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The Effect of Science Teaching Enriched With Technological Applications on the Science Achievements of 7th Grade Students

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Abstract

This study aims to research the impacts of science teaching enriched with technological applications on the science course achievement levels of 7th grade students. 13 weeks long research was carried out with 7th grade students studying at a state secondary school in Turkey in 2016. In the study, quasi-experimental method, experimental design with the pretest-posttest control group was used. There were 83 students (control=42, experiment=41) in the study group. “Science Achievement Test” developed by the researchers was used as data collection tool. There are 28 multiple-choice, four-choice items in the achievement test covering subjects taught, and the KR 20 reliability coefficient is 0.78. “Science Achievement Test” was used as the pretest, posttest, and follow-up test. Teaching was carried out by the same science teacher in the science class in both the control and experiment groups. In the control group, student-centered learning approach suitable to the 2013 Science Course Curriculum was given to the students, and no experimental procedure was applied. In the experiment group, 2013 Science Course Curriculum was followed, and teaching was carried out with technology enriched science teaching applications. At the end of the research, it was found that the achievement levels of the experiment group with the technology enriched science teaching applications increased significantly and was higher at a meaningful level than the achievement of the control group students. According to this findings, it can be suggested that technology enriched teaching should also be used in science teaching to address individual differences by enriching teaching.

Keywords: technology, science teaching enriched with technological applications, science teaching, achievement

1. Introduction

Today, societies are changing rapidly. This change brings with it the improvements in the technology and communication. If traditional approaches are thought to be inadequate to come through the challenges in solving the learning-teaching problems, one of the alternative approaches today is to make use of the facilities provided by technology (Caglar, 2007; Yemen, 2009). It is expected that the use of technological applications in the education will contribute to the development of the student’ attitude toward the course. One of the prominent variables affecting the achievement in a course is the attitude towards that course (Cheung, 2009; Erokten, 2017; Guden & Timur, 2016; Gurbuzoglu Yalmanci, 2016). For this reason, one of the most prominent aims of parents and educators should be to improve and increase the attitudes of students towards the class in a positive way (Akcay, Aydogdu, Yildirim, & Sensoy, 2005). Technology enriched teaching can also contribute to the achievements of the students by improving attitudes towards the course with interesting and interactive technological applications that can provide attendance.

When examining the place of technology in teaching, it is observed that one of the most important areas where technology is used for the future of societies is education and training. For this reason, all societies, especially the developed countries, aim to bring quality education to individuals by using technology (Milli Egitim Bakanligi [MEB], 2006). In today’s world where education is influenced by technology, the use of computer technology in teaching-learning process has become compulsory because it is negatively affected by a teaching approach that is not reflected in the educational environment and away from technology (Erdemir, Bakirci, & Eyduran, 2009). In consequence of rapid progresses in the technology, technology has become involved in the education system by integrating with learning environments (Bull at al., 2007; Ekici, Taskin Ekici, & Kara, 2012; Tabach, 2011). The basic aim of the technology in education is to compose effective and permanent learning that is to contribute to human development (Isman, 2005). In fact, the use of technology is regarded by educators, teachers, and researchers as a sign of qualified education (Yildirim & Cakir, 2009). When considering the objects that will facilitate the meaningful and permanent learning of the learners, nowadays computer technology comes to mind, and it is thought that their use in the educational environment will enrich the learning-teaching environment, provide meaningful learning, and support constructivist learning (Ince, 2015).

The inclusion of technology in the learning process provides several advantages. Technological developments constitute a learning process based on discussion and cooperation, in which the students can be active and find solutions to their problems in their own developmental process by avoiding rote learning, create hypotheses and test them, and make assumptions and inferences (Guveli & Baki, 2000). In addition, technology supported teaching not only facilitates learning and teaching situations in the classroom environment but also provides an effective learning environment for those who are interested in the subject outside the classroom without any limitation (Hohenwarter, Hohenwarter, Kreis, & Lavicza, 2008). Technology supported learning environments offer students the opportunity to conduct more qualified learning without space and time constraints (Eristi, Sisman & Yildirim, 2008). Ersoy (2005) stated that, together with technology supported teaching, some learning topics are more individualized and more effective for education. According to Miller (2003), technology is a cognitive tool that, in combination with learning theories applied in classes in today's conditions, aids students in learning initiatives and enhances their learning capacities. According to Tatar, Kagizmanli, & Akkaya (2013), while forming the conceptional and operational knowledge in education in the minds of students, benefiting from technology will facilitate the duty of teachers. In this sense, the teaching of the concepts of the teachers and the students to embody the concepts is possible with the preplanned technology supported course. In Schreyer Bennethum & Albright's study (2011), it is emphasized that the education supported with technology provides a better comprehension of the concepts than the teaching using traditional approaches such as direct instruction method. In this way, students are provided with a more relaxed and flexible approach to problem-solving.

The learning environments using technology influence the emotional state of the students (Dogan, 2012), and offer important opportunities to teachers to develop learning environments where students are motivated, display the least behavioral troubles in the class and learners participate more effectively in the teaching (Bate, Day, & Macnish, 2013). Using these opportunities depends on the use of technology by the teacher, and this occurs when teachers use it effectively in their technology class (Dilworth at al., 2012; Escuder, 2013). Teachers are expected to effectively integrate their teaching with technology in the process of technology integration in education (Albion, 1999; Chen, 2010; Hicks, 2006). The use of various technologies is increasing in the learning-teaching process. These technologies help the teachers through the process of designing and aping the learning-teaching process in and out of the classroom. The design, preparation, and application of the technology supported teaching process not only require high-level technological knowledge, it also requires pedagogical knowledge and content knowledge (Ergun, 2017). According to this, it can be told that Technological-Pedagogical-Content-Knowledge (TPACK) is needed for technology supported teaching. Based on this information, the literature on TPACK has been included in the research.

Successful science education is only possible with qualified and up-to-date teachers who can keep up with technological changes. Science teachers are anticipated to integrate technology into the class environment. Teachers should demonstrate competence to utilize technology to assess learners, to direct them to research topics, and to use student-centered strategies integrated with technology (Babacan, 2016). Bhattacherjee & Premkumar (2004) and Govender & Govender (2009) states that it is requisite to create opportunities for teachers to integrate technology effectually with teaching. This can be accomplished by teachers with TPACK competencies and learning environments that allow using TPACK. Examples of learning environments using TPACK can be technology enriched learning environments. In this study, research on the impact of the science teaching enriched with technological applications, therefore learning environments where TPACK is used, on achievement bring prominence into this study.

In addition, TPACK is among the competencies that a qualified and sufficient teacher should have in the research titled "Teaching Profession Competencies" by Turkish Education Association [TEA] and in the "National Teacher Profession Strategy Document Draft" published by MEB (MEB, 2011; TEA, 2009). The application of technology supported teaching strategies in the education, the inclusion of technology-enriched teaching environments, and the measurement of student learning through technology is included in the National Education Technologies Standards emitted by International Society for Technology in Education (ISTE) in 2002 and 2008 (ISTE, 2002; ISTE, 2008). In this context, teachers need to integrate the teaching process with technology. The integration of the teaching process with technology points to the utilizing of TPACK in the education due to the integration of pedagogical knowledge and technology. TPACK is theoretically structured on the theoretical framework of Pedagogical Content Knowledge given by Schulman (1986) in the literature (Abbitt, 2011; Agyei & Voogt, 2012; Archambault & Crippen, 2009; Graham at al., 2009; Koehler, Mishra, & Yahya, 2007; Koh, Chai, & Tsai, 2015; Tabach, 2011). In other words, TPACK is a theoretical framework explaining how to integrate technology into the education (Yuksel Arslan, 2013). TPACK represents a diverse set of information that is different from, and beyond, a combination of technology, pedagogy, and content knowledge (Mishra & Koehler, 2006). TPACK is a dynamic relation among the technology, pedagogy, and the content knowledge (Koehler, Mishra, & Yahya, 2007). TPACK contributes to how a teacher can transform technological instruments into pedagogic strategies and contextual presentations while instructing a subject and how it influences students' learning (Graham at al., 2009).

When the importance of using technology in teaching is examined, Caglar (2007) points out that the use of educational technology enriches the educational environment and place students in the learning center. In education, technology plays a supporting, balancing, and helpful role in the different learning styles, different learning characteristics (Sani Bozkurt, 2017). When examining the literature on the use of technology in the education, there are studies providing interactive communication of technological tools in science education (Polman & Pea, 2001), instructing concepts thanks to mutual online controversy (Hoadley & Linn, 2000), making technology supported scientific discussions that enable a society to value sharing information as much as the formation of knowledge (Bell & Linn, 2000; de Vries, Lund, & Baker, 2002), and emphasizing that technological tools are effective in increasing the learning of abstract concepts (Ayvaci, Ozsevgec, & Aydin, 2004). In addition, when literature on technology supported teaching is examined, it can be seen that achievement (Akcay, Tuysuz, & Feyzioglu, 2003; Guven & Sulun, 2012; Yemen, 2009), attitude (Akcay at al., 2003; Kocak Altundag, & Alkan, 2016; Korucu & Yucel, 2015), interest (Korucu & Yucel, 2015; Kaya & Aydin, 2011; Karamustafaoglu, Aydin, & Ozmen, 2005; Sani Bozkurt, 2017; Tekinarslan et al., 2015), motivation (Korucu & Yucel, 2015; Kaya & Aydin, 2011; Karamustafaoglu at al., 2005; Sani Bozkurt, 2017; Kramarski & Feldman, 2000) contributes to the development of recall and understanding levels (Kaya & Aydin, 2011), learning (Saka & Akdeniz, 2006; Fulton, Glenn & Valdez, 2004; Hohenwarter at al., 2008), to the effective participation of learners in the learning and class, materializing the abstract concepts (Laney, 1990; Ozmen, 2004), facilitating meaningful and permanent learning (Ince, 2015), enriching the learning-teaching process (Caglar, 2007; Ersoy, 2005; Ince, 2015; Karamustafaoglu at al., 2005; Kirbag Zengin, Kirilmazkaya, & Kececi, 2014; Laney, 1990; Ozmen, 2004), adding visual aids to class (Birinci Konur & Ayas, 2009; Eric & Stratton, 2003), providing meaningful learning (Ince, 2015), and support for constructive learning (Ince, 2015).

In addition to the above studies indicating the benefits of using technology in teaching, in their research, Bahcekapili (2011), Celik & Kahyaoglu (2007), Cubukcu & Tosuntas (2016), Dagdalan & Tas (2017), Erdemir at al. (2009), Gumusdag at al. (2013); Guven & Sulun (2012), Karoglu Kocaman (2015); Korucu & Yucel (2015), ISTE (2002), ISTE (2008), Saka Ozturk (2017), Seferoglu, (2009), Tekinarslan at al. (2015), Timur (2011) emphasized that technology ought to be included in the learning environments.

In summary, technology-supported teaching has an important role in enabling students to learn more effectively and materialize the scientific concepts (Ozmen, 2004). Moreover, according to Akgun, Yilmaz, & Seferoglu (2011), students think that they can better understand and remember the topics in the class supported by technology. For this reason, it is thought that technology ought to be integrated with learning environments to make the teaching-learning processes more efficient and to train more qualified individuals (Birinci Konur, Sezen, & Tekbiyik, 2008).

The research is seen to be substantial in the sense of the use of TPACK in the science teaching process, which is accepted as a teacher competency by TEA and MEB (MEB, 2011; TEA, 2009), the application of the technology supported teaching strategies in the learning process and the inclusion of technology-enriched learning environments specified in the National Education Technology Standards published by the ISTE in 2002 and 2008 (ISTE, 2002; ISTE, 2008). Moreover, it can be said that this research differs from the studies in the literature by integrating various technological applications that can enrich the learning-teaching process and address individual differences in the learning-teaching process. It is also thought that this research is important for showing that the technological tools and programs such as the computer, tablet, smartphone, internet, etc. can be used in teaching process besides playing games and following social media.

1.1 Purpose of the Research

Based on these reasons, this research was carried out to examine the effects of science teaching enriched with technological applications on the science achievements of 7th grade students and the permanence of these achievements. In this context the following problems were examined in the research.

1. Is there a significant difference between science course achievements pre-test, post-test, and follow up test scores of the students in the experiment group who are taught by science teaching enriched with technological applications?

2. Is there a significant difference between science course achievements pre-test, post-test, and follow up test scores of students in the control group who are taught by science teaching suitable to the Science Course Curriculum with student-centered learning approach?

3. Is there a significant difference between the science course achievements pre-test, post-test, and follow up test scores of the experiment and control group students?

2. Method

2.1 Research Design

The method of the research is the quasi-experimental method. As the research design, experimental design with the pretest-posttest control group was applied (Linn & Gronlund, 2000). The research is quasi-experimental because while assigning the students to the control and the experimental groups, existing classes used without randomness or drawing (Buyukozturk at al., 2016; Karasar, 2016).

2.2 Study Group

There are 83 students in the study group of the research. 42 of these students are in control and 41 of them are in the experimental group. In the research, there were two controls from the 4 existing classes in the school, and the other two were determined as experimental groups.

2.3 Participant Characteristics

The participants' characteristics were determined by items in the personal information section of the data collection tool. The study group composed of the 7th grade students studying at a public elementary school in Turkey in 2016. There were 21 female and 20 male students in the experimental group and 21 female and 21 male students in the control group. All students live in the district. All of the students have computers (tablet computer or desktop computer or laptop) in their homes and they use computers. All students have the possibility to use the internet through internet connection in their home or parents' smartphones. 27 student's (control:male=8, female=6; experiment:male=7, female=6) interest towards technology is very high, 37 student's (control:male=10, female=9; experiment:male=9, female=9) interest towards technology is high and 19 student's (control:male=3, female=6; experiment:male=4, female=6) interest towards technology is medium level.

2.4 Sampling Procedures

While determining the sample, it was considered to choose students and science teachers that researchers can easily teach, train, guide about the science teaching enriched by technological applications, and follow the applications. For this reason, the sampling method of the research is a convenience sampling (Buyukozturk at al., 2016; Karasar, 2016).

2.5 Data Collection Tools

In this research, "Science Achievement Test" developed by the researchers. "Science Achievement Test" was used to determine the achievement level of the science course. The achievement test covers the topics of "Force and Energy, Electricity, Light" which is aimed to be taught in the research and it was prepared to measure the targets of these subjects in 2013 Science Course Curriculum. The science achievement test consists of four multiple choice items. The validity of the test was evaluated in the sense of content validity. The achievement test was examined with the table of specifications by asking the expert opinion of the two faculty members working in the science education, and it was decided that the content validity is provided. The achievement test prepared with 36 items at the beginning was applied to 283 7th-grade students learning the "Force and Energy, Electricity, Light" before the experimental process. The final 28 item achievement test was obtained by subtracting the items with lower item discrimination index than 0.20. The Kunder Richardson 20 reliability coefficient of science achievement test was 0.78.

This test was used as a pre-test to detect the science course achievement levels of the 7th-grade students at the beginning of the research, as posttest at the end of the research to determine the effect of the experimental application, and as a follow up test 6 week after the completion of the research. The total score from the achievement test indicates the individual's the level of achievement in the science course.

The characteristics of the participants (gender, location, presence of a computer at home, internet usage status, interest towards technology) were determined by items in the personal information section of the data collection tool. The level of students' interest towards technology has been determined by the question "How do you express your level of interest towards technology? Very high, high, medium, low or very low". It was assumed that the answers given by the students reflect the level of students' interest towards technology.

2.6 Data Analysis

SPSS 22 was used to analyze the quantitative data of the research. The descriptive statistical techniques and the Shapiro-Wilk test were used to detect the general distribution of answers given by the students and to the test whether the quantitative data were normally distributed. In addition, central tendency and central distribution values of science achievement test scores were used. "Independent Sample t-test" analysis was applied to detect whether there was a meaningful difference between the averages of the scores of control and experimental group in the research. "One-Way

ANOVA for Repeated Measures" was used in the control and the experimental group to detect whether there was a meaningful difference between the pretest score averages at the beginning of the research, posttest score averages in the end of the research, and the follow-up test score averages at 6 weeks after the research was completed.

All analyzes were evaluated at .05 significance level (Buyukozturk, 2016). The Eta Squared ($\eta 2$) value was calculated to determine the effect size when a significant difference was detected. If Eta Squared ($\eta 2$) value is $0.14 \leq \eta 2$, it can be interpreted as the high effect size. If Eta Squared ($\eta 2$) value is $0.01 < \eta 2 < 0.06$, it can be interpreted as the small effect size. For the Eta Squared ($\eta 2$) value, $0.06 \leq \eta 2 < 0.14$ can be interpreted as the medium effect size (Cohen, 1988).

2.7 Experimental Manipulations or Interventions

This research was conducted with students studying in 7th grade at a public elementary school in Turkey in 2016. The research application lasted 13 weeks. The application of the measuring tool isn't included in this period. At the beginning of the research, "Science Achievement Test" was used as the pretest. The application step was performed by the same science instructor in both groups. In the control and experiment group, the teaching of subjects of Force and Energy, Electricity, Light was carried out in accordance with the curriculum taking into consideration the durations and aims for these subjects. The teaching of these subjects was done in 52 hours during 13 weeks in 4-hour science course. Teaching in the control and experiment group was carried out according to the aims of the Science Course Curriculum that was started to be implemented in 2013.

The topic of "Force and Energy" includes "Mass, Weight, Solid Pressure, Liquid Pressure, Gas Pressure, Work, Energy and Energy Transformations". In this topic; it is aimed to gain knowledge and skills about "mass and weight, relation between force and solid pressure, factors affecting solid pressure, relation between force, work and energy, energy types and energy transformations". The topic of "Light" includes "Mirrors, Reflection and Absorption of Light". In this topic; it is aimed to acquire knowledge and skills about "mirror types and usage areas, light absorption, color appearance of objects in this context and ways of utilizing solar energy". The topic of "Electricity" includes "Electricity Connection and Connection of Bulbs". In this topic; it is aimed to acquire knowledge and skills about "serial and parallel connection, use of ammeter and voltmeter, ohm's law, transformation of electricity energy into heat, light and motion energy taking into consideration technological applications".

There is no experimental application on the control group students. Teaching in the control group was carried out by considering the aims stated in the 2013 Science Course Curriculum and the activities in the science course book were carried out by a student-centered learning-teaching process. Cause the 2013 Science Course Curriculum has a student-centered teaching practice requirement. In addition, no manipulations have been performed that could affect the results of the study, other than teaching in the control group.

In the experimental group, teaching was carried out with science teaching enriched with technological applications considering the aims of the science curriculum. In other words, while teaching was carried out in a similar way to control group, teaching was enriched by technological applications. Technology enriched teaching practices include teaching practices supported by TPACK. Technology Enriched Teaching Practices include Student Reply Program, Online Exam-Competition Preparation and Application Programs, Puzzle Preparation and Application Programs, Concept Map Preparation Programs, Concept Caricature Preparation Programs, Digital Story Preparation Programs, Virtual Classroom Preparation and Application Program, Educational Information Network, Learning Objects and Teaching Practices such as Vitamin, Morpa Campus, Okulistik, etc., QR Code Teaching Practices, Web 2.0 Tools, Presentation Preparation Tools, Online Simulation Preparation and Application Programs, Online Animation Preparation and Application Programs, Online Video Preparation and Application Programs, Social Media Networks and Applications in Teaching. These applications have been used in education by using smart board, internet, and tablet computer by considering the aims of the curriculum and preparing them on the online programs. In the experimental group teaching process; concept cartoons, animations, concept maps prepared by the researchers in the online programs are used in the course introduction; experiment-activities conducted with the simulations during the development phase; presentations and videos in the explanation stage; increased reality applications and digital story in the extension phase; puzzles, exams, concept map in the evaluation stage. QR Code and virtual classroom applications are utilized in each step of the course. At the end of the experimental step, "Science Achievement Test" was used as a posttest. The achievement test was applied as a follow up test six week after it was administered as a posttest.

3. Findings

The statistical method to be used in the analysis of quantitative data was investigated before students' achievement pretest, posttest, follow-up test scores and first-semester science course grades were analyzed. Descriptive analysis was carried out to detect the statistic techniques that should be used in the analysis of the achievement test data and the first-semester science course grades, and the findings are presented in Table 1. The findings of Table 1 were examined, and it was evaluated whether the data showed normal distribution.

Table 1. Descriptive statistical results of science achievements test and first-semester science course grades

Test	Group	N	$\bar{X}$	S	Median	Mod	Skewness	Kurtosis	Shapiro-Wilk p
Pretest	Control	42	9.14	3.65	9.00	9.00	0.13	-0.96	0.20
	Experiment	41	8.83	3.25	9.00	8.00	-0.12	-1.03	0.12
Posttest	Control	42	19.71	3.93	19.50	18.00	0.19	-0.98	0.18
	Experiment	41	23.32	3.09	24.00	25.00	-0.30	-0.79	0.11
Follow-up Test	Control	42	15.78	4.23	15.00	14.00	0.45	-0.57	0.12
	Experiment	41	21.68	2.97	22.00	23.00	0.14	-0.66	0.46
Science course grades	Control	42	72.81	13.04	71.50	73.00	0.15	-0.46	0.88
	Experiment	41	72.59	12.26	72.00	70.00	0.03	-0.49	0.66

The findings in Table 1 show that both the experimental and control group's arithmetic average, median and mode values for each of the achievement score in the pretest, posttest, follow up test, and first semester science course grade of the students are close to each other. In addition, according to Table 1, the kurtosis and skewness coefficients of pretest, posttest, follow-up test scores, and first-semester science course grades are between -1.5 and +1.5. In addition, the Shapiro-Wilk test was performed to determine whether the data had a normal distribution. Table 1 show that the level of significance in the results of the Shapiro-Wilk analysis of the achievement pre-test, post-test, and follow-up test data and first-semester science course grades is greater than .05.

It can be told that the experiment and control group achievement pretest, posttest, and follow-up tests and the first-semester science course grades are normally distributed based on the findings that arithmetic mean, median and mode values of achievement pretest, posttest, follow-up tests and first-semester science course grades are close to each other, the range (-1.5 to +1.5 interval) of the kurtosis and skewness coefficients, the number of samples in the experiment and control group is greater than 30, the significance level of Shapiro-Wilk Test is greater than 0.05 (Baykul & Guzeller, 2014; Kalayci, 2016; Koklu, Buyukozturk, & Cokluk Bokeoglu, 2006; Tabachnick & Fidell, 2013). Parametric tests were used in the analysis of the data, which showed normal distribution.

In order to detect whether the students in the experimental and control groups were equal in terms of achievement levels at the beginning of the research period, the students' scores in the first semester science course were compared in Table 2.

Table 2. Results of the Independent Sample t-test analysis of the 7th grade 1st semester science course grades of the experiment and control group students

Group	N	$\bar{X}$	S	df	t	p
Control	42	72.81	13.04	81	0.08	0.94
Experiment	41	72.59	12.26			

When the findings in Table 2 are examined, it is seen that 7th grade students in experiment and control group did not differ significantly in the first semester science course achievement scores ($t_{(81)}$= 0.08; p>.05). Based on this finding, it can be said that at the beginning of the research period, the science achievements levels of the experimental and control group students are similar and equal.

At the beginning of the application step of the research, the equivalence of the experimental and control group students in terms of the achievement level of the subjects to be taught was compared, and the results are given in Table 3.

Table 3. Results the Independent Sample t-test analysis regarding the achievement pretest scores of the control and experimental groups in the science course

Group	N	$\bar{X}$	S	df	t	p
Control	42	9.14	3.65	81	0.41	0.68
Experiment	41	8.83	3.25			

According to the findings in Table 3, it is seen that at the beginning of the research, the average scores of the achievement pretests of the students in the experimental and control groups did not differ significantly ($t_{(81)}$= 0.41; p>.05). This can be interpreted as the fact that at the beginning of the research, the achievements of the students of the experimental and control groups are similar.

Table 4. Results of the Independent Sample t-test analysis regarding to the post-test scores of the students in the control and experimental groups

Group	N	$\bar{X}$	S	df	t	p*
Control	42	19.71	3.93	81	-4.64	.000
Experiment	41	23.32	3.09			

* p<0.05

According to the results of the t-test analysis in Table 4, at the end of the experimental process, there was a significant difference between the achievement posttest average scores of the students in the experimental group and the control group ($t_{(81)}$= -4.64; p<.05), and this difference is in favor of students in the experimental group receiving technology enriched science teaching. In other words, at the end of the application step of the research, the posttest average score of the students of the experimental group ($\bar{x}$ = 23.32) was significantly higher than the score of the students of the control group ($\bar{x}$ = 19.71). The effect size value for this significant difference was calculated as η2 = 0.21. Since η2 ≥0.14, the effect size can be explained as a high-level effect (Cohen, 1988).

Table 5. Results of the Independent Sample t-test analysis regarding the science achievement follow-up test scores of the students in the control and experimental groups

Group	N	$\bar{X}$	S	df	t	p*
Control	42	15.78	4.23	81	-7.34	.000
Experiment	41	21.68	2.97			

* p<0.05

When the findings in Table 5 were examined, it was seen that there was a significant difference between the achievement test scores of the experimental and control group students after 6 weeks of the experimental procedure ($t_{(81)}$= -7.34; p<.05). When the arithmetic average of the achievement follow-up test scores of the students in the experiment ($\bar{x}$= 21.68) and control ($\bar{x}$= 15.78) are compared, it can be said that the scores of the students in the experimental group are significantly higher than those in the control group. The effect size value η2 = 0.40 was calculated for the significant difference. Since η2 ≥0.14, the effect size means an effect at a high level (Cohen, 1988).

Table 6. The measures of central tendency and spread of the science achievement test scores of the control group students

Measurement No	Measurement	N	$\bar{X}$	S
1	Pretest	42	9.14	3.65
2	Posttest	42	19.71	3.93
3	Follow up test	42	15.78	4.23

Table 7. The One-Way ANOVA results for repeated measures of achievement test scores of students in the control group

Source of Variance	Sum of Square	df	Mean Square	F	p*	Significant Difference
Between Subjects	1447.881	41	35.314	211.518	.000	1-2 1-3 2-3
Measurement	2398.429	2	1199.214			
Error	464.905	82	5.670			
Total	4311.215	125				

* p<0.05

According to the findings in Tables 6 and 7, there is a significant difference between the science achievement pretest ($\bar{x}$ = 9.14), posttest ($\bar{x}$ = 19.71), and follow-up test ($\bar{x}$ = 15.78) scores of the students in the control group (Wilks' Lambda= 0.07, $F_{(2-82)}$= 211.518; p<.05). As a result of the Bonferroni analysis to determine the direction of difference, this difference is in favor of posttest between pretest-posttest and is in favor of follow-up test between the pretest-follow up tests. Accordingly, it can be said that student-centered teaching in the control group is effective at increasing the level of achievement. However, when Table 7 is examined, it is seen that there is a significant difference between posttest and follow-up test in favor of posttest. In other words, the achievements of the control group students at the end of the research 6 weeks later decreased at a significant level compared to the end of the research. According to this, it can be said that this increase in achievement has not been preserved after 6 weeks. The effect size value was calculated as η2 = 0.93 for the significant difference. Because η2 ≥0.14, the effect size of student-centered teaching in the control group can be interpreted as a high-level effect (Cohen, 1988).

Table 8. The measures of central tendency and spread of the science achievement test scores of the experimental group students

Measurement No	Measurement	N	$\bar{X}$	S
1	Pretest	41	8.83	3.25
2	Posttest	41	23.32	3.09
3	Follow up test	41	21.68	2.97

Table 9. The One-Way ANOVA results for repeated measures of achievement test scores of students in the experimental group

Source of Variance	Sum of Square	df	Mean Square	F	p*	Significant Difference
Between Subjects	487.935	40	12.198	308.413	.000	2-1 3-1
Measurement	5163.041	2	2581.52			
Error	669.626	80	8.37			
Total	6320.602	122				

* p<0.05

The findings in Tables 8 and 9 shows that there is a significant difference in the level of achievement pretest, posttest, and follow-up test scores of the experimental group students (Wilks' Lambda=0.06, $F_{(2-80)}$=308.413; p<.05). According to Table 9, this significant difference is in favor of posttest between the scores of the pretest-posttest and is in favor of the follow-up test between the scores of the pretest-follow-up test. According to this finding, it can be said that the achievement level of the students in the experimental group were higher significantly at the end of the research ($\bar{x}$ = 23.32) and at the end of the six weeks after the end of the research ($\bar{x}$ = 21.68) than the achievement level at the beginning of the research ($\bar{x}$=8.83). In addition, according to the findings in Table 9, it was determined that the difference between the follow-up and posttest score averages was not significant, although the average of the follow-up test scores obtained six weeks after the application step was lower than the average of the posttest scores. This result shows that the students in the experimental group have similar levels of science achievements at the end of the experimental procedure and 6 weeks after the experimental procedure. These results demonstrate that technology enriched science teaching practices are effective at a significant level in improving the achievement levels of science teaching and maintaining its permanence. The effect size value was as $\eta 2$ = 0.95 calculated for the significant difference. Since $\eta 2 \geq 0.14$, it means an effect at a high level (Cohen, 1988).

4. Discussion and Conclusion

This research was realized to investigate the impact of science teaching enriched with technological applications on the science achievements of 7th grade students. At the beginning of the experimental process, the pupils in the experiment and control groups are similar and equal in sense of the achievement level of the first-semester science course ($t_{(81)}$= 0.08; p>.05). In addition, at the beginning of the research period, the science achievements related to the subjects to be taught of the experimental and control group students are similar ($t_{(81)}$= 0.41; p>.05). This situation overlaps with the aim of comparing the effect of the experimental process on the science achievements of the students in the experiment and control group. The science achievements related to "Force and Motion, Electricity, Light" of the students in the experiment and control group have an arithmetic average of 8.83 and 9.14 respectively at the beginning of the research. This finding can be explicate by the fact that the 2013 Science Course Curriculum has a spiral structure and students learn these topics at a simpler level in the 6th grade.

It was seen that the science course achievement scores of the control group students increased significantly at the end of the research period ($F_{(2-82)}$= 211.518; p<.05). This result can be explained by that teaching in the control group is in accordance with the 2013 Science Course Curriculum and the activities specified in the program are student-centered. However, six weeks after the research was completed, there was a meaningful reduce in the achievement compared to the end of the study. Accordingly, it can be said that this increase in achievement has not been preserved six weeks after the research. This result can be explained by the fact that cognitive characteristics such as achievement may change in a short time.

The science course achievement level of students in the experimental group at the end of the research period and after 6 weeks of the research were found to be significantly higher than those at the beginning of the research ($F_{(2-80)}$=308.413; p<.05). Moreover, the achievement level of the experimental group at the end of the research period and after 6 weeks of the study is similar. According to these findings, it can be said that the technology enriched science teaching is effective in improving the science course achievement scores of the students in the 7th grade and that this improvement in the science course achievement scores is preserved after 6 weeks. In addition, the increase in the science course achievement of the students in the experimental group is higher than the increase in the science course achievement of the students in the control group. This conclusion can be explained by technology enriched teaching involving technological applications with interesting, interactive, participatory, visual, and auditory features. The preservation of this development in the achievement can be explained by visual, auditory, verbal, participative elements facilitating learning and remembering in technological applications and motivating students to learn by attracting attention.

The research findings show that at the end of the experimental process, the achievement scores of the students in the experimental group were significantly higher than those in the control group ($t_{(81)}$= -4.64; p<.05). 6 weeks after the experimental procedure, the achievement scores of the students in the experimental group are significantly higher than those in the control group ($t_{(81)}$= -7.34; p<.05). According to this, it can be said that the technology enriched science teaching is more effective than the teaching in the control group on the increase of the science achievements level of the 7th grade students in the middle school and the preservation of this increase after 6 weeks.

When investigating the literature on the impact of the technology enriched science teaching on the achievement, it seems to have a positive effect. In the research conducted by Benli, Kayabasi & Sarikaya (2012), it was determined that the technology supported teaching had a meaningful impact on 7th grade students' successes in the Light chapter of science class and its permanence. In his research, Sensoy & Yildirim (2017) has reached the conclusion that science teaching with information technologies and applications contributed significantly to the success of the 6th-grade students. In the study conducted in the Ogreten & Ulucinar Sagir (2013), it was determined that the interactive teaching method increased the success level significantly on the subject of "Getting to know the matter" more than the training based on the constructivist approach. Kara & Yesilyurt (2007) reached the conclusion that interactive educational lesson software contributes to the development of achievement in cell division subject and reduces the misconceptions of students. In the research conducted by Caglar (2007), it was determined that technology supported teaching in the teaching of Acid-Base topic in the university general chemistry classes significantly increased the achievement compared to the traditional teaching technique. Oner (2009) reached the conclusion that the technology supported teaching method increased the success of 7th grade students. In the study of Kumas (2015), the result was that teacher guidance materials enriched with technological practices significantly contributed to the 9th-grade students in the elimination of learning difficulties, understanding levels, application skills in the process and achievements. Sirakaya (2015) found that increased reality practices were effective at improving the science achievements of 7th grade students and eliminating misconceptions at a meaningful level. Hassan Zadeh Baran (2014) found that teaching animations contributed significantly to the development of the achievements of 2nd-grade science teacher candidates and 11th grade students. In Demirci (2004) research, it was found that web based teaching is effective in the improvement of the achievement in the force and motion subjects and in the elimination of conceptual misconceptions.

Oktay & Cakir (2013) found that the technology supported teaching used in the 8th-grade science class showed a significant difference in favor of the experimental group in sense of success and permanent learning. Linn et al. (1998) found that web-based teaching materials contributed to the students to understand the concept and adaptation of life-long learning to their own lives. In the study carried out by Keles (2007), it was determined that web-based teaching material significantly increased student achievement. The study by Yemen (2009) found that technology supported teaching improves the achievement of 8th grade students. Nick & Urhahne (2004) found that the students who participated in the chemistry class supported by 3D simulations were more successful. In his research, Abraham & Williamson (1995) reached the conclusion that animations make the lessons easier for students to learn and provide the permanent learning. Curaoglu (2012) has reached the conclusion that technology supported teaching has a favorable efficacy on the problem solving skills of 6th-grade students. Kocak Altundag & Alkan (2016) determined that the technology supported teaching enhances the academic achievement of science teacher candidates on volumetric titration.

Since computer supported teaching is a part of the technology supported teaching, the literature on the influence of computer supported teaching on the success has also been examined. In the study conducted by Sahin & Akbaba (2018), it was detected that computer supported teaching contributed meaningfully to the learning of abstract concepts and the improving of academic achievement of the 7th grade students. Altunay (2006) found that computer supported teaching in the 6th grade science class was positively affected the achievement in the lesson and the recall of topics compared to traditional teaching. Ozabaci & Olgun (2011) stated that computer supported science teaching increased the 6th grade students' achievement in science class. Aycan et al. (2002) reached the conclusion that computer supported teaching is more impact than traditional method in the development of the success. Furthermore, it was detected that the experimental group students found the topic more interesting and permanent with computer supported teaching. In his meta-analysis study, Onuoha (2007) found that computer-based laboratory applications positively influenced students' attitudes toward science achievements and science compared to traditional laboratory practices.

Moreover, in many studies, it has been observed that using technology in teaching has improved the students' achievement (Akcay at al., 2003; Bakac, Kartal, & Akbay, 2010; Bozkurt & Sarikoc, 2008; Pektas, Turkmen, & Solak, 2006; Tas, Kose, & Cepni, 2006; Tezcan & Yılmaz, 2003; Turkan, Yalcin, & Turkan, 2010; Tuysuz, 2010; Wainwright, 1989; Yigit & Akdeniz, 2003).

The above research results show that technology and computer supported teaching increases the achievement at a meaningful level. Computer supported teaching practices are also included within the scope of technology enriched teaching. Therefore, the conclusions of the above studies support the result of this research that the technology enriched teaching increases the science achievements at a significant level.

To summarize the results of study, it has been determined that science teaching enriched by technological applications has a meaningful impact on the increase of the science course achievements level of the 7th grade students and the permanence of this achievement. Student-centered teaching in the control group also showed a significant rise in the science course achievements scores. However, the increase in the science course achievement of the experimental group students in the research process is higher than the increase in the achievement of the control group students. In addition, six weeks after the research was completed, the increase in the science course achievements of the control group students was not preserved. In addition, at the beginning of the application phase, the science course achievement levels of the students in the experiment and control groups did not show any significant difference. However, at the end of the application stage and six weeks after the application stage, the science course achievement level of the experiment group students were found to be significantly higher than the control group students. These results show that technology enriched science teaching is more effective than teaching in the control group to increase the science course achievement scores of the 7th grade students and to ensure the permanence of the achievements.

On the basis of these results, it can be said that the enrichment of science teaching process with technological applications can contribute to the development of cognitive attributes such as achievement. In the studies conducted, it has been observed that in educational environments where technological tools and computers are used, the achievement level of students has increased, students learn with comprehension not memorization, and high-level thinking skills of students have improved (Renshaw & Taylor, 2000). Therefore, using technology in learning environments in a logical and strategic way with teaching methods will ease and enhance learning and training (Oktay & Cakir, 2013). In the study conducted by Bacanak, Karamustafaoglu, & Kose (2003), it was emphasized that the usage of technology, which is applied in learning environments and has a favorable influence on the success of the students, should be included in the education.

The contribution of technology enriched teaching to the development of achievement at a meaningful level can be explicated by the fact that technology enriched teaching involves interesting, interactive, and technological applications that make possible students to join actively in class. Based on the positive effect of science teaching enriched with technological applications in the research, it can be said that teaching should be supported with technology to enrich the learning-teaching process and technological applications should be included in education. In other words, TPACK should be used in the teaching environments. To support the teaching environments with technological applications, teachers need to have and use TPACK. For this purpose, it can be said that the education faculties who train teachers should include TPACK and the use of TPACK in teaching in their program.

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