The Effects of Tablet Computer Assisted Instruction on Students' Attitude toward Science and Technology Course

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ABSTRACT The purpose of this study is to investigate the effects of tablet computer assisted instruction at science and technology course on students' attitudes toward the use of technology, and using the technology output during the lessons, and students' attitudes toward science and technology courses at fifth grade. The study was implemented with 56 students, 27 students in experimental group and 29 students in control group, at the spring semester of 2011-2012 academic year. The experimental group was instructed with tablet computer assisted instruction and the control group was instructed with traditional methods during science and technology courses. Three instruments, Attitude toward Technology Scale, Attitude toward the Use of Technology in the Courses Scale, and Attitude toward Science and Technology Course Scale, were used in the current study and they were implemented as pre-test and post-test in all groups. The Wilcoxon Signed Rank Test and Mann Whitney U-Test were used as inferential statistics. The results of the study showed that the tablet computer assisted instruction had positive impacts on students' attitudes toward technology and technology usage in the courses; however, it had both negative and positive impacts toward science and technology courses in different aspects. Also, gender differences were not seemed significantly important.

1. INTRODUCTION

Nowadays, changes and innovations in the area of science and technology happen continuously in the world. Educational/instructional innovations have an important place in this aspect. As a result, to give the importance of education and instruction activities and to have an idea about how to give good quality of education play a determinant role for the future of the countries and this should be the first priority of the all countries that have a foresight and perception about their future. We can conclude that the investment that made on education is much more valuable action to take and the outcomes of this investment is the most profitable. This profitable investment for our future greatly concentrated on the qualities of people. As a result of the paradigm changes, there is a need for the people who can discover relationships, construct knowledge, connect it with the life, make inferences, and query the knowledge. In this aspect, science and technology education that help us to know more about universe, earth, our environment, and even ourselves become more important than ever. Thus, almost all of the countries are aim to increase the quality of science and technology education (MEB 2004) and fulfill the needs of the equipment needed for science and technology (Ayas et al. 1993).

In an experimental study conducted by Yenice (2003), it was found that computer assisted instruction had positive effects on students' attitudes toward science and computers. Guven and Sulun (2012), in their study, investigated the effects of computer assisted instruction on students' attitudes toward science and technology course and achievement in the unit of properties and structure of matter. Results of their study showed that the computer assisted instruction increased the students' achievement; however, it was found that there were no differences between students who had instructed with this instruction and who had instructed with the traditional methods. In order to increase the efficiency of the use of equipment in biology curses of secondary schools, Yildirim and Kete (2002) studied the use of equipment as one of the fields of instructional technologies. They concluded that in order to increase the efficiency of the courses, instructional technology has great importance. Moreover, they summarized that one should use technological devices and the other equipment to have permanent learning.

In Turkey, starting from the academic year of 2011-2012, the project of FATIH is started at elementary schools. With this project, the courses were started to be offered with the help of smart boards, Internet, and tablet computers. The purpose of that project was to equip all of the classrooms with the information technology devices and use these devices at the process of instruction by the end of 2013.

The subjects in the science and technology courses are compatible with the hands-on activities and the instruction becomes more effective when incorporated with interactive activities. Kaptan and Kusakci (2002), in their study, asked the students that how do you want to receive the science instruction. The most of the students expressed that they want to receive the instruction with games, interactive activities, and experiments. In this aspect, we should discuss the following questions. How will we plan and organize the instruction? How can we provide interactive instruction that enables the learning while feeling, hearing, and touching?

The science and technology curriculum emphasizes on students centered learning. Moreover, technology literacy and information technology and communication skills are emphasized with this curriculum. In this respect, the name of the course changed from "Science" to "Science and Technology", and this is an important thing to express the relations with science and technology related concepts (ERG 2005). As can be seen from the research studies, there are many instruction methods for science and technology. Computer assisted instruction is one of these methods. Use of technological devices is not merely magical tool to solve all the problems related with the teaching and learning process; however, in order to increase the efficiency and quality of the instructions use of these devices can help us (Akkoyunlu 2002; Kirschhner and Selinger 2003). Indeed the research studies on meaningful and permanent learning show that use of multimedia devices, development of instructional materials, and enriching instruction with the help of instructional technologies have an important place in students' learning (Sahin 2003; Elikucuk 2006; Baki et al. 2009; Uyangor and Ece 2010). With the help of technological devices, it is possible to produce instructional materials that have multimedia properties. Therefore, one of the biggest contributions of the technology to instructional activities is to helping to produce effective course materials (Sonmez 2003). Especially, as one of the technological devices the computers has big role to produce instructional materials. At elementary level the students have problems to learn abstract concepts. Computers can help us to visualize these abstract concepts. Furthermore, these devices help to observe situations repeatedly to learn the details of the processes deeply (Akpinar et al. 2005).

At the science and technology course, use of computers can help teachers to present concepts in an effective way that requires multi-sense. The research studies showed that the methods that utilize computers and other technological devices is more effective to increase students' achievement than the traditional methods (Dervis 2009; Hancer 2007; Akcay et al. 2005; Kibos 2002; Chang 2002). Moreover, the findings from the research studies supports that the use of computers especially in science courses is more effective way to increase achievement than the other methods (Aycan 2002; Yigit and Akdeniz 2003; Yenice et al. 2003; Cepni 2005; Cepni et al.2006; Guven and Sulun 2012).

Apart from these findings, it is needed to study how the use of tablet computers affects students' attitudes toward science and technology course. Therefore, the researchers implemented tablet computer assisted instruction method at elementary school science and technology course. Use of tablet computers is piloted with the FATIH project in Turkey. The results of this study will be a reference for the future implementations.

1.1 Purpose of the Study

The purpose of this study is to investigate the effects of tablet computer assisted instruction on students' attitudes toward the use of technology in science and technology course and students' attitude toward science and technology. With these purposes, following research questions were investigated at the current study:

1. Is there any significant difference of students' attitude toward technology between the students instructed with tablet computer assisted instruction and traditional instruction?

2. Is there any significant difference of students' attitude toward use of technology in science and technology course between the students instructed with tablet computer assisted instruction and traditional instruction?

3. Is there any significant difference of students' attitude toward science and technology course between the students instructed with tablet computer assisted instruction and traditional instruction?

4. Is there any significant difference of students' attitude between male and female students?

2. METHOD

This study is a pre-test/post-test control group design, one of the quantitative research methods. The experimental group was received tablet computer based instruction whereas the control group received the traditional instruction. Here, traditional instruction referred to the instruction method in which the teacher followed the science and technology curriculum as he/she already does before.

2.1 Sample of the Study

The sample of the study consisted of 56 students from two elementary schools in a small city at the west part of the Turkey. There were 29 students in the control group whereas there were 27 students in the experimental group. These two groups were from different schools; however, both schools were similar to each other with respect to background of students and teacher demographics. The number of the students participated in the study is relatively low; however, as stated in the introduction section, use of tablet computers in the city is at the pilot phase. Therefore, this limited the number of the students participated in the study. There were nine female and 18 male students in the experimental group. On the other hand, there were 18 female and 11 male students in the control group.

2.2 Data Collection Instrument

In this study, the researchers used the three instruments that were developed by Kenar and Balci (2012) to collect the data. These instruments were as follow: Attitude toward Technology Scale, Attitude toward the Use of Technology in the Courses Scale, and Attitude toward Science and Technology Course Scale.

2.2.1 Attitude toward Technology Scale

This scale has 12 Likert type items and three dimensions: Interest and Satisfaction (five items), Anxiety (four items), and Use of Time (five items). These three dimensions accounted for 45% of the total variance. The Cronbach alpha coefficient of the scale was reported to be .76 for the whole scale, .72 for the Interest and Satisfaction dimension, .69 for the Anxiety di-

mension, and .54 for the Use of Time dimension. The possible minimum score was 12 whereas the possible maximum score was 60.

2.2.2 Attitude toward the Use of Technology in the Courses Scale

This scale has 15 Likert type items at three factors. These factors are Anxiety (seven items), Interest (five items), and Impact on Achievement (three items). These three factors explain 57% of total variance. The Cronbach alpha coefficient was calculated for whole scale, Anxiety dimension, Interest dimension, and Achievement dimension and found to be .86, .87, .69, and .65, respectively. The possible minimum score is 15 whereas the maximum score was 75.

2.2.3 Attitude toward Science and Technology Course Scale

This scale has 3 factors and 12 Likert type items. The factors are Interest (six items), Enjoyment (three items), and Sustaining the Work (three items) (Kenar and Balci 2013). These three factors explain 60% of total variance. The Cronbach alpha coefficient for the whole scale was found to be .83. Moreover, it was found to be .84 for the Interest dimension, .70 for the enjoyment dimension, and .56 for the Sustaining the Work dimension. The possible minimum score was 12 and the possible maximum score was 60.

2.3 Implementation

This study was carried out at the spring semester of 2011-2012. At the beginning of this semester the pre-tests of each scale were administered to both experimental and control groups. Then, February to May, all of the subject in the Science and Technology curriculum was instructed with the help of tablet computers at the experimental groups, while the control group received the instruction in the traditional way. At end of the implementation, both groups received the post-tests of each scale.

2.4 Data Analysis

As an inferential statistics, Wilcoxon Signed Rank and Mann Whitney U-Test were used.

Wilcoxon Signed Rank was used to compare experimental and control groups' attitude scores. Mann Whitney U-Test is used to compare demographics of each group.

3. RESULTS

As can be seen from Table 1, there is a significant increase at the attitudes toward technology scores of the students in the experimental group (p< .05). However, for the scores of attitude toward science and technology courses, there is a significant decrease (p< .05). Moreover, there is increase at the scores of attitude toward the use of technology in the courses but this increase is not significant. However, for the control group students there is no significant difference between pre and post-test scores (p> .05).

3.1 Results for the First Research Question

In order to test if there is any difference between pre and post-test scores of students' attitudes toward technology for each factor, Wilcoxon Signed Rank Test was conducted. The results of this test can be seen in Table 2.

As can be seen from this table, there is a significant increase for each factor scores at the experimental group. This means tablet computer assisted instruction increased students interest and decreased their anxiety about the technology. However, there is no difference for the students in the control group (p> .05).

3.2 Results for the Second Research Question

In order to investigate the students' attitudes toward the use of technology in the courses for each factor of the attitudes toward the use of technology in the courses scale, Wilcoxon Signed Rank Test was conducted. The results of this test can be seen in Table 3.

As can be seen from Table 3, there are positive increases for each factor for the students in the experimental group. However, only for enjoyment factor, this increase is significant (p < .05). On the other hand, there is no difference for the students in the control group.

3.3 Results for the Third Research Question

In order to investigate the students' attitudes toward science and technology course for each

Table 1: Wilcoxon Signed Ranks Test results for both experimental and control groups pre and post tests scores of attitudes toward technology, attituders toward the use of technology at courses, and attitude toward science and technology course

		N	Mean rank	Sum of ranks	ZAsymp. Sig. (2-tailed)
D2ty - D1ty	Negative Ranks	4(a)	7,13	28,50	-3,334(a)
	Positive Ranks	19(b)	13,03	247,50	,001
	Ties	4(c)			
	Total	27			
D2dt - D1dt	Negative Ranks	7(a)	7,14	50,00	-1,813(a)
	Positive Ranks	12(b)	11,67	140,00	,070
	Ties	8(c)			
	Total	27			
D2ft - D1ft	Negative Ranks	26(g)	14,50	377,00	-4,565(b)
	Positive Ranks	1(h)	1,00	1,00	,000
	Ties	0(i)			
	Total	27			
K2ty - K1ty	Negative Ranks	16(j)	11,25	180,00	-,115(b)
	Positive Ranks	10(k)	17,10	171,00	,909
	Ties	3(l)			
	Total	29			
K2dt - K1dt	Negative Ranks	12(m)	16,50	198,00	-,216(b)
	Positive Ranks	15(n)	12,00	180,00	,829
	Ties	2(o)			
	Total	29			
K2ft - K1ft	Negative Ranks	17(p)	14,06	239,00	-1,616(b)
	Positive Ranks	9(q)	12,44	112,00	,106
	Ties	3(r)			
	Total	29			

Table 2: Experimental and control group students' attitudes toward technology

		N	Mean rank	Sum of ranks	ZAsymp. Sig. (2-tailed)
tD2fktr1 - tD1fktr1	Negative Ranks	3(s)	6,00	18,00	-2,402(a)
	Positive Ranks	12(t)	8,50	102,00	,016
	Ties	12(u)			
	Total	27			
tD2fktr2 - tD1fktr2	Negative Ranks	2(v)	6,00	12,00	-3,074(a)
	Positive Ranks	15(w)	9,40	141,00	,002
	Ties	10(x)			
	Total	27			
tD2fktr3 - tD1fktr3	Negative Ranks	3(y)	9,33	28,00	-2,307(a)
	Positive Ranks	14(z)	8,93	125,00	,021
	Ties	10(aa)			
	Total	27			
tK2fktr1 - tK1fktr1	Negative Ranks	9(tt)	12,56	113,00	-,773(a)
	Positive Ranks	14(uu)	11,64	163,00	,440
	Ties	6(vv)			
	Total	29			
tK2fktr2 - tK1fktr2	Negative Ranks	14(ww)	10,61	148,50	-1,153(b)
	Positive Ranks	7(xx)	11,79	82,50	,249
	Ties	8(yy)			
	Total	29			
tK2fktr3 - tK1fktr3	Negative Ranks	10(zz)	11,90	119,00	-,895(a)
	Positive Ranks	14(aaa)	12,93	181,00	,371
	Ties	5(bbb)			
	Total	29			

factor of the attitudes toward the science and technology course scale, Wilcoxon Signed Rank Test was conducted. The results of this test can be seen in Table 4.

As can be seen from Table 4, for the students from experimental group, negative significant difference was found for the Interest and Enjoyment factors of the attitude toward science and

Table 3: Experimental and control group students' attitudes toward the use of technology in courses

		N	Mean rank	Sum of ranks	ZAsymp. Sig. (2-tailed)
dtD2fktr1 - dtD1fktr1	Negative Ranks	5(bb)	5,90	29,50	-1,124(a)
	Positive Ranks	8(cc)	7,69	61,50	,261
	Ties	14(dd)			
	Total	27			
dtD2fktr2 - dtD1fktr2	Negative Ranks	1(ee)	3,00	3,00	-2,539(a)
	Positive Ranks	9(ff)	5,78	52,00	,011
	Ties	17(gg)			
	Total	27			
dtD2fktr3 - dtD1fktr3	Negative Ranks	5(hh)	5,80	29,00	-1,491(a)
	Positive Ranks	9(ii)	8,44	76,00	,136
	Ties	13(jj)			
	Total	27			
dtK2fktr1 - dtK1fktr1	Negative Ranks	12(ccc)	16,04	192,50	-,433(b)
	Positive Ranks	14(ddd)	11,32	158,50	,665
	Ties	3(eee)			
	Total	29			
dtK2fktr2 - dtK1fktr2	Negative Ranks	9(fff)	14,06	126,50	-,815(b)
	Positive Ranks	11(ggg)	7,59	83,50	,415
	Ties	9(hhh)			
	Total	29			
dtK2fktr3 - dtK1fktr3	Negative Ranks	7(iii)	10,86	76,00	-,418(a)
	Positive Ranks	11(jjj)	8,64	95,00	,676
	Ties	11(kkk)			
	Total	29			

Table 4: Experimental and control group students' attitudes toward science and technology course

		N	Mean rank	Sum of ranks	ZAsymp. Sig. (2-tailed)
ftD2fktr1 - ftD1fktr1	Negative Ranks	27(kk)	14,00	378,00	-4,657(b)
	Positive Ranks	0(ll)	,00	,00	,000
	Ties	0(mm)			
	Total	27			
ftD2fktr2 - ftD1fktr2	Negative Ranks	25(nn)	13,00	325,00	-4,057(b)
	Positive Ranks	1(oo)	26,00	26,00	,000
	Ties	1(pp)			
	Total	27			
ftD2fktr3 - ftD1fktr3	Negative Ranks	2(qq)	7,00	14,00	-1,975(a)
	Positive Ranks	10(rr)	6,40	64,00	,048
	Ties	15(ss)			
	Total	27			
ftK2fktr1 - ftK1fktr1	Negative Ranks	14(lll)	13,18	184,50	-2,403(b)
	Positive Ranks	7(mmm)	6,64	46,50	,016
	Ties	8(nnn)			
	Total	29			
ftK2fktr2 - ftK1fktr2	Negative Ranks	10(ooo)	9,35	93,50	-,813(b)
	Positive Ranks	7(ppp)	8,50	59,50	,416
	Ties	12(qqq)			
	Total	29			
ftK2fktr3 - ftK1fktr3	Negative Ranks	11(rrr)	12,68	139,50	-,428(b)
	Positive Ranks	11(sss)	10,32	113,50	,669
	Ties	7(ttt)			
	Total	29			

technology course scale (p< .05). However, for the third factor it was found that there is a significant positive difference. In the control group, it was found that there is significant negative difference at the Interest factor; however there is no significant difference for the other factors.

3.4 Results for the Fourth Research Question

Mann Whitney U-Test was conducted to see if there is a difference between male and female students. The results of this test can be seen in Table 5. It can be seen that there is no difference between male and female students at both groups.

4. DISCUSSION

In this study, elementary school students' attitudes toward technology, use of technology, and science and technology courses were analyzed. The results of the study showed that the experimental group students had higher attitude scores in general. It was found that the tablet computer assisted instruction have positive impacts on students' attitude toward science and students' attitude toward use of technology in the course. However, when we check the dimensions of the Attitude toward Science and Technology Course Scale, it was seen that the tablet computer assisted instruction has negative effect on interest and enjoyment dimensions. There were no significant difference was found between pre and post-test scores of the students in the control group. It was concluded that the tablet computer assisted instruction had positive impacts on students' willingness and motivations in a course. As a result it can be said that use of tablet computers in the instructions have several advantages for both students and teacher. First it allows using multimedia. Use of multimedia increases students' motivation and help students' learning. The results of the current study supports the results of similar studies (Morc 2004; Akpinar et al. 2005; Ozmen 2005; Comek and Bayram 2006; Guzeller and Korkmaz 2007; Liao 2007; Yavuz and Coskun 2008; Bulbul 2009; Naseriazar et al. 2010; Okur and Unal 2010; Guven and Sulun 2012).

Okur and Unal (2010) studied the importance of computer assisted instruction in science teaching. In their study, they found that computer assisted instruction enhances the critical thinking skills. They proposed to use computer assisted instruction methods to have an effective science teaching. Karamustafaoglu et al. (2005), in their study, worked with pre-service science teachers. They concluded that the computer as-

Table 5: Mann Whitney U-Test results for male and femal students from both group

Deney 1	tD1fktr1	tD1fktr2	tD1fktr3	tyD1fktr1	tyD1fktr2	tyD1fktr3	ftD1fktr1	ftD1fktr2	ftD1fktr3
Mann-Whitney U	70.000	73.500	75.500	71.000	76.500	78.500	54.000	75.000	72.500
Wilcoxon W	241.000	118.500	120.500	116.000	121.500	123.500	225.000	120.000	243.500
Z	-.612	-.405	-.298	-.579	-.277	-.149	-1.605	-.455	-.493
Asymp. Sig. (2-tailed)	.540	.685	.766	.562	.782	.882	.108	.649	.622

Deney 2	tD2fktr1	tD2fktr2	tD2fktr3	tyD2fktr1	tyD2fktr2	tyD2fktr3	ftD2fktr1	ftD2fktr2	ftD2fktr3
Mann-Whitney U	67.500	77.500	60.000	63.500	72.000	64.000	80.000	72.000	80.500
Wilcoxon W	112.500	248.500	105.000	108.500	117.000	109.000	251.000	117.000	251.500
Z	-1.275	-.291	-1.747	-1.074	-1.414	-1.292	-.094	-1.019	-.047
Asymp. Sig. (2-tailed)	.202	.771	.081	.283	.157	.196	.925	.308	.962

Kontrol 1	tK1fktr1	tK1fktr2	tK1fktr3	tyK1fktr1	tyK1fktr2	tyK1fktr3	ftK1fktr1	ftK1fktr2	ftK1fktr3
Mann-Whitney U	77.500	78.000	79.500	89.500	79.500	62.000	96.500	92.500	95.500
Wilcoxon W	143.500	144.000	145.500	260.500	145.500	128.000	267.500	263.500	161.500
Z	-.984	-.963	-.894	-.434	-.937	-1.781	-.121	-.312	-.168
Asymp. Sig. (2-tailed)	.325	.336	.371	.665	.349	.075	.903	.755	.866

Kontrol 2	tK2fktr1	tK2fktr2	tK2fktr3	tyK2fktr1	tyK2fktr2	tyK2fktr3	ftK2fktr1	ftK2fktr2	ftK2fktr3
Mann-Whitney U	90.500	79.000	51.500	95.500	79.000	70.000	70.000	78.500	79.500
Wilcoxon W	261.500	250.000	222.500	266.500	250.000	241.000	241.000	249.500	250.500
Z	-.398	-.910	-2.197	-.159	-.930	-1.465	-1.342	-1.016	-.931
Asymp. Sig. (2-tailed)	.691	.363	.051	.873	.352	.143	.180	.310	.352

sisted instruction is an effective way to teach science subjects. Naseriazar et al. (2010) found that the use of tablet computers in chemistry courses helped students to have meaningful learning. Morc (2004) concluded that the feedbacks of the students about the use of tablet computers at the courses were positives. Simon et al. (2004) found that the tablet computer assisted instruction increased teacher efficiency and students participation. All of these recent studies support the findings of the current study that is related with the tablet computers.

In the current study, there is no difference found with respect to gender variable. This result is parallel with the results of Yenice (2003). However, there are several studies which show that gender is one of the factors that make difference on learning outcomes (Zeegers 2001; Cano 2005); while some others showed that there is no difference with respect to gender (Cavallo 1994; Yenice 2003).

5. CONCLUSION

Use of tablet computer in the courses is at the pilot phase in Turkey and some other countries. This makes the results of this study more valuable. The results of this study give insights on effects of such usages on students' attitudes. As can be seen from the results of the study, the data support that the use of tablet computers in the form of tablet computer assisted instruction had positive impacts on students' attitude toward science and students' attitude toward use of technology in the course. However, it is not same for the students' attitudes toward science and technology courses.

6. RECOMMENDATIONS

Based on the literature review, the observations, and the results of the current study, we can recommend that the use of computers in education should not be limited to the class hours. The teachers should give homework, activities, and projects that can be completed with the help of the use of computers out of the classrooms. However, in the classrooms, the teachers should use such devices to help students to learn science related concepts better and have necessary skills to use anytime anywhere. The current study only focused on the attitudes. Moreover, it was limited to the elementary level. There should be more studies on higher levels and on learning outcomes.

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