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THE EFFECTS OF COMPUTER-ASSISTED INSTRUCTION DESIGNED ACCORDING TO 7E MODEL OF CONSTRUCTIVIST LEARNING ON PHYSICS STUDENT TEACHERS' ACHIEVEMENT, CONCEPT LEARNING, SELF-EFFICACY PERCEPTIONS AND ATTITUDES *

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ABSTRACT

The purpose of this study was to investigate the effects of a Computer-Assisted Instruction designed according to 7E model of constructivist learning(CAI7E) related to "electrostatic" topic on physics student teachers' cognitive development, misconceptions, self-efficacy perceptions and attitudes. The study was conducted in 2006–2007 academic year and was carried out in three different classes taught by the same teacher, in which there were 79 2nd, 3rd and 4th grade university students, in central city of Diyarbakır in Turkey. An experimental research design including the electrostatic achievement test (EAT), the electrostatic concept test (ECT), physics attitude scale (PAS) and self-efficacy perception scale (SEPS) was applied at the beginning and at the end of the research as pre-test and post-test. After the treatment, general achievement in EAT increased (P<0.05), but not all of subgroup. Difference between pre-test and post-test both knowledge and application levels of cognitive domain was found significant (P<0.05), but not in comprehension level. This result showed that using CAI7E in teaching electrostatic topic was very effective for physics student teachers already learned this topic in several physics course to reach knowledge and application levels of cognitive domain. Analysis of electrostatic concept test (ECT); CAI7E changed students' misconceptions related to electrostatic and electric field positively (P<0.05) and additionally change was found in SEPS (P<0.05). It was also found out that there was no change about students' attitudes towards physics (P>0.05).

Keywords: **Evaluation methodologies, improving classroom teaching, interactive learning environments, simulations; teaching/learning strategies.**

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INTRODUCTION

Recent advances in science and technology have changed the structure and the education systems of societies. The characteristic 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 be understood 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 and Özmen, 1998; Kadıoğlu, 1996; Özmen, İbrahimoğlu and Ayas, 2000). The students' conceptions, which may not be defined as scientific are named as ''misconception'', ''alternative conception'', ''naive theories'', and ''children science'' in the literature (Barker and Carr, 1989; Simpson and Arnold, 1982; Treagust, 1988). 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 and Parim, 2002; Saka and 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 will give them the ability to show the physical phenomenon in a way that students can visualize in a three dimensional form (Çepni, Ayas, Johnson and Turgut 1997; Soylu and İbiş,1998).

The constructivist learning has been presented as a method that assists the teaching process. In constructivist learning method; 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 and Keser, 2000; Özmen, 2004; Vygotsky, 1982 and 1998).

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 and Johansen, 1983; Thornton and Sokoloff, 1990, 1998; Saka and Akdeniz, 2006, Gönen, Kocakaya and İnan, 2006).

Using 7E constructivist model: excite, explore, explain, expand, extend, exchange, and examine, teachers are better able to articulate their educational purpose for their selection and defend the appropriateness of the chosen technology. Another advantage of incorporating the use of the 7E model is best summarized in the quote below.

The 7E model is based on a constructivist philosophy of learning. The theory of constructivism encourages educators to focus on making connections between facts that are required and tailoring instructional strategies that allow students to actively construct meaning and foster understanding of objectives. Effective use of technology is the perfect instrument to achieve this goal. Analyses of quantitative data obtained in this study that performed on effectiveness of method will be handled subsequently.

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 (Ferguson and Chapmen,1993; Coye and Stonebraker, 1994; Tjaden and Martin, 1995; Rowe and Gregor, 1999; Akpınar, 1999; Arı and Bayhan 1999; Tsai, 2000; Chang, 2001; Lee, 2001; Tsai and Chou, 2002; Baki, 2002; Powell, Aeby and Carpenter-Aeby, 2003; Saka and Akdeniz, 2006). In addition, it is reported that student abilities and skills in scientific investigations are affected positively by Computer-assisted instruction (CAI) (Shute and Bonar, 1986; Bayraktar, 2000). Moreover, it is also stated that the using computers makes students feel confident and helps them to discover interactions among the components of a complex system (Ramjus, 1990).

On the other hand, some researchers advocate that the traditional learning method is more useful than CAI in science teaching (Wainwright, 1989; Morrell, 1992). They argued that the use of computers negatively influences the students' attitudes and achievement in the teaching-learning process. Other researchers did not find an important difference between the methods (Coye and Stonebraker, 1994; Tjaden and Martin, 1995). However, it was reported that CAI has some advantages in developing students' abilities on making synthesis and evaluation (Baki, 2000). If CAI materials are developed and implemented in an effective way, students' achievement and motivation increase in science lessons (Şahin and Yıldırım, 1999; Lee, 2001). In addition, the computer is being increasingly used for educational purpose and has had a considerable effect on learning and instructional practice. Teachers should have the necessary computer skills, and self-efficacy beliefs to improve the learning capacity of their students. Bandura (1977, 1997) formally defined perceived self efficacy as personal judgments of one's capabilities to organized and execute courses of action to attain designated goals and he sough to asses its level, generality and strength across activities and contexts. Also, Bandura (1986) defined that self-efficacy refers to perceptions one's capabilities to organize and implement actions necessary to attain designated performance of skill for specific task. Students' self-efficacy beliefs are responsive to change instructional experience and play a causal role in students' development and use of academic competencies (Zimmerman, 2000).

Student's attitudes towards physics are influenced by expectations of society. Expectations of society, student's values and being an indicator of success compose pressure on students. Kloosterman (1996) in his research says problem solving also a big factor for students. Students meet a lot of problems at the process of learning physics. Students' learning processes are influenced by their beliefs; other scholars have investigated the motivational and volitional relevance of students' beliefs. Attitude was explained by Allport (1954), as "The term itself may not be indispensable but what it stands for is" (p. 45). Even if one's behavioral intentions and subsequently behavior, and the relative personal importance of attitudinal and normative considerations, a pedagogical approach that even consider student's attitudinal interrelationships may provide promise toward positively enhancing science-related attitudes. Ajzen (1989) expanded the theory of reasoned action to the prediction of behavioral goals in his theory of planned behavior.

Based on this model, many researchers have examined attitudes by studying the variables that influence it or by examining its relationship to a specific behavioral goal such as achievement (Albert, Aschenbrenner, and Schamolhover, 1989).

In this study, We investigated effects of a Computer-Assisted Instruction designed according to 7E model of constructivist learning (CAI7E) related to ''electrostatic'' topic on physics student teachers' cognitive development, misconceptions, self-efficacy perceptions and attitudes toward physics lessons. 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 and 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 simulation to students, it was aimed to help better understand the electrical processes without entirely depending on the mathematical definitions. Simulations such as used can provide valuable help to students in visualizing and interacting with electrostatic phenomena. However, ensuring that students work on them effectively either inside or outside of class can be a daunting task for an instructor, as well as the logistics of outfitting a computer laboratory with these simulations. A solution to this problem is to use the World Wide Web and Java applets. Students can use any computer with an Internet connection from http://webphysics.davidson.edu, www.lisefizik.com, www.falstad.com, www.ltu.edu, and etc.

AIM

The aim of this study was to investigate the effects of a Computer-Assisted Instruction designed according to 7E model of constructivist learning (CAI7E) related to ''electrostatic'' topic on physics student teachers' cognitive development, misconceptions, self-efficacy perceptions and attitudes toward physics lessons. Physics student teacher had already learned this topic in many physics course, but it was observed that they still have some misconceptions. For that reason present study aimed to reveal, which method/s or mixed method/s can provide to solve this problems.

MATERIAL AND METHOD

The steps below were followed during the development process of CAI7E:

LESSON PLAN

For this experiment four lesson plans designed according to 7E model applied during eight hours were developed. The first one related to basic electrostatic concepts, the others are respectively related to conductivity, Coulomb force, electric field and movement in it. Experiment process stated below step by step (see Gönen and Kocakaya, 2010 for more details).

Excite stage

In this stage, students' prior conceptions will be tried to be identified. The activities in this section capture the student's attention, stimulate their thinking and help them access prior knowledge. A question containing a discrepant event, a warm-up question, a question related with a misconception is asked to students.

Explore stage

In the exploration part an interactive exercise is designed for students to explore the concepts that will be introduced in the lesson. In this phase students explore the ideas by making observations. A simple experiment may be included in the exploration part.

Explain stage

In the explanation part a suggested explanation for the concepts related with the lesson are given with the support of animations, 2D and 3D models, flash, java etc.

Expand stage

This section gives students the opportunity to expand and solidify their understanding of the concept and/ or apply it to a real world situation In the teachers resources there are pre-test, post-test, homework questions for each lesson, suggested readings and web links for the lesson, additional learning activities and lesson plans.

Extend stage

The addition of the expand phase to the extend phase is intended to explicitly remind teachers of the importance for students to practice the transfer of learning. Teachers need to make sure that knowledge is applied in a new context and is not limited to simple elaboration.

Exchange stage

We already design interactive exercises, experiments for the students to apply the concepts systemically in new situations. The software programs used in this study were downloaded from the sites including qualified software programs concerning physics topics (www.lisefizik.com http://webphysics.davidson.edu, www.falstad.com).

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 the examination, the software programs suggested by the experts were used in the instruction process.

Examine stage

In the examine part; teacher assesses students' knowledge and skills. Examine part is helpful for the teacher to observe whether the students gained the concepts related with the lesson correctly or not. For the examine purposes, the printable versions of the questions are provided to teachers so that teachers can hand out these questions to students. After the evaluation part, the teacher would have some idea about the level of understanding of students in the class.

COMPUTER SOFTWARE

Some of software made flash 5.0 created by researchers and some of ones downloaded from the site including qualified software programs concerning physics topics (www.lisefizik.com). Software made java is downloaded from some web sites concerning physics topics (www.falstad.com www.ltu.edu http://webphysics.davidson.edu).

In addition in preparing the CAI7E, the main concepts in "electrostatic" topic, connections with other subjects and the behavioral objectives in the physics curriculum were taken into consideration.

DATA COLLECTION INSTRUMENTS

The electrostatic achievement test, the electrostatic concept test, the physics attitude scale and self-efficacy perception scale was used in the study.

ELECTROSTATIC ACHIEVEMENT TEST

To measure students' electrostatic achievement, an electrostatic achievement test (EAT) developed by the Gönen, Kocakaya and İnan (2006) was used in this study and its content validity and reliability were checked. 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 discrimination. After these processes, 30 questions included in the test were grouped according to Bloom taxonomy on cognitive domain's knowledge, comprehension and application levels are selected. The EAT items were selected from the textbooks, preparation books written for the University Entrance Examination and asked University Entrance Examination (in TURKEY) consisting of 30-item multiple choices tests (including 8 items at the knowledge level, 14 items at the comprehension level, and 8 items at the application level). All of these items were arranged according to the levels of behavioral objectives in the Physics Curriculum (YÖK,1998). Subsequently, these items were grouped into the three levels of the cognitive domain (knowledge, comprehension, and application) of Bloom's taxonomy. Knowledge items involve recalls or recognition of ideas or concepts; comprehension items emphasize on student understanding of ideas or concepts; application items require students to apply the acquired knowledge or application of knowledge on new situation (Colletta and Chiappetta, 1989).

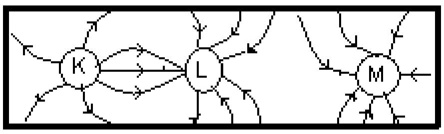
Sample questions are given below. The reliability of the test (r = 0.72) was determined by using Spearman-Brown's method of division of the test to two equivalent halves. For data collection, a test consisting of 30 multi choice questions and each item in the test was scored "1" point when responded truly. Thus, maximum score of the test was limited to 30.

SAMPLE QUESTIONS

Knowledge level

Which particle/s in the matter brings on electrical events?
A. Electron B. Proton C. Neutron D. Electron and proton E. Proton and neutron

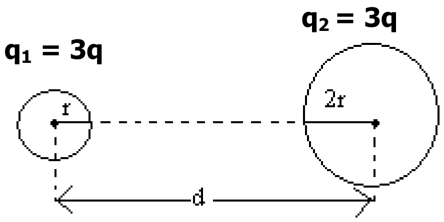
Comprehension level



Field lines of interacted three particles given above. For this figure; what is sign of K, L and M charges?

	K	L	M
A)	+	+	+
B)	-	+	+
C)	-	-	+
D)	+	-	-
E)	+	-	+

Application level



These spheres repel each others with F force. If these spheres touch one to another and they are sent away as far as d/2; what will be repel force between them?

A) 2F / 9 B) 8F / 9 C) 9F / 64 D) 9F / 2 E) 32F / 9

ELECTROSTATIC CONCEPT TEST

A true-false test including 24 questions (including 14 items on electric field and force and 10 items on electrostatic concepts) designed according to literatures (http://amasci.com; Demirci and Çirkinoğlu, 2004; w3.gazi.edu.tr; http://phys.udallas.edu) related to misconceptions on electrostatic phenomena. The test is divided into two parts. In the first part, we wanted to know, what their misconceptions about basic electrostatic and electric field concepts are. All responses of this test are false. Because all sentences in this test are misconception related to electrostatic events which students have. We declared to student; when they are not sure whichever, do not respond the question.

PHYSICS ATTITUDE SCALE

Likert type attitude scale developed by Özyürek and Eryılmaz (2001) was applied in present study to assess participants' attitudes towards physics. The Cronbach-Alpha internal consistency coefficient of the attitudes scale used in the study has been determined as α=0,89. In these sentences with five alternatives were stated strongly agree to strongly disagree and there are positive and negative statements. In the scale, positive statements were scored as 5, 4, 3, 2, and 1, negative statements were scored as 1, 2, 3, 4, and 5 according to its grade.

SELF-EFFICACY PERCEPTION SCALE

Likert type scale developed by Maskan (2006) was applied in this study to assess participants' self-efficacy and perceptions towards physics. The Cronbach-Alpha internal consistency coefficient of the attitudes scale used in the study has been determined as α=0,82. In these sentences with five alternatives stated "any time", "rarely", "some times", "usually", and "every times". There are positive and negative statements. In the scale, positive statements were scored as 1, 2, 3, 4, and 5, negative statements were scored as 5, 4, 3, 2, and 1 according to its grade.

THE EXPERIMENT AND THE ANALYSIS OF THE DATA

For all grades, instructions were carried out by same teacher. During the experiments, data related to students who did not attend all activities, has been excluded from the analysis process. As a result, although the experiment has originally commenced with a total of 107 students, only 79 of those students' data have been included in the analysis.

At the application process, during the two hours, the courses are processed to all students (grade 2, 3 and 4) with CAI7E. To provide interaction between the students, computers used in twain. 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. The activities were performed in guidance of the teacher by considering the stages in the model. The study has been carried out during two hours for each grade.

The all grades were given prepared flash animations, java scripts and presentation programs related to "electrostatics". The software programs used in CAI7E were downloaded from the sites including qualified software programs concerning physics topics (www.lisefizik.com, http://webphysics.davidson.edu www.falstad.com, www.ltu.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 the experts' examination, selected software programs were used in the instruction process.

When the instruction process has been completed, all tests have been carried out to students again. A SPSS package program has been utilized in the investigation and the paired sample t-test was applied to compare the differences between pre-tests and post-tests in order to determine significance differences.

RESULTS

The data collected in accordance with the aim of this study has been presented here. To determine whether there are any differences between students' pre-test and post-test for achievement test's total score and its subgroups' score, the data has been subjected to t-test analysis. The result of the analysis is shown in the Table 1.

Table: 1
Paired Sample t-test for Achievement Test

		N	$\overline{X}$	S	df	t	P
Knowledge lev	Pre-test	79	5,72	1,405	78	3,697	0.001*
	Post-test	79	6,27	1,337			
Comprehensio level	Pre-test	79	11,39	1,931	78	1.753	0,084
	Post-test	79	11,76	1,848			
Application lev	Pre-test	79	6,35	1,271	78	2,102	0,039*
	Post-test	79	6,66	1.036			
Total score	Pre-test	79	23,47	3,540	78	37,09	0,001*
	Post-test	79	24,68	3,115			

*P<0.05

As seen in Table 1, differences between pre-test and post-test for achievement test's total score, knowledge level score, and application level score were found significant as statistically (P<0,05), but not in comprehensive level(P>0,05). To determine whether there are any differences between students' pre-test and post-test for physics attitude score, the data has been subjected to t-test analysis. The result of the analysis is shown in the Table 2.

Table: 2
Paired Sample t-test for Physics Attitude Scale

		N	$\overline{X}$	S	df	t	P
Physics attitud	Pre-test	79	4,00	0,498	78	0,509	0.612
	Post-test	79	4,03	0,635			

As seen in Table 2, difference between pre-test and post-test for physics attitude score was not found significant as statistically (P>0,05).To determine whether there are any differences between students' pre-test and post-test for Self-efficacy perception score, the data has been subjected to t-test analysis.

The result of the analysis is shown in the Table 3.

Table: 3
Paired Sample t-test for Self-efficacy Perception Scale.

		N	$\overline{X}$	S	df	t	P
Self-efficacy perce	Pre-test	79	3,65	0,479	78	2,008	0,048*
	Post-test	79	3,73	0,549			

***P<0.05**

As seen in Table: 3, difference between pre-test and post-test for Self-efficacy perception score was found significant as statistically (P<0,05).

To determine whether there are any differences between students' pre-test and post-test for electrostatic concept test, the data has been subjected to t-test analysis. The result of the analysis is shown in the Table 4

Table: 4
Paired Sample t-test for Electrostatic Concept test

		N	$\overline{X}$	S	df	t	P
Total score	Pre-test	79	8,51	2,275	78	7,834	0,001*
	Post-test	79	10,89	2,537			
Electrostatic concepts	Pre-test	79	2.12	1.121	78	2,780	0,007*
	Post-test	79	2.57	1.365			
Electric field concepts	Pre-test	79	6.39	1.891	78	7,076	0.001*
	Post-test	79	8.32	2.042			

***P<0.05**

As seen in Table 4, differences between pre-test and post-test for concept test's total score, electrostatic concept test score, and electric field concept test score were found significant as statistically (P<0,05). It is given in Table 5a, how many students have misconceptions related electrostatic and electric field concepts. "True" and "False" show students' responses on concept test. "False" shows to account of how many students have misconception on related question and "True" shows reverse. "Missing" shows to non responded questions which students is not sure. Q1, Q2,…. show question which asked in concept test.

Table: 5a
Students Misconceptions after Pre-Test and Post-Test Application

	PRE-TEST						POST-TEST					
	False (N)	True (N)	Missing (N)	False (%)	True (%)	Missing (%)	False (N)	True (N)	Missing (N)	False (%)	True (%)	Missing (%)
Q. 1	58	16	5	73,42	20,25	6,33	32	46	1	40,50	58,23	1,27
Q. 2	50	23	6	63,29	29,12	7,59	15	62	2	18,99	78,48	2,53
Q. 3	38	41	0	48,10	51,90	0	11	68	0	13,92	86,08	0
Q. 4	55	22	2	69,62	27,85	2,53	46	31	2	58,23	39,24	2,53
Q. 5	39	39	1	49,37	49,37	1,27	41	37	1	51,90	46,83	1,27
Q. 6	14	64	1	17,72	81,01	1,27	10	68	1	12,65	86,08	1,27
Q. 7	62	16	1	78,48	20,25	1,27	38	41	0	48,10	51,90	0
Q. 8	35	42	2	44,31	53,16	2,53	30	48	1	37,97	60,76	1,27
Q. 9	36	36	7	45,57	45,57	8,86	29	45	5	36,71	56,96	6,33
Q. 10	27	47	5	34,18	59,49	6,33	36	40	3	45,57	50,63	3,80
Q. 11	58	18	3	73,42	22,78	3,80	39	39	1	49,37	49,37	1,27
Q. 12	8	69	2	10,13	87,34	2,53	23	55	1	29,11	69,62	1,27
Q. 13	60	16	3	75,95	20,25	3,80	71	8	0	89,87	10,13	0
Q. 14	19	56	4	24,05	70,89	5,06	10	69	0	12,66	87,34	0
Q. 15	72	6	1	91,14	7,59	1,27	69	10	0	87,34	12,66	0
Q. 16	55	19	5	69,62	24,05	6,33	53	24	2	67,09	30,38	2,53
Q. 17	52	21	6	65,82	26,59	7,59	60	19	0	75,95	24,05	0
Q. 18	17	62	0	21,52	78,48	0	6	73	0	7,59	92,41	0
Q. 19	64	13	2	81,01	16,46	2,53	62	15	2	78,48	18,99	2,53
Q. 20	70	8	1	88,60	10,13	1,27	66	12	1	83,54	15,19	1,27
Q. 21	69	9	1	87,34	11,39	1,27	73	6	0	92,41	7,59	0
Q. 22	67	12	0	84,81	15,19	0	60	19	0	75,95	24,05	0
Q. 23	69	5	5	87,34	6,33	6,33	66	11	2	83,54	13,93	2,53
Q. 24	65	12	2	82,28	15,19	2,53	64	14	1	81,01	17,72	1,27

Differences at students' misconceptions after post-test is shown in Tablo 5b.

According to Table 5a and 5b, it is seen that most of students' misconceptions on related topics decreased.

Questions asked to students in concept test are shown in appendix.

Table: 5b
Differences at Students' Misconceptions after Post-test

	Differences(post-pre)			% Differences(post-pre)				Differences(post-pre)			% Differences(post-pre)		
	False	True	Missing	False	True	Missing		False	True	Missing	False	True	Missing
Q. 1	-26	30	-4	-32,91	37,97	-5,06	Q. 13	11	-8	-3	13,92	-10	-3,8
Q. 2	-35	39	-4	-44,3	49,37	-5,06	Q. 14	-9	13	-4	-11,39	16,5	-5,06
Q. 3	-27	27	0	-34,18	34,18	0	Q. 15	-3	4	-1	-3,79	5,06	-1,27
Q. 4	-9	9	0	-11,39	11,39	0	Q. 16	-2	5	-3	-2,53	6,33	-3,8
Q. 5	2	-2	0	2,53	-2,53	0	Q. 17	8	-2	-6	10,13	-2,5	-7,59
Q. 6	-4	4	0	-5,06	5,06	0	Q. 18	-11	11	0	-13,92	13,9	0
Q. 7	-24	25	-1	-30,38	31,65	-1,27	Q. 19	-2	2	0	-2,53	2,53	0
Q. 8	-5	6	-1	-6,32	7,59	-1,27	Q. 20	-4	4	0	-5,06	5,06	0
Q. 9	-7	9	-2	-8,86	11,39	-2,53	Q. 21	4	-3	-1	5,06	-3,8	-1,27
Q. 10	9	-7	-2	11,39	-8,86	-2,53	Q. 22	-7	7	0	-8,86	8,86	0
Q. 11	-19	21	-2	-24,05	26,58	-2,53	Q. 23	-3	6	-3	-3,79	7,59	-3,8
Q. 12	15	-14	-1	18,98	-17,7	-1,27	Q. 24	-1	2	-1	-1,26	2,53	-1,27

DISCUSSION AND CONCLUSIONS

This study has shown that computer-assisted instruction designed according to 7E model of Constructivist learning has assisted in increasing the level of understanding of the concepts related to electrostatic.

The results of the final achievement tests have shown that students achievement in the cognitive domain of knowledge and application levels are increased and found to be meaningful ($P<0,05$). Based on the responses provided to cognitive domain questions, the students have not shown any meaningful differences in the comprehension level of the cognition domain (Table 1). This indicates that the computer assisted teaching designed according to 7E is more effective on students' lower cognitive domain.

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 will 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 (Ausubel, 1968; Bodner, 1986 and 1990). This is in line with the findings reported by other studies (Savelsbergh, de Jong and Ferguson-Hessler, 2000; Zele, Hoecke, Lenaerts and Wieme, 2003; Ayvacı, Özsevgeç and Aydın, 2004; Saka and Yılmaz, 2005).

It is widely reported that the computer assisted teaching effects positively on the level of success in all education levels (Gönen, Kocakaya and İnan 2006, Çepni, Taş and Köse, 2006, Başaran, 2005; Powell et al., 2003; Tsai and Chou, 2002; Lee, 2001; Chang, 2001; Bayraktar, 2000; Büyükkasap, Düzgün, Ertuğrul and Samancı, 1998; Tjaden and Martin, 1995;Coye and Stonebraker, 1994; Ferguson and Chapmen, 1993).

However, when the post-test attitude scores are considered; there are not differences between post-test and pre-test (Table 2). This result indicated that this instruction method does not change students' attitudes in a short period. It was also stated by many other researchers that the attitudes of students towards courses cannot be changed in a short period (Hacıoğlu and Ulu, 2003; Hardal and Eryılmaz, 2004; Maskan and Guler, 2004). We concluded that even though, CAI7E does not change the students' attitudes toward physics; it develops their self-efficacy perceptions, and they can link between daily life and physics more effectively. Thus, they can convey same behaviors to their students when in charge.

When we looked for students' Self-efficacy perception in Table 3; student perceptions on physics increased after experiment ($P<0,05$) and it shows instruction including virtual simulations provide to students to link between physics an daily life.

According to Table 4, Table 5a and table 5b; physics student teachers have misconceptions on related questions and after experiment and it seen that differences at account of students who have misconceptions decreased at most of questions and differences are found significant ($P<0,05$), but only 5th, 10th ,12th ,13th ,17th , and 21st questions showed reverse results. It might be stemming from students do not realize of these questions. We think that setting-out of these questions or regulation of this method can reduce these problems.

The results obtained in this study are very important due to these students will be physics teachers after graduate at university. If we early recognize these deficiencies as physics educators, physics student teachers will have fewer misconceptions, so do high school students. It is well known that it is not easy to eliminate misconceptions by just employing traditional instructional methods. One of the alternative ways of overcoming this problem is to develop and use CAI7E in science classrooms.

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 topics 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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APPENDIX

Questions asked to students in concept test

ELECTRIC FIELDS AND FORCES

1. **A moving charge will always follow a field line as it accelerates.**
2. **If a charge is not on a field line, it feels no force.**
3. **Field lines are real.**
4. **Coulomb's law applies to charge systems consisting of something other t point charges.**
5. **A charged body has only one type of charge.**
6. **The electric field and force are the same thing and in the same direction.**
7. **Field lines can begin/end anywhere.**
8. **There are a finite number of field lines.**
9. **Fields don't exist unless there is something to detect them.**
10. **Forces at a point exist without a charge there.**
11. **Field lines are paths of a charges motion.**
12. **The electric force is the same as the gravitational force.**
13. **Field lines actually radiate from positive to negative charges and convey mot**
14. **Field lines exist only in two dimensions.**

ELECTROSTATIC

15. **'Static Electricity' is electricity which is static.**
16. **Friction causes 'static electricity'**
17. **'Static electricity' is made of electrons**
18. **Neutral object have no charge.**
19. **'Charging' a capacitor fills it with charge.**
20. **Clouds are charged by rubbing together.**
21. **Charges are named "positive charge" and "negative charge".**
22. **Batteries create electricity.**
23. **Electrical energy flows inside of fire.**
24. **Damp air is conductive**