THE EFFECT OF THE COMPUTER ASSISTED TEACHING AND 7E MODEL OF THE CONSTRUCTIVIST LEARNING METHODS ON THE ACHIEVEMENTS AND ATTITUDES OF HIGH SCHOOL STUDENTS

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ABSTRACT
This study provides a comparative effect study of the Computer Assisted Teaching and the 7E model of the Constructivist Learning methods on attitudes and achievements of the students in physics classes. The experiments have been carried out in a private high school in Diyarbakır/Turkey on groups of first year students whose pre-test scores of achievements and attitudes show no statistically significant difference. One of the groups received computer assisted, and the other were given instructions based on 7E model of the constructive learning method. An achievement test consisting of 29 multi-choice questions related to subject of electrostatics has been carried out to compare the group's achievements. A statistical analysis of achievement tests showed a significant difference between the students achievements at the knowledge and comprehension levels of cognitive domain (P<,05). On the other hand no difference was noted between their achievements at the application level of cognitive domain. To determine the effect of the instruction methods on the student's attitudes towards the physics course, a physics attitude scale was applied to both groups. The results have indicated that the student's attitudes towards physics learning were not affected by different instruction methods.
Keywords: Physics education, attitude, computer assisted teaching, 7E model.

BİLGİSAYAR DESTEKLİ ÖĞRETİM İLE BÜTÜNLEŞTİRİCİ ÖĞRETİMİN 7E MODELİNİN LİSE ÖĞRENCİLERİNİN BAŞARI VE TUTUMLARINA ETKİSİ

ÖZET
Bu çalışmada Bilgisayar Destekli Öğretim ile Bütünleştirici Öğretimin 7E modelinin öğrencilerin fizik başarı ve tutumlarına etkisi karşılaştırmalı olarak incelenmiştir. Bu amaçla çalışma Diyarbakır ilindeki özel bir lisenin 1. sınıfında okuyan kontrol ve deney grupları üzerinde gerçekleştirildi. Gruplar, başarı ve tutum ön-test sonuçları arasında istatistiksel açıdan anlamlı bir fark bulunmayan iki şubenin öğrencilerinden seçildi. Gruplardan deney grubuna Bilgisayar Destekli Öğretim, kontrol grubuna ise bütünleştirici öğretimin 7E modeline göre ders işlendi. Grupların başarılarını karşılaştırmak amacıyla elektrostatik konusunda hazırlanmış çoktan seçmeli 29 sorudan oluşan bir başarı testi uygulandı. Başarı testinin istatistiksel analizi sonucunda bilişsel alanın bilgi ve kavrama düzeylerinde öğrencilerin başarıları arasında anlamlı bir fark bulundu (P<,05). Bununla birlikte, bilişsel alanın uygulama basamağında öğrencilerin başarıları arasında fark bulunmadı. Uygulanan öğretim yöntemlerinin öğrencilerin fizik dersine yönelik tutumlarına etkisini belirlemek için bir fizik tutum ölçeği uygulandı. Elde edilen sonuçlar öğrencilerin fiziğe karşı tutumlarının öğretim yöntemlerinden etkilenmediğini gösterdi.
Anahtar kelimeler: Fizik eğitimi, tutum, bilgisayar destekli öğretim, 7E model.

INTRODUCTION

Recent advances in science and technology have changed the structure and the education systems of societies. The increasing importance of skilled person not only to use knowledge but to be a producer of knowledge puts additional responsibilities on the educators of science (Akkoyunlu, 1996). A glance at the system of education in this country would reveal a picture of generally inward looking setup, limited to a classroom environment with a teacher and group of students, a subject book, a desk and a blackboard (Başaran, 1993). It is generally known that physics, chemistry and biology have many theoretical concepts that are difficult to understand by students, and have misconceptions about. It is also known that students do not or rarely link the knowledge gained from those sciences to their daily life (Ayas & Özmen, 1998; Kadıoğlu, 1996; Özmen, İbrahimoğlu & Ayas, 2000). In many of these cases it was stated that in education and learning process inadequate traditional education system and the existing educational materials are neither helping the solution of the existing problems nor assisting in the development of conceptual learning (Şahin & Parim, 2002; Saka & Cerrah, 2004). Due to its positive effect to increase the attention and curiosity of students, and the helps that provides in the conceptual learning, the use of computers in education is spreading widely. In addition, because most of the knowledge related to natural phenomenon is now available in the computer environment. That is why, when teachers use computers as a teaching tool, this would give them the ability to show the physical phenomenon in a way that students can visualize in a three dimensional form (Soylu & İbiş,1998). It is known that the sense organs are used in

education; the more efficient education can be achieved. (Kaptan, 1998). The visually observing the subject under study would help the students to consolidate the knowledge gained and finds ways to link this to their surroundings. The computer environments provide a platform to apply the knowledge in a given situation, and their interactions results in the discovery of new knowledge that will help cognitive domain development and the accumulation of knowledge (Akpınar 1999). Students do not take the knowledge as is given to them by teachers, but rather they do restructure that knowledge themselves (Bodner, 1986, 1990). If computers are used effectively in this restructuring process, teachers can use them as a teaching tool. Many studies showed that during teaching process computer assisted applications aid the consolidation of attitudes and the restructuring of the knowledge by students themselves (Akpınar, 1999; Arı & Bayhan 1999; Baki, 2002; Saka & Akdeniz, 2006).

The constructivist learning has been presented as a method that assists the teaching process. In constructivist learning method (Vygotsky, 1982 & 1998); the subject is generally presented to the student with a problem. With this, the students use the existing knowledge to solve problems. In recent years many reforms in science and mathematics teaching are largely based on the constructivist learning method. In an application of the constructivist learning method, for a meaningful learning to occur, a suitable learning environment need to be provided to students to develop their own knowledge through testing their own experience (Çepni, Akdeniz & Keser, 2000; Özmen, 2004).

In the constructivist learning, development in cognition and improvement in conceptualization depends on the process used to internalize the knowledge. As a result all learning is a process of discovery. Many researchers indicated that learning concepts in a meaningful way, the use of the multi-dimensional environment, more importantly simulations containing multi-dimensional environments, are far more powerful than those classical learning methods (Hewson, 1985; Novak, Gowin & Johansen, 1983; Thornton & Sokoloff, 1990, 1998; Saka & Akdeniz, 2006). Use of multi-dimensional environments in instruction applications would help improve motivation of the students, and by visualizing the physical and chemical processes, improves the understanding of the concepts (Trindade, Fiolhais & Almeida, 2002; Yiğit, 2004). The misconceptions developed during learning theoretical concepts in physics would negatively effect on the later years' knowledge developments. For that reason, persisting misconceptions causes many problem in cognitive process (Üstüner & Sancar, 1999). This in mind, in 2005, the primary education science classes have been replaced with "science and technology" classes. In science and technology classes four staged and 5E model of constructivist learning method have been introduced (Ayas et al., 2005). To test the success of the model, the 7E model - a higher model than 5E (Çepni et al., 2001) has been used with the reference group in this study. To find out the success level of the model without computer assisted teaching, the experiment group in the study has been instructed using the computer assisted teaching method, and the results have been contrasted with that obtained from the application of model 7E of the constructivist learning method.

To enable a meaningful comparison, "electrostatics" topic was selected for instructions, for it is being conceptually hard to understand and in the same time suitable for simulation in computer environment. One of the hardest area of the electrostatics for students is the difficulty to visualize the electrical forces and the related mathematical terms such as ($F \sim 1/r^2$) (Scott & Risley, 1999). They have also problem in visualizing the movement and the direction of an electrical charge (positive or negative) in an electrical field. By providing such programs to students, it was aimed to help better understand the electrical processes without entirely depending on the mathematical definitions.

AIM

The aim of this study was to determine whether there are any statistical differences in the level of achievements and in the attitudes when one group of students received instruction in electrostatics according to the computer assisted method and the other with 7E model of constructivist learning.

METHOD

This study employed test-retest method with reference group model to contrast the group's success levels.

Sample: The study was conducted on 33 first year students of a private high school in Diyarbakir. 19 students of those were chosen as the experiment group and the other 14 as the reference group.

Data collection instruments: For data collection, a test consisting of 29 multi choice questions and each item in the test was scored "1" point when responded truly. Thus, maximum score of the test was limited to 29. In addition, a Likert type 5 level physics attitudes scale with 24 suggestions were used.

The questions in the achievement test were selected from 40 questions following expert's advice on the basis of level of difficulty and the indexes of defined differences. 29 questions included in the test were grouped according to Bloom taxonomy on cognitive domain's knowledge, comprehension and application levels. In the

test, 8 questions are of the knowledge, 14 comprehension and the remaining 7 are of the application levels. The reliability constant of the test has been determined according to Spearman-Brown's method of division of the test to two equivalent halves (α=0,72). To determine the attitude towards physics classes, an attitudes scale developed by Maskan & Güler (2004) has been used. The Cronbach-Alpha internal consistency constant of the attitudes scale used in the study has been determined as α=0,81.

The experiment and the analysis of the data: The data subjected to analysis belongs to two groups with no statistically meaningful differences in their preliminary tests. For both groups, instructions were carried out by same teacher.
During the experiments any data related to students who did not attend all activities, has been excluded from further analysis. As a result although the experiment has originally commenced with a total of 42 students, only 33 of those students' data have been included in the analysis. 19 of these students were given computer assisted teaching, the remaining 14 students received instructions that were based on the 7E model of constructivist learning. In the classroom in which computer-assisted teaching (CAT) was applied, a computer was given to two students, and thereby the interaction between them was provide at the same time. Then, the teacher demonstrated to students how to use software programs related to physics topics, and after several applications, the students were allowed to study by themselves. In addition, they were assisted by teacher when they had any difficulties. In the class-rooms where 7E model was applied, however, the activities were performed in guidance of the teacher by considering the stages in the model.

The study has been carried out over duration of three weeks. Before the commencement of the experiment, a physics attitude scale and the electrostatics preliminary achievement tests were conducted on all of the first year classes. From those, only two classes that did not show any meaningful statistical differences with regard to achievement and attitudes were selected for further study. In one of the classes, the 7E model of constructivists learning and in the other computer assisted instruction were given. Selection of the class for the type of the instruction was selected randomly. The computer assisted instruction group was given pre prepared flash animations, java scripts and presentation programs related to "electrostatics", while the other group received instructions on the same topic in accordance with the 7E model of constructivist learning levels. The software programs used in CAT were downloaded from the sites including qualified software programs concerning physics topics (www.lisefizik.com, http://webphysics.davidson.edu). These downloaded software programs were examined by two physics educators and one computer and instructional technologist, in order to determine whether those programs are suitable to aim of research, or not. At the end of examination, the software programs suggested by the experts were used in the instruction process.

When the instructions have been completed, a final achievement test has been carried out and repeated the attitude test. A SPSS package program has been utilized in the investigation to determine any significant differences between the preliminary and the final tests.

RESULTS AND DISCUSSION
The data collected has been presented here in accordance with the aim of this study. To determine whether there are any differences between two groups in regard to achievements in physics classes and the attitudes, the data has been subjected to t-test analysis. The result of the analysis is provided in the Table 1.

Table 1: Analysis of the pre-test results of the computer assisted and constructivist learning groups

Variance source	Instruction Method	f	$\overline{X}$	Standard Deviation	df	P	t
Knowledge level	CAT	19	3,26	1,485	31	,165	1,422
	7E	14	2,57				
Comprehension Level	CAT	19	4,53	2,245		,433	,794
	7E	14	3,93				
Application Level	CAT	19	1,00	,816		,458	-,751
	7E	14	1,21				
Total Score	CAT	19	8,79	3,326		,319	1,012
	7E	14	7,71				
Physics Attitude Score	CAT	19	3,90	,495		,363	,923
	7E	14	3,73				

P> ,05
CAT: Computer assisted teaching
7E : 7E model of constructivist learning

According to the data in the Table 1, there is no meaningful difference between two students groups regarding preliminary tests scores. As a result, it can be concluded that, based on the preliminary achievements and the attitudes, these two groups are equivalent.

To determine whether there are any differences between two groups based on the results of the final achievement and the attitudes tests, the collected data has been subjected to t-test analysis. The results of the analysis of the final tests have been provided in the Table 2.

Table 2: Analysis of the post-tests data of the computer assisted and constructivist learning groups

Variance source	Instruction Method	f	$\overline{X}$	Standard Deviation	df	P	t
Knowledge Level	CAT	19	5,00	,943	31	,026*	2,334
	7E	14	4,14				
Comprehension Level	CAT	19	7,84	1,500		,023*	2,399
	7E	14	6,36				
Application Level	CAT	19	1,68	,820		,463	-,743
	7E	14	1,93				
Total Score	CAT	19	14,53	1,467		,032*	2,245
	7E	14	12,43				
Physics Attitude Score	CAT	19	3,80	,5918		,701	-,388
	7E	14	3,87				

* P< ,05

There are some differences in the result of the final achievement tests between students of computer assisted and the constructivist learning groups in the area of knowledge, comprehension levels and in general achievements. But in the application level no meaningful differences have been recorded between these two groups (Table 2). This result has indicated that both of the teaching methods have equal effects in acquiring behaviors at the application level of Bloom's Taxonomy. In CAT applications, the students can construct different problem situations on computer by using the software programs concerning physics topics, and they can see differences about results by changing variables. Thus, they can construct cause-effect-relationship on their mind. In this point of view, students' practicing on physics subjects and seeing cause-effect-relationship among the physics concepts on the computer may be maintained as a process of constructing knowledge. Similarly, while taking into consideration the stages of 7E model, the students take concepts and relationship among concepts that form problem situations by handling them step by step in mental process, and try to get result. It is thought that there is no linear relationship between knowledge-comprehension and comprehension-application levels although gains in application level based-on gains of knowledge and comprehension levels. Therefore, it can be expected that both methods contribute equally to students' understandings at the application level of Bloom Taxonomy.

It is noted that the level of knowledge and the comprehension of the students of the computer assisted teaching instruction group has been higher as it was reflected in their better responses to tests questions. This is in line with the findings reported by other studies (Saka & Yılmaz, 2005; Ayvacı, Özsevgeç & Aydın, 2004; Zele et al.., 2003; Savelsbergh et al.., 2000). It is widely reported that the computer assisted teaching effects positively on the level of success in all education levels (Başaran, 2005; Büyükkasap et al., 1998).

Table 3 provides the correlations between the achievements and the attitudes of the students toward physics courses.

Table 3. Correlations between achievements and attitudes of students toward physics courses

		Post-test knowledge level	Post-test Comprehension level	Post-test Application Level	Post-test Total Score
Attitudes	Pearson Correlation	-,155	-,050	-,322	-,201
	P	,389	,783	,068	,263
	N	33	33	33	33

No correlation has been found between the achievements in physics and the attitudes towards physics courses (Table 3). Maskan and Guler's (2004) study showed that the students' attitudes do not relate to the method of instruction given. It was also stated by many other researchers that the attitudes of students towards courses cannot be changed in a short period (Hacıoğlu & Ulu, 2003; Hardal & Eryılmaz, 2004).

CONCLUSIONS

This study has shown that instructions provided following both the computer assisted and the constructivist learning methods have assisted in increasing the level of understanding of the concepts related to electrostatics. The results of the final achievement tests have shown that students belonging to computer assisted instruction group are better than the constructive learning instruction group in the area of knowledge and comprehension levels, and the difference between the two groups was found to be meaningful ($P<0,05$). Based on the responses provided to cognitive domain questions, the two groups of students have not shown any meaningful differences in the level of achievement related to the application level of the cognition domain. This has indicated that the computer assisted teaching knowledge and cognition levels are more effective that the 7E model. However, when the final attitudes tests are considered there are no basic differences between these two instruction methods.

Based on the result of this study it can be suggested that; for physics students, there is a need to determine the existing misconceptions in various areas of physics and lead those students to design and develop suitable computer assisted material. The use of new technologies should be encouraged in the application of the 7E model of constructivist learning and the students should be supported with the new technologies in physics classes to ensure a better quality of learning. As it is considered, it is necessary but not adequate to utilize the various version of the constructivist learning theory such as four staged, 5E and 7E models, the computer technologies in a larger scales should be introduced to the education system to help students to interact on one to one basis, develop skills of self learning and better use of the new technologies. Physics teachers should be educated to be familiar with the constructivist learning and skilled in working with the new technologies to enable them to develop simulations and software animations for use in a learning environment. It is further suggested that more research should be carried out on applications of the constructivist learning method in various areas of physics.

The conclusions reached in this study, as no doubt, have been limited by the sampling presented. Further work would contribute to a better understanding of the subject and help to its wider applicability.

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