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The effect of computer assisted ınstruction in teaching ıonic compounds on pre-service elemantary science teachers' academic achievement and permanent learning

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Abstract

In this study, the effect of the use of computer assisted teaching method for ionic compounds included in content of General Chemistry course in science education undergraduate programme on academic achievement and permanance have been researched. This study was carried out with 70 pre-service elemantary science teachers studying their first year at Ondokuz Mayıs University, Faculty of Education, Science Education Department. While the traditional teaching method was applied to the first group, the computer assisted teaching method was applied to the second group. As a means of data collection, 50-item-multiple choice achievement test whose Kuder Richardson-20 (KR-20) was 0.868, was applied as a pretest for pre-study, posttest at the end of the study and 12 weeks later it was applied as a permanance test at the end of the study. Also 5 open-ended questions related to the subject were applied to each of 2 groups both before teaching the subject and after teaching the subject. The data was analysed with SPSS statistical package programme. The data was evaluated using t test, Mann Whitney-U test, Wilcoxon signed-rank test and percentage (%) distribution. According to the results obtained from the statistical analyses, the experimental group applied computer assisted teaching method was significantly observed to be more successful than the control group applied traditional teaching method ($t_{(68)}$ =21.318; $p < .05$). It was concluded that the use of computer affected permanance in a positive way.

Keywords: Chemistry education; ionic compounds; computer assisted instruction.

1. Introduction

Computer assisted instruction (CAI) is a teaching method in which computer is used as a supporting device for the teacher in learning environment, which strengthens teaching process and students' motivation, which makes it possible for the student to learn according to his/her learning speed and which is formed by combining self-learning in another word interactive learning principles with the computer technology (Şahin & Yıldırım, 1990; Uşun, 2000).

While teaching abstract and difficult concepts, it is very important to develop and implement instruction activities that may stimulate students' visual and intellectual structures. Computer-assisted instruction is one of the methods used for this purpose (Ertepınar et al., 1998). In CAI applications, with the use of simulations related to abstract

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concepts which enable students to participate in learning process enable students to configure the concepts easily which they have difficulty in understanding (Karamustafaoğlu, Aydın & Özmen, 2005).

Although, the success of this method in teaching-learning process depends on several variables, the use of educational software pertinent to academic goals and objectives is vital for the success of the method. In computer-assisted instruction method, computer technology involves in traditional teaching methods as an option not in teaching process, and improves efficiency in terms of quantity of education (Uşun, 2000). According to Namlu (1999), computer-assisted instruction is the best example of integration of technology and science. In CAI, computer is not an option for the teaching process but the complementary or strengthening element of the system. Again, İşman (2005) stated that computers support education and training process and are used by teachers as supporting tools.

Previous studies revealed that effective teaching tools and materials enrich learning, draw students' attention, helps students in gaining target behaviors and provide learning in less time and cost (Barron & Orwing, 1995; Clark & Sugrue, 1995). Accurate representation of chemical events is the first step in solving the problems related to teaching. Effective presentation and images supported by explanations is vital in terms of conceptual understanding basis (Herron, 1996).

The study aimed to investigate the effect of traditional instruction method (teacher-centered) which is widely used in chemistry courses and computer-assisted instruction method in teaching ionic compounds on academic achievement of teacher candidates.

2. Method

A total of 70 I. grade teacher candidates from Ondokuz Mayıs University Faculty of Education, Science Education Department participated in the study. In this study, a pretest-posttest control group quasi-experimental design was used in this study (Campbell & Stanley, 1966). The study consists of two groups as experimental group to whom CAI was applied (N=35) and control group to whom traditional method was applied (N=35).

To obtain and analyze the data in the study, an achievement test consisting 50 multiple choice question about ionic compounds included in General chemistry course for the first graders was developed by the researchers. In a multiple-choice test, each question has five options. Achievement test was applied to the group of students to whom topics were taught before the application and Kuder Richardson-20 (KR-20) reliability of the test was found to be 0,868. According to expert opinion, test items are clear and understandable and content validity of the test is high.

In order to determine that whether there is a significant difference between pre-service elemantary science teachers' academic achievement before and after application, an achievement was applied to all students as pre-test before the application and post-test after the application. 12 weeks after the end of the application, achievement test was applied as permanency test to all students. In addition, 5 open-ended questions about ionic compounds were administered to both groups before and after instruction. Open-ended questions are as follows;

1. Explain the concept of ionic bond?
2. How is ionic bond formed, explain by giving example?
3. Describe the properties of ionic compounds?
4. How is crystal lattice formed?
5. Explain the concept of doublet, octet, anion and cation?

The responses of teacher candidates were grouped as correct (complete answer), partially correct (not full answer but an acceptable level), wrong (wrong answer or irrelevant answer) and empty (not responded) and were evaluated as percentages (%).

The topic of ionic compounds was taught to experimental group using a PowerPoint presentation, whereas traditional instruction method was administered in control group in 8-hour period. PowerPoint presentation used in lectures includes following sub-topics; concept of anion-cation, electron arrangement, doublet and octet rules, detection of anions and cations according to group number, concept and formation of ionic bond, writing and naming ionic compounds, properties of ionic compounds, properties and crystal lattice structure. The transitions between package programs and slides were provided through the bridge. Some screenshots from the package programs used in CAI application are shown in Figure 1.

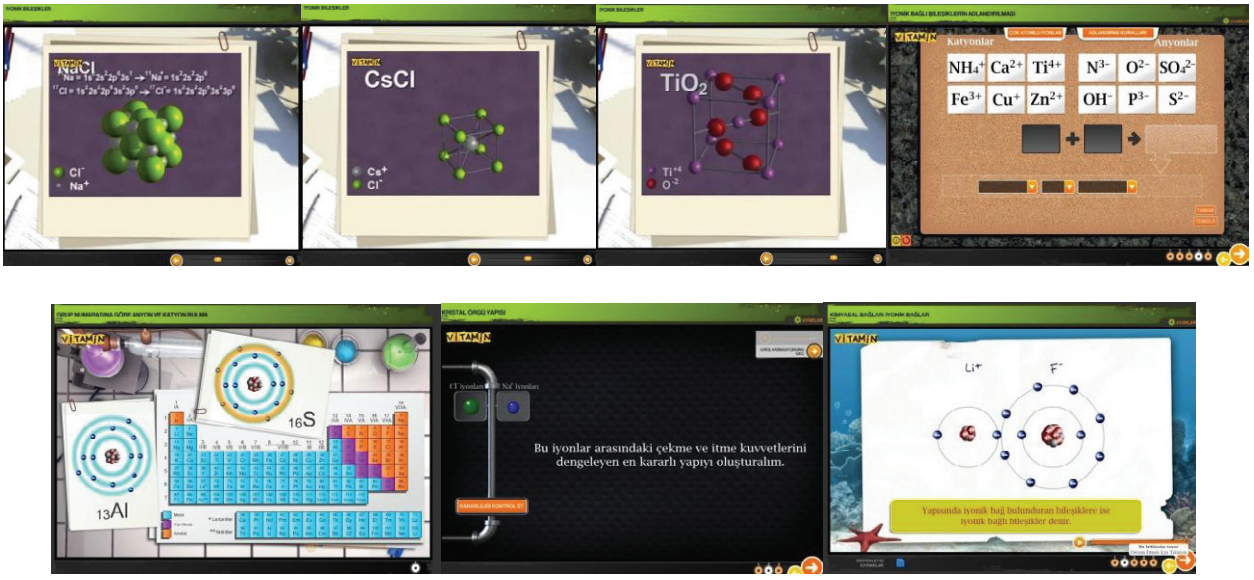

Figure 1: Screen shots from package program (http://www.ttnetvitamin.com.tr)

The data obtained from the study were analyzed as paired and independent t test, Mann Whitney-U test, Wilcoxon rank test and percentages using SPSS statistical package program.

3. Findings and Remarks

Independent samples t-test results of experimental and control group teacher candidates' pre-test scores are given in Table 1.

Table 1. Independent t-test results of groups pre-test scores

Test	Group	N	$\bar{X}$	SD	t	p	Explanation
Pre-test	Experiment	35	43.20	6.664	- .807	.423	p > .05 not significant
	Control	35	44.40	5.756			

As shown in Table 1, no significant difference was observed between experimental and control groups' pre-test scores t (68) = -. 807; p> .05). Having close averages in both control and experimental groups' pre-test scores and having no significant difference between pre-test scores suggested that these groups were similar in terms of success level related to ionic compounds.

Achievement scores of prospective teachers in experimental and control groups which were received from pre and post-test were compared with the dependent t-test. The results are given in Table 2.

Table 2. Dependent t-test results of the groups regarding pre-test scores

Test	Group	N	$\bar{X}$	SD	t	p	Explanation
Pre- test	Experiment	35	43.20	6.654	-35.397	.000	p < .05 significant
Post-test		35	88.86	5.766			
Pre-test	Control	35	44.40	5.756	-10.723	.000	p < .05 significant
Post-test		35	58.23	6.245			

As shown in Table 2, significant differences were observed between in-group pre-test and post-test scores in both experimental ($t_{(34)}$ = -35.397, p < .05) and control group ($t_{(34)}$ = -10.723, p < .05). These differences were in favor post-test scores. Having an increase in the success level of students in both groups after instructing the topic and therefore having an academic achievement in favor of post-test is a normal result. As it is seen from the arithmetic means, there was an increase in both groups' average after the instruction. But this increase was greater in experimental group.

Independent t-test results of experimental and control group teacher candidates' post-test scores are given in Table 3.

Table 3. Independent t-test results of the groups regarding post-test scores

Test	Group	N	$\bar{X}$	SD	t	p	Explanation
Post-test	Experiment	35	88.86	5.766	21.318	.000	p < .05 significant
	Control	35	58.23	6.245			

As shown in Table 3, significant difference was observed between post-test scores in experimental and control group ($t_{(68)}$ = 21.318, p < .05). When this difference in arithmetic averages was analyzed in terms of increase in academic achievement of the teacher candidates, it was revealed that application of CAI in experimental group significantly increased the academic achievement in comparison with the control group in which traditional instruction method was applied.

Mann Whitney-U test results regarding permanency test scores which were applied to determine the effect of experimental and control group on permanent learning are shown in Table 4.

Table 4. Mann Whitney-U test results of the groups regarding permanency test scores

Test	Group	N	Mean Rank	Sum of Ranks	U	p	Explanation
Permanency	Experimental	35	88.86	5.766	.000	.000	p < .05 significant
	Control	35	58.23	6.245			

As shown in Table 4, According to Mann Whitney-U test results, significant difference was observed between CAI and traditional instruction methods in terms of permanent learning [U = .000, p < .05]. The arithmetic average of experimental group permanency-test scores was 69.26 whereas it was 42.97 in control group. There was a difference as 26.29 points in favor of experimental group. When this difference was analyzed in terms of increase in permanent learning of the teacher candidates, it was revealed that the use of CAI in experimental group significantly increased the permanent learning as opposed to the traditional instruction method in control group.

Dependent t-test results of experimental group's post-test and permanency test scores are given in Table 5.

Table 5. Dependent t-test results of the experiment group regarding post-test and permanency test scores

Test	Group	N	$\bar{X}$	SD	t	p	Explanation
Post-test	Experimental	35	88.86	5.766	18.851	.000	p < .05 significant
Permanency		35	69.26	3.729			

As shown in Table 5, there was a significant difference between post-test and permanency test scores of teacher candidates in experimental group ($t_{(34)}$ = 18.851, p < .05). When arithmetic averages were analyzed, it was revealed that these differences were in favor of post-test scores.

Wilcoxon Signed-Rank test results of control group regarding post-test and permanency test scores are given in Table 6.

Table 6. Wilcoxon Signed-Rank test results of control group regarding post-test and permanency test scores

Test	Group		N	Mean Rank	Sum of Ranks	Z	p	Explanation
Post-Test Permanency	Control	Negative Ranks	35	18.00	630.00	-5.169	.000	p < .05 significant
		Positive Ranks	0	.00	.00			
		Ties	0					

As shown in Table 6, there was a significant difference between post-test and permanency test scores of teacher candidates in control group (Z = -5.169, p < .05). The arithmetic average of control group permanency-test scores was 58.23; the arithmetic average of control group permanency test was 42.97. There was a difference as 15.26 points in favor of post-test.

Percentage distribution of the experimental group teacher candidates' answers to the 5 open-ended questions about ionic compound before instruction and after instruction is given in Table 7.

Table 7. Frequency (f) and percentage distribution (%) of the experimental group prospective teachers' answers to the questions

Questions	Group	Correct		Partially Correct		Wrong		Unanswered	
		f	%	f	%	f	%	f	%
1	**Before**	4	11.4	7	20.0	12	**34.3**	12	**34.3**
	After	23	**65.7**	9	25.7	2	5.7	1	2.9
2	**Before**	6	17.1	7	20.0	10	**28.6**	12	**34.3**
	After	24	**68.6**	8	22.9	3	8.6	-	-
3	**Before**	7	20.0	5	14.3	13	**37.1**	10	28.6
	After	22	**62.9**	10	28.6	3	8.6	-	-
4	**Before**	6	17.1	10	28.6	12	**34.3**	7	20.0
	After	21	**62.0**	11	31.4	2	5.7	1	2.9
5	**Before**	9	25.7	11	**31.4**	9	25.7	6	17.1
	After	20	**57.1**	11	31.4	3	8.6	1	2.9

When the data in Table 7 were analyzed, it was seen that teacher candidates in experimental group mainly gave the wrong answers or unanswered the question before instruction, but they gave correct and partially correct answers after instruction.

Percentage distribution of the control group teacher candidates' answers to the 5 open-ended questions about ionic compound before instruction and after instruction is given in Table 8.

Table 8. Frequency (f) and Percentage Distribution (%) of the control group teacher candidates' answers to the questions

Questions	Group	Correct		Partially Correct		Wrong		Unanswered	
		f	%	f	%	f	%	f	%
1	**Before**	6	17.1	6	17.1	11	**31.4**	12	**34.3**
	After	16	**45.7**	14	**40.0**	4	11.4	1	2.9
2	**Before**	6	17.1	9	25.7	10	**28.6**	10	**28.6**
	After	12	**34.3**	12	**34.3**	7	20.0	4	11.4
3	**Before**	7	20.0	9	25.7	10	**28.6**	9	25.7
	After	8	22.9	13	**37.1**	8	22.9	6	17.1
4	**Before**	7	20.0	11	31.4	12	**34.3**	5	14.3
	After	10	28.6	15	**42.9**	7	20.0	3	8.6
5	**Before**	7	20.0	13	**37.1**	6	17.11	9	25.7
	After	12	**34.3**	12	34.3	6	7.1	5	14.3

When the data in Table 8 were analyzed, it was seen that teacher candidates in control group mainly gave the wrong answers or unanswered the question before instruction, but they gave correct and partially correct answers after instruction. However, when these two tables were analyzed together, it was revealed that the percentage of correct and partially correct answers of teacher candidates in experimental group were higher than those in control group.

4. Conclusions and Implications

In accordance with the post-test results of experimental and control group students ($t_{(68)} = 21.318$, $p < .05$), academic achievement of the experimental group teacher candidates to whom topics were taught by the use of CAI was higher than those in control group in which traditional instruction method was administered. Additionally, according to the permanency test results, it was seen that learning in experimental group was more effective and permanent.

Similar results were also obtained in many studies conducted previously. For example, Wiley (2001) taught microscopic, macroscopic, and symbolic structures of chemical substance using animations and observed a significant difference between pre-test and post-test scores at the end of the 6-week study. Tezcan and Yılmaz (2003) expressed that teaching chemical reactions and collision with the use of conceptual animations was more effective than the use of traditional method. In other studies, CAI was found to be more successful than other traditional instruction methods (Yigit & Akdeniz, 2003; Karamustafaoğlu, Aydın & Özmen, 2005; Pektaş, Türkmen & Solak, 2006).

It was seen that CAI not only improves students' success but also helps them to develop higher level thinking skills thus provides meaningful learning (Renshaw, & Taylor, 2000). Many studies on different topics in chemistry courses support our study findings. The implementation of CAI method increase teacher candidates' participation and make them more successful. Consequently, in order to provide a meaningful and permanent learning in teaching chemical topic which are difficult to understand, the use of method in which students are active would be very useful.

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