Science" developed by Gürdal (1997) with a Cronbach alpha reliability coefficient of .82 and the "General Attitude Scale toward the Computer" developed by Reece and Gable, and adapted to Turkish by Yaşar (1992) with a Cronbach alpha reliability coefficient of .95 were used as a means of collecting data. The high scores gotten from both scales show positive approach and perception and the low scores show negative approach and perception.

Application

This study was conducted over a period of four weeks. In order to test whether there wass a statistically significant difference between the experimental and control groups the Attitude Scale toward Science and General Attitude Scale toward the Computer were used before the application as a pretest and as a posttest after the application in order to compare the level of development the groups attained. In the study, the control group was administered a traditional instruction method. The subject was taught by the teacher and diagrams were drawn on the board. The lesson was conducted with question-asking and discussions. The same period of time was allocated to the experimental group. For the experimental group the "Computer-Assisted Instruction Program Based on the Constructivist Approach" was used to teach "The Cell". In this program the aim was to attain a more effective and retentive instruction by making use of technology. Interactive instruction was achieved by means of slides, CD's, animations and video.

Data Analysis

The SPSS 12.0 package program was used in the statistical analysis of the data. Due to the suggestion that the results of the Shapiro-Wilk test be taken into consideration instead of the Kolmogorov-Sminorov test since the number of participants was less than 50, the Shapiro-Wilk test was used to test whether the data obtained from the attitude scale to science and he computer displayed a normal distribution (Coakes & Steed, 1997; Tabachnick & Fidell, 2000). Since the statistical hypothesis (null) in the Shapiro-Wilk test is formed as "the distribution of the points not significantly different from the normal distribution", the interpretation was that the scores did not display a significant diversion when the calculated p value turned out to be higher than .05 (Büyüköztürk, 2006). When the results of the Shapiro-Wilk test were taken into consideration, a t-test and a paired samples t-test were used for data displaying normal distribution. Among the non-parametric tests, the Mann-Whitney U test and Wilcoxon Signed-Rank Test for Paired Data were used in order to determine the significance of the difference between the attitude scores of the experimental and control groups. The statistical significance level in the study was accepted as .05.

RESULTS

In order to compare the scores obtained from "Attitude toward Science" and "Attitude toward the Computer" the constant variables of the study, the Shapiro-Wilk test were used to see whether the variables were suitable for normal distribution. As a result of the analysis, it was determined that $\text{Shapiro-Wilk}_{\text{Attitude Pre-test toward Science}}$=0,964 Standard Deviation (SD)=43 p=.201; $\text{Shapiro-Wilk}_{\text{Attitude Post-test toward Science}}$=.952 SD=43 p=.070; $\text{Shapiro-Wilk}_{\text{Attitude Pretest toward the Computer}}$=.883 SD=43 p=.000; $\text{Shapiro-Wilk}_{\text{Attitude Posttest toward the Computer}}$=.761 SD=43 p=.000. It was determined that the attitude scores

toward science displayed a normal distribution while the attitude scores toward the computer did not display a normal distribution.

Findings Regarding the Hypothesis One Results

Before the study commenced, the scale toward science and the computer was given as a pretest both to the group that was given computer-assisted science instruction based on the constructivist approach and to the group that was not. In the experimental group (N=22) and in the control group (N=21) that were given computer-assisted instruction based on the constructivist approach, the arithmetic mean of the attitude toward science and the computer scores the students got from the pretest was found to be $\bar{x}_{\text{Experiment Science Attitude}}$=111.730; $\bar{x}_{\text{Control Science Attitude}}$=118.570; $\bar{x}_{\text{Control Computer Attitude}}$=63.227 and $\bar{x}_{\text{Control Computer Attitude}}$=66.142 (See Table 2 and Table 3) Whether the difference between the attitudes of the groups toward science and the computer was significant or not was verified with a t test and a Mann Whitney U test. It was determined that there was not a statistically significant difference between the pretest attitude scores in either group ($t_{\text{Science Attitude Posttest}}$=1.086 p>.05; Mann Whitney $U_{\text{Computer Attitude Pretest}}$=151.500 p>.05). That there is no significant difference between the pretest score means shows that both groups were similar before the experiment and that the starting conditions were the same for the experimental and control groups.

Table 2. Independent groups t-test result of the pretest attitude scores of the experimental and control groups toward science

	Groups	N	$\bar{x}$	SD	df	t	p
Pretest	Experimental	22	111.730	16.163	41	1.086	.284
	Control	21	118.570	24.510			

Table 3. Mann-Whitney U test result of the pretest attitude scores of the experimental and control groups toward the computer

	Groups	N	Mean Rank	Sum of Ranks	U	p
Pretest	Experimental	22	18.39	404.50	151.500	.053
	Control	21	25.79	541.50		

Findings Regarding the Hypothesis Two Results

The arithmetic mean of the attitude toward science and the computer posttest scores of the experimental and control groups was found to be $\bar{x}_{\text{Experiment Science Attitude}}$=124.000 and in the control group $\bar{x}_{\text{Control Science Attitude}}$=123.619; $\bar{x}_{\text{Experiment Computer Attitude}}$=70.409 and in the control group $\bar{x}_{\text{Control Computer Attitude}}$=68.047 (See Table 4 and Table 7).

Table 4. Independent groups t-test result of the posttest attitude scores of the experimental and control groups toward science

Groups		N	$\bar{x}$	SD	df	t	p
Posttest	Experimental	22	124.000	16.477	41	.081	.936
	Control	21	123.619	14.217			

Whether the difference between the attitudes of the groups toward science and the computer was significant or not was verified with a t test and a Mann Whitney U test. It was determined that there was not a statistically significant difference between the pretest attitude scores in either group ($t_{\text{Science Attitude Posttest}}$=.081 p>.05; Mann Whitney $U_{\text{Computer Attitude Pretest}}$=181.500 p>.05).

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Table 5. Mann-Whitney U test result of the posttest attitude scores of the experimental and control groups toward the computer

Groups		N	Mean Rank	Sum of Ranks	U	p
Posttest	Experimental	22	24.25	533.50	181.500	.219
	Control	21	19.64	412.50		

Findings Regarding the Hypothesis Three Results

The arithmetic mean of the level of development (Pretest-Posttest) of the experiment and control group students was found to be $\bar{x}_{\text{Experiment Science Development}}$= 12.270 and $\bar{x}_{\text{Control Science Development}}$=5.047 and $\bar{x}_{\text{Experiment Computer Development}}$=7.182 and $\bar{x}_{\text{Control Computer Development}}$=1.905.

Table 6. Paired samples t-test result of the pretest-posttest (level of development) attitude points of the experimental and control groups toward science

Groups Pretest-Posttest (Level of Development)		N	$\bar{x}$	SD	df	t	p
Experimental	Pretest	22	111.730	16.163	21	3.538	*.002
	Posttest	22	124.000	16.477			
Control	Pretest	21	118.570	24.510	20	1.480	.155
	Posttest	21	123.619	14.217			

* The mean difference is significant at the .05 level.

Whether the difference between the attitudes of the groups toward science was significant or not was verified with a t test and Wilcoxon Signed-Rank Test for Paired Samples. It was determined that there was a statistically significant difference between the mean development scores of the two groups in favor of the experimental group ($t_{\text{Experimental Science Attitude Development}}$=3.538 p<.05; $t_{\text{Control Science Attitude Development}}$=1.480 p>.05 See Table 6).

Table 7. Descriptive statistics of the pretest-posttest (level of development) attitude points of the experimental and control groups toward the computer

Groups		N	$\bar{x}$	SD	Min.	Max.
Experimental	Pretest	22	63.227	6.553	48.00	72.00
	Posttest	22	70.409	2.403	65.00	75.00
Control	Pretest	21	66.142	7.087	46.00	72.00
	Posttest	21	68.047	5.248	56.00	72.00

Whether the difference between the attitudes of the groups toward the computer was significant or not was verified with a t test and Wilcoxon Signed-Rank Test for Paired Samples. It was determined that there was a statistically significant difference between the mean development scores of the two groups in favor of the experimental group ($Z_{\text{Experimental Computer Attitude Development}}$=3.855 p<.05; $Z_{\text{Control Computer Attitude Development}}$=.818 p<.05 See Table 8).

Table 8. Wilcoxon signed-ranks test result of the pretest-posttest (level of development) attitude points of the control and experimental groups toward the computer

Pretest-Posttest (Level of Development)		N	Mean Rank	Sum of Ranks	z	p
Experimental	Negative Ranks	2	4.00	8.00	**3.855	*.000
	Positive Ranks	20	12.25	245.00		
	Ties	0	-	-		
	Total	22	-	-		
Control	Negative Ranks	9	10.22	92.00	.818	.413
	Positive Ranks	12	11.58	139.00		
	Ties	0	-	-		
	Total	21	-	-		

* The mean difference is significant at the .05 level.
**Based on negative ranks

DISCUSSION AND SUGGESTIONS

As a result of the study, it was determined that computer-assisted science instruction based on the constructivist approach affected the attitude of the students toward science and the computer positively and that there was a statistically significant difference between the mean attitude toward science and the computer development points in favor of the experimental group.

The results of the study conducted by Knezek, Christensen & Rice (1997) in south Texas whereby six weeks of computer-assisted science instruction was provided determined that having computer experience had an important effect on the attitude toward the computer, that working with the computer and being given instruction decreased computer anxiety and that it enabled the acquisition of a positive attitude toward the computer. In Meyveci's study entitled "The effect of computer-assisted physics instruction on the achievement of the student and the attitude of the student toward the computer" Meyveci (1997) arrived at the conclusion that scores for attitude toward the computer of the students given computer-assisted physics instruction were higher than those of the students given traditional instruction. In Feyzioğlu's experimental study with high-school students, Feyzioğlu (2002) concluded that there was a positive change in student attitude toward chemistry in the students to whom the Internet based teaching method was applied. In a study conducted with 8th grade primary school children, Akçay, Tüysüz & Feyzioğlu (2003) determined that the computer-assisted program had a positive effect on the attitude of the students toward science and the computer in favor of the experimental group. In Yenice's study conducted to pinpoint the effect of computer-assisted science instruction on the attitude of the students toward science and the computer, Yenice (2003) determined that computer-assisted science instruction positively affected the attitude of the students toward science and the computer. She found significant correlations between the period of computer use and the attitude toward the computer. As a result of the experimental study entitled "The effects of computer-assisted english instruction on high-school preparatory students' attitudes toward computers and english" Ateş, Altunay & Altun (2006) determined that computer-assisted English instruction significantly increased the attitude scores of the students toward the computer. Olgun's (2006) 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. Demirer (2006), in her study entitled "The effect of the computer-assisted intruction method (CAI) and the traditional teaching method on

students' academic achievement and their attitude toward science and the permanence of the acquired behaviors", determined that the CAI 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 CAI method on the attitude of the students was significantly higher in comparison to the traditional methods. Hançer & Yalçın (2007) reached the conclusion that there was a significant difference in favor of the experiment group in their study entitled "The effect of computer-assisted learning based on the constructivist approach in science on the attitude toward the computer". 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. Boyraz (2008) in her study entitled "The effects of computer based instruction on 7th grade students' spatial ability, attitudes toward geometry, mathematics and technology" determined that there was a statistically significant difference between the groups regarding their scores from the geometry, mathematics and technology attitude scales in favor of the experimental group. 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". 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. Teyfur (2009) in her study entitled "The effect of computer-aided learning on student achievement and their attitude toward the 9th grade geography lesson" determined that the computer-assisted geography lesson affected the attitude of the students toward the geography lesson more positively than did the traditional geography lesson. 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. 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. These results of this study on computer-assisted instruction based on the constructivist approach are consistent with the findings of these other studies mentioned above. The results of this study on computer-assisted instruction based on the constructivist approach are not consistent with the findings of other some studies. Yet, when all the studies are analyzed, it is seen that they relatively support the result of the present study from the point of view that computer-assisted applications do increase success in general. It can be understood from the results of this study conducted on computer-assisted instruction based on the constructivist approach and from literature on this topic that one of the most important factors enabling the positive development of the students' attitude toward the computer is the active use of the computer in class. Therefore, it was determined that the computer-assisted learning method based on the constructivist approach whereby students can be active and can better express themselves has an important effect; the increase in the scores of students' attitudes toward the computer and science. There is a significant difference in the mean value of the pre-test attitudes and the post-test attitudes in the Science and Technology and the topic "the cell" between the computer-assisted science instruction based on the constructivist approach applied group and conventional training approach applied group. Thus, it can be said that computer-assisted science and technology instruction based on

the constructivist approach is more effective than conventional instruction in developing the attitude of the 6th grade primary school children toward science and the computer. As a result, the applications of the computer-assisted science instruction based on the constructivist approach were effective.

The suggestions can be given according to these research results,

1. Considering the fact that the study was limited to a brief four week period, the long-term effects of the study should be further investigated.
2. During in-service training, teachers should be encouraged to further develop software in science and technology by teaching teachers to use programs for preparing computer-assisted instruction such as Macromedia Flash, Macromedia Authorware, and Adobe Photoshop.
3. More research can be done on the effect of the computer-assisted science and technology instruction based on the constructivist approach on the success of students.
4. Similar research should be conducted in other primary and middle school classes.

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