THE EFFECT OF USING AUGMENTED REALITY APPLICATIONS ON SOCIAL STUDIES EDUCATION*

Araştırma Makalesi

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Abstract

The aim of this study is to examine the effects of investigate social studies teaching supported by teaching materials developed with augmented reality (AR) technology applications on students' academic achievement, attitudes and motivations towards the course and to determine the attitudes of students using AR technology towards the use of AR applications in the classroom. An experimental design using quantitative research methods was employed in the present study. The study sample consists of 70 5th grade students studying at a junior high school in south Turkey in the 2017-2018 academic year. Positive effects of the use of AR applications on students' academic achievement, attitudes and motivation towards the course were observed. In addition, students using AR applications were satisfied with the use of the applications, were willing to use the application and did not have any worries while using the application. Therefore, an increase in the use of activities related to AR applications in education processes is predicted to be beneficial for teaching and learning.

Keywords: augmented reality, social studies, educational technology

1 Introduction

The period in which we live is described as a technology era in which continuous and rapid developments occur. The impact of technology on human life is increasing daily, resulting in the development of innovations aiming to improve human life. Innovations generated by technology accelerate the discovery of other innovations. Changes and developments in the technological field exert a positive effect on our lives and are used to solve many of our problems, prompting the hypothesis that technology can also be used for teaching purposes (Yiğit, 2009). Technology is a tool that helps educators to reach the target audience in a short period and allows students to obtain the necessary skills in a more qualified manner using advanced teaching materials (Kaya, 2006).

Technology offers many innovations in the field of education. One of these innovations is augmented reality (AR) technology, which is one of the most popular technologies developed in recent years. Augmented reality is defined as the visualization of a real world environment or element in a live, direct or indirect manner, and an enrichment of these elements by adding perceptual inputs, such as audio, video, graphics, and Global Positioning System (GPS) location information (Abdüsselam, 2014). In addition to computer-generated virtual environments, augmented reality applications combine virtual data such as audio, video, graphics, and GPS location information produced by the computer with the real world.

Augmented reality is widely used in many fields, such as architecture, maintenance and repair, medicine and surgery, entertainment and games, education and training (Yusoff and Sunar, 2014), and is becoming increasingly involved in our daily lives (İçten and Bal, 2017).

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1.1 *Review of the literature about augmented reality technology and its use in education*

In this section, augmented reality technology will be introduced briefly and literature related to its use in education will be presented.

1.1.1 What is Augmented Reality?

Augmented reality is one of the most recent developments in human-computer interaction technology (Billinghurst, Clark and Lee, 2014). This technology is called augmented reality because it increases the user's visual field (Caudell and Mizell, 1992). Augmented reality, defined as the enrichment of a real environment through computers, is a new field that has recently had the opportunity to reach more users through the development of the technology (Somyürek, 2014). This new area is based on the ability to completely align computer graphics with a real world environment (Billinghurst, 2002). In other words, augmented reality material is created by adding virtual objects, such as text, image, video, 3D, sound, and GIFs, to a real image in computer environment.

Certain features of augmented reality systems are expressed in 3 ways:

(1) Real elements and virtual elements are combined,
(2) Interactions are provided in real time, and
(3) The data can be saved in a 3D format (Azuma, 1997).

Augmented reality has been confused with virtual reality, and therefore we must distinguish these two technologies. AR is an extension of virtual reality (Cai, Wang and Chiang, 2013). Virtual reality technologies completely immerse the user in a synthetic environment. The user cannot see the real world around him. In contrast, augmented reality allows the user to see the real world by combining the real world with virtual objects and presenting them interactively (Azuma, 1997).

AR technology is a combination of four different environmental elements. These environmental elements are a camera, computer infrastructure, a marker and the real world. The positioning of these four elements in the real world in 3D is defined as AR (Çakal and Eymirli, 2012).

1.1.2 Research on AR in Education

The areas in which AR applications are used are expanding, as the technology was initially used in the military, industry and health (Caudel and Mizell, 1992). Currently, AR technology, which is used in many fields (Altınpulluk, 2015), has begun to be used in the educational environment following the introduction of devices such as telephones and Tablet computers (Gün, 2014; Güngör and Kurt, 2014; Özdemir, 2017). The availability of software to develop applications for this technology increases the availability of AR technology in the classroom as well (Somyürek, 2014).

Recently, an increasing number of studies have examined the availability of AR technology in education. Based on these studies, the use of AR technology in the educational environment has some advantages. Increasing academic achievement (Cai et al. 2014; İbili, 2013; Ersoy, Duman and Öncü, 2016; Küçük, Yılmaz and Göktaş, 2014; Sırakaya, 2015; Sırakaya, 2016; Şahin, 2017), arousing curiosity and increasing participation in students (Abdüsselam, 2014; Ersoy et al., 2016; Ivanova and Ivanov, 2011; Vojciechowski and Cellary, 2013), increasing the motivation of students and teachers (Atasoy, Gün and Karaoğlu, 2017; İbili, 2013; Çakır, Solak ve Tan., 2015; Di Serio, Ibanez and Kloos, 2013; Erbaş, 2016; Ivanova and Ivanov, 2011; Küçük, Yılmaz, Baydaş and Göktaş, 2014; Sumadio and Rambli, 2010; Vojciechowski and Cellary, 2013), remarkably entertaining properties (Yılmaz, 2014; Yoon, Elinich, Wang, Steinmeier and Tucker, 2012; Vojciechowski and Cellary, 2013), enabling the learning environment to become enjoyable and interactive (Lee, 2012; Gün and Atasoy, 2017), positively influencing student attitudes (Atasoy at al., 2017; Küçük, Yılmaz and Göktaş, 2014 Şahin, 2017), helping students to visualize objects in their minds (Balak and Kısa, 2016; Gün, 2014; Gün and Atasoy, 2017; Shelton and Hedley, 2002; Squire and Klopfer, 2007); Vojciechowski and Cellary, 2013), creating permanent learning (Ersoy et al., 2016; Ivanova and Ivanov, 2011), improving students' visual skills (Kaufman and Schmalstieg, 2003) and their visual intelligence (Yılmaz and Batdı, 2016), and positive effects on self-efficacy perceptions (Erbaş, 2016) and creativity (Gurjar and Somani, 2016) are some of these advantages. Additionally, AR materials are easy to use (Sırakaya, 2015) and save time (Akçayır and Akçayır, 2016; Li, 2010). The use of AR technology for educational purposes is also supported by

studies of prospective teachers (Uluyol and Eryılmaz, 2014) and teachers (Abdüsselam, 2014b; Erbaş, 2016). AR technology may become an indispensable technology in educational environments in the near future (Demirer and Erbaş, 2015; Özdemir, 2017).

None of the studies mentioned here has analysed social studies education. However, since this technology addresses multiple senses at the same time, students might be able to learn about historical subjects without memorizing information and instead enjoy the material presented in social studies courses. Historical sites and museums can be visited, abstract time can be made concrete, and maps and places can be visualized in three-dimensions to allow students to spatially perceive the material (Özel, 2014). The present study attempts to eliminate this deficiency in the literature. In addition to academic achievement, the effects of AR on motivation and attitude will be examined.

Motivation is one of the factors that emphasizes the effectiveness of learning-teaching processes because it affects the students' energy and behaviour (Akbaba, 2006). One of the prerequisites for learning in education is the motivation of the student. A student who has sufficient motivation is ready to learn. When students are motivated, they generally learn the subjects in a short time.

According to Turgut (1990), attitude is the tendency of an individual to behave positively or negatively towards a particular person or situation. Affective, behavioural and cognitive factors affect students' attitudes in educational environments. According to Büyükkaragöz (1997), positive attitudes towards learning make learning easier and negative attitudes make learning difficult. Therefore, the effects of AR-supported social studies teaching on the attitude towards the course should be examined (Gömleksiz and Kan, 2013).

1.2 *Significance of the study*

AR technology is used in many fields, such as health, military, engineering, education, advertising, sports and entertainment, and its use is increasing daily. The use of this technology in the field of education is new and limited. The use of AR technology in education is viewed as a new technological tool. Considering the opportunities offered by AR technology, the benefits of its use in education for students, teachers, and the education process must be evaluated. Therefore, this study is expected to contribute to the literature about the use of AR technology in educational settings.

Studies conducted in the field of education examining AR technology are generally related to teaching courses such as physics, mathematics, science and language. A study targeting social studies education does not exist. Thus, a study examining the use of AR technology in social studies courses will contribute to the social studies literature. A study analysing the effects of teaching a social studies course with AR-supported materials will allow us to determine the positive or negative effects of this method. Therefore, the potential positive effects of AR technology on academic achievement, attitude and motivation in social studies courses must be determined. If a positive effect is observed, the development of new teaching materials and implementation of new classroom practices using this technology will become possible.

1.3 *Purpose of the study*

The general purpose of this study is to determine the effects of the use of AR applications in social studies courses. From this perspective, the basic research question is "What are the effects of using AR applications in a social studies course on the academic achievement, motivation and attitude of the student towards the social studies education course?" Based on this basic problem sentence, the sub-problems listed below will be investigated.

(1) In terms of academic achievement, attitude and motivation towards the course:

- Does a significant difference exist between the pre-test scores of the experimental and control groups?
- Are the pre-test and post-test scores of the experimental group significantly different?
- Are the pre-test and post-test scores of the control group significantly different?

- Are the post-test scores of the experimental and control groups significantly different?

(2) In terms of attitude towards activities prepared with AR:

- What is the attitude of the experimental group towards the use of AR technology?

2 Methods

2.1 *Model used in the study*

In this study, a pre-test/post-test control group model, which is a real experimental model, has been used. This model includes two groups determined by neutral assignment. One group is designated as the experimental group and the other as the control group. Measurements are performed before and after the experiment in both groups.

The dependent variables of this study were teaching with AR-supported instruction and a textbook, and independent variables were academic achievement, attitudes towards the social studies course, motivation and attitudes towards AR materials.

The topics "Journey to History" and "My Beautiful Country" in the 5th grade "Culture and Heritage" learning area in the curriculum of the social studies course were covered with both groups. IA textbook supported with AR materials was used by the experimental group, while only a regular textbook was used by the control group. The data related to the model used in the study is presented in Table I.

Table I. Model of the research.

GROUP	PRE-TEST	TREATMENT	TIME	POST-TEST
Experimental Group	1. Social Studies Course Achievement Test 2. Social Studies Course Motivation Scale 3. Social Studies Attitude Scale	Using textbook supported with the materials prepared Via AR	2 weeks 6 hours	1. Social Studies Course Achievement Test 2. Social Studies Course Motivation Scale 3. Social Studies Attitude Scale 4. Attitude Scale for Augmented Reality Applications
Control Group	1. Social Studies Course Achievement Test 2. Social Studies Course Motivation Scale 3. Social Studies Attitude Scale	Execution of the course with the current textbook	2 weeks 6 hours	1. Social Studies Course Achievement Test 2. Social Studies Course Motivation Scale 3. Social Studies Attitude Scale

2.2 *Population and sampling*

The population of this research consists of 5th grade students studying in secondary schools in a province in Turkey in the 2017-2018 academic year. Cluster sampling, one of the random sampling methods, was used in the present study. In cluster sampling, the sampling unit of clustered subgroups around a particular property is selected. This approach is relatively suitable for studies with a large population (Baştürk and Taştepe, 2013). Demographic information about the sample is presented in Table II

Table II. Demographic Information about the Sample.

Groups	Female	Male	Total
Experimental Group	15	20	35
Control Group	21	14	35
Total	**36**	**34**	**70**

As shown in Table II, the experimental group consisted of 35 students (15 girls and 20 boys), the control group consisted of 35 students (21 girls and 14 boys) and the total number of students was 70.

2.3 *Data collection tools*

"Social Studies Course Academic Achievement Test" was used to evaluate academic achievement, while "Social Studies Course Attitude Scale" was used to measure attitude towards the social studies course. and "Social Studies Course Motivation Scale" was used to examine their motivation. In addition, the "AR Applications Attitude Scale" was administered to students in the experimental group.

Achievement test. An achievement test was developed by the researchers and administered to the experimental and control groups during the pre-test and post-test stages. First, a Table of specifications was created that was consistent with the acquisition of knowledge related to "Journey to History" and "My Beautiful Country" within the content of the 5th grade secondary school social studies course by the students. Afterwards, a question pool of 40 items was created to develop a multiple choice achievement test in line with the acquisitions of Table of specifications. The 5th grade social studies textbooks approved by the Ministry of National Education were used to create the question pool. After the question pool was created, opinions of four experts were recorded and some questions were corrected based on their suggestions. Some questions, on the other hand, were removed from the test, and thus the number of questions was reduced to 33. Based on the results of the pilot study, the average difficulty index of the test was 0.64. Since this score is relatively high, we eliminated some items that increased the difficulty index, resulting in an achievement test with 24 items. The final average difficulty index of the test was 0,587. Item difficulties ranged from 0,80 to 0,30. The mean discrimination index of the test was 0,546. The lower limit of item discrimination value was 0,42.

Social Studies Course Attitude Scale. A new attitude scale was not developed for the study. An attitude scale for the social studies course had already been developed by Gömleksiz and Kan (2013). This scale has 29 five-point Likert-type items. It has five sub-dimensions: love, benefit, interest, desire, and trust. The reliability coefficients of the love, benefit, interest, desire, and trust dimensions are 0,87, 0,88,0,77, 0,76, and 0,74, respectively. Cronbach's alpha value for the whole scale was determined to be ,61 by the developers.

Social Studies Course Motivation Scale. For this study, a motivation scale described in the literature was employed. This motivation scale was developed by Gömleksiz and Kan (2012) and the subscales of the scale were intrinsic motivation, extrinsic motivation and caring. The Cronbach alpha coefficient of the whole scale was 0,79, according to the researchers.

AR Applications Attitude Scale. In this study, the "Augmented Reality Applications Attitude Scale" developed by Küçük at al. (2014) was used to determine the attitudes of students in the experimental group towards the use of AR materials. The scale is a five-point Likert-type scale with 15 items and consists of 3 sub-factors. The Cronbach alpha coefficient of the whole scale was 0,83. Cronbach alpha coefficients of the scales used in this study are presented in Table III.

Table III. Cronbach Alpha coefficients of the scales used in this study

Data collection toll	**Groups**	**Tests**	**Cronbach Alpha Values**
Attitude Scale	Experimental Group	Pre-test	.873
		Post-test	.768
	Control Group	Pre-test	.933
		Post-test	.880
Motivation scale	Experimental Group	Pre-test	.793
		Post-test	.833
	Control Group	Pre-test	.760
		Son-Test	.784

AR Applications Attitude Scale	Experimental Group	Post-test	.802

2.4 *Augmented Reality Materials*

Information about the AR materials used by the students in the experimental group is discussed in this section.

2.4.1 Science Cards: AR Historical Places Cards

Consistent with the achievement benchmarks related to the subject, "AR Historical Places Cards" prepared by the Ders Zamanı Eğitim Yayınları (Lesson Time Education Publications) were provided. Permission was obtained from the institution to use these materials before the study began. After obtaining permission, the students downloaded mobile "AR Science Cards", a mobile AR application, to their mobile devices. Two hours of classroom applications were available through this application, which also works without an internet connection.

2.4.2 Materials Prepared with HP Reveal AR Studio

A user account is first created on a website to create AR materials with the HP Reveal Studio program. Through this program, the textbook was enriched by adding a number of virtual objects to the existing visuals in the textbook. Prior to the application, students downloaded the HP Reveal mobile application to their mobile devices and viewed the materials created through the application.

2.5 *Data Analysis*

The data obtained from the study were statistically analysed with the SPSS 21 program. First, the normal distribution of the data was assessed using a normality test. The data with a normal distribution are presented in Table IV

Table IV. Skewness and kurtosis coefficients of all statistical data obtained from experimental and control groups

	Group	Skewness	Kurtosis
Attitude towards the course	Experimental Group - Pre-test	-.162	-.010
	Experimental Group - Post-Test	.002	-.843
	Control Group - Pre-test	-.645	-.133
	Control Group - Post-Test	-.307	-.281
Motivation towards the course	Experimental Group - Pre-test	-.221	-.083
	Experimental Group - Post-Test	.065	-.574
	Control Group - Pre-test	.078	-1.011
	Control Group - Post-Test	-.095	-.204
Academic achievement test	Experimental Group - Pre-test	-.057	-.565
	Experimental Group - Post-Test	.351	-.738
	Control Group - Pre-test	.226	.430
	Control Group - Post-Test	.197	-1.042
Attitude towards AR materials	Experimental Group - Post-Test	-.409	-1.068

Skewness and kurtosis values should range from +2 to -2 to accept the normal distribution of data (Field, 2009). Based on the skewness and kurtosis values presented in Table 4, the data are within the acceptable normal distribution ranges. Therefore, an independent groups t-test, which is a parametric test, was used to compare the data from the experimental and control groups, and the significance level was set to ,05. A dependent groups t-test, which is a parametric test, was used to compare the pre-test and post-test scores within groups, and the significance level was set to ,05.

3 Results

3.1 *Results Related to Academic Achievement*

An independent groups t-test was applied to determine whether a statistically significant difference in academic achievement existed between the experimental and control groups before the intervention. The results are presented in Table V.

Table V. Independent Groups t-Test Results Related to Values Obtained from Experimental Group Pre-Test and Control Group Pre-Test Achievement Test

	Group and Test	$\bar{X}$	SS	*t*	*p*
Achievement	Experimental Group - Pre-test	12.8	4.2	-.187	.852
	Control Group - Pre-test	13.0	3.3		

According to the data presented in Table V, a significant difference in the scores on pre-intervention achievement test was not observed (t=-.187, p>.05).

A dependent groups t-test was applied to determine whether statistically significant differences between the pre-test and post-test results on the achievement test existed in the experimental group. The results are presented in Table VI

Table VI. Dependent groups t-test results related to Pre-test and post -test Achievement values

	Group and Test	$\bar{X}$	SS	*t*	*p*
Achievement	Experimental Group - Pre-test	12.8	4.2	-5.091	.000
	Experimental Group - Post-test	16.6	2.5		

According to the data presented in Table VI, a significant was observed difference between the scores the experimental group achieved on the pre-test and post-test (t = -5.091, p <.05). Teaching the course with AR-supported materials exerted a positive effect on academic achievement in the experimental group.

After the intervention, an independent groups t-test was performed to determine the difference in academic achievement between the experimental and control groups. The results are presented in Table VII.

Table VII. Independent Groups t-Test Results regarding post-test achievement scores of experimental and control group

	Group and Test	$\bar{X}$	SS	*t*	*p*
Achievement	Experimental Group - Post-test	16.6	2.5	2.977	.004
	Control Group - Post-test	14.5	3.3		

As shown in Table VII, a significant difference in the scores on the post-test achievement test was observed between the groups (t = 2.977, p <.05). Therefore, a significant difference existed between the experimental group and the control group.

After the application of AR technology, the dependent groups t-test was performed to determine whether a difference in the achievement test results of the control group existed. The results are presented in Table VIII.

Table VIII. dependent Groups t-Test Results regarding pre-test and post-test achievement scores of control group

	Group and Test	$\bar{X}$	SS	*t*	*p*
Achievement	Control Group - Pre-test	13.0	3.3	-1.939	.057
	Control Group - Post-test	14.5	3.3		

According to the data presented in TableVIII, a significant difference between in scores for the pre-test and post-test achievement test was not observed in the control group. (t=.-1.939, p>.05).

3.2 *Results Related to Attitudes towards the Social Studies Course*

An independent groups t-test was conducted to determine whether a statistically significant difference in the values obtained from "Social Studies Course Attitude Scale" existed between the experimental and control groups of students. The results are presented in Tables.

First, the existence of a difference between the experimental and control groups before the treatment was examined, and the results are presented in Table IX

Table IX. Independent Groups t-Test Results Related to attitude Values Obtained from pretest conducted to Experimental and Control Group groups

	Group and Test	$\bar{X}$	SS	*t*	*p*
Attitude	Experimental Group - Pre-test	69.2	9.7	-	.316
	Control Group - Pre-test	72.2	14.5	1.011	

A significant difference in the pre-test scores for the attitude scale was not observed between the two groups (t=-1.011, p>.05).

Next, a significant difference in the attitudes of the experimental group towards the course following the introduction of the AR technology was determined. A dependent groups t-test performed for this purpose, and the results are presented in Table X.

Table X. Dependent groups T-test results of pretest and posttest attitude values of the experimental group

	Group and Test	$\bar{X}$	SS	*t*	*p*
Attitude	Experimental Group - Pre-test	69.2	9.7	-9.984	.000
	Experimental Group - Post-test	87.1	3.9		

According to the data presented in Table X, a significant difference was observed between values obtained from the pre-test and post-test using the attitude scale (t=-9.984, p<.05).

A significant difference between the experimental group and the control group in their attitudes towards the course following the implementation of AR technology was also analysed using an independent group t-test, The results are presented in Table XI.

Table XI. **.** Independent groups t-test results related to posttest values of experimental and control groups

	Group and Test	$\bar{X}$	SS	*t*	*p*
Attitude	Experimental Group - Post-test	87.1	3.9	6.708	.000
	Control Group - Post-test	76.9	8.1		

As shown in Table XI, a significant difference in the post-test scores for the attitude scale was observed between the two groups (t=6.708, p<.05). In the experimental group, the use of AR technology increased the positive attitudes towards the course to a greater extent than the control group.

A difference in the attitudes of the control group towards the lesson after the application was also examined. The results of the dependent groups test are presented in Table XII.

Table XII. Dependent groups t-test showing the pretest and posttest results of the control group regarding the attitude

	Group and Test	$\bar{X}$	SS	*t*	*p*
Attitude	Control Group - Pre-test	72.2	14.5	-1.655	.104
	Control Group - Post-test	76.9	8.1		

According to the data presented in Table XII, a significant difference between pre-test and post-test values of the control group was not observed (t=-1.655, p>.05).

Results related to motivation for the Social Studies course

Before the introduction of the application, we aimed to determine whether a significant difference existed in the motivation of experimental and control groups towards the social studies course. An independent groups t-test was conducted for this purpose, and the results are presented in Table XIII.

Table XIII. Independent groups t-test results related to pretest motivation values of experimental and control groups for social studies course

Group and Test	$\bar{X}$	SS	*t*	*p*

Motivation	Experimental Group - Pre-test	78.5	5.4	.480	.633
	Control Group - Pre-test	77.9	5.8		

A significant difference in the pre-test motivation values was not observed between the groups (t=.480, p>.05).

A statistically significant difference in the motivation of the experimental group for the course was analysed after the intervention, and the results are presented in Table XIV.

Table XIV. Dependent groups t-test results of experimental group related to the pretest and posttest values of the motivation towards the course

	Group and Test	$\bar{X}$	**SS**	*t*	*p*
Motivation	Experimental Group - Pre-test	78.5	5.4	-5.858	.000
	Experimental Group - Post-test	86.5	4.4		

According to the data presented in Table XIV, a significant difference was observed between the pre-test and the post-test values obtained from the motivation scale (t=-5.858, p<.05).

Following the intervention, the presence of a significant difference in motivation for the course was analysed between the experimental group and the control group using an independent groups t-test. The results are listed in Table XV.

Table XV. Independent groups t-test results demonstrating post-test achievement scores of experimental and control groups

	Group and Test	$\bar{X}$	**SS**	*t*	*p*
Motivation	Experimental Group - Post-test	86.5	4.4	4.249	.000
	Control Group - Post-test	79.5	8.5		

As shown in Table XV, a significant difference was observed in the post-test values between the two groups (t=4.249, p<.05). However, in the experimental group, the level of motivation towards the lesson increased to a greater extent than the control group.

The existence of a significant difference in the motivation level of the control group after the procedure was also examined. For this purpose, a dependent groups t-test was performed and the results are presented in Table XVI.

Table XVI. Dependent groups t-test related to motivation levels according to pre-test and post-test scores of the control group

	Group and Test	$\bar{X}$	**SS**	*t*	*p*
Motivation	Control Group - Pre-test	77.9	5.8	-1.286	.207
	Control Group - Post-test	79.5	8.5		

As shown in Table XVI, a significant difference was not observed in the post-test values between the two groups (t=-1.286, p>.05).

3.3 *Results on the Attitude towards AR Applications*

Descriptive analyses were conducted to determine the attitudes of experimental group towards AR applications. The results are presented in Table XVII.

Table XVII. Descriptive Analysis of the Data Obtained from Attitude Scale for AR Applications Applied to Experimental Group

Factor	**Min.**	**Max.**	$\bar{X}$	**SS**
Satisfaction	77.1	100	91.5	7.0
Anxiety	20	86.6	28.6	14.4
Desire	70	100	96.8	7.1

When examining the descriptive statistics of the factors included in the attitude scale towards AR applications consisting of 3 sub-dimensions, students in the experimental group were pleased to use AR applications (x = 91.5, sd = 7.0), did not experience anxiety while using AR applications (x = 28.6, sd = 14.4) and were willing to use AR applications (x = 96.8, sd = 7.1).

3.4 Findings and Discussion

3.4.1 The Effect of AR Applications on Academic Achievement

The potential effects of the use of textbook supported by AR technology and other AR-supported teaching materials by the experimental group and the use of the existing textbook by the control group on a significant difference in academic achievement were examined. A statistically significant difference was observed between the experimental group and control group in favour of the experimental group. Significant differences were observed between the pre-test achievement test scores and the post-test achievement test scores of the experimental group, with higher post-test scores recorded. Based on these results, AR technology applications increase academic success. The results obtained in other fields of education (Abdüsselam and Karal, 2012; Fleck and Simon, 2013; Gün, 2014; Korucu, Usta and Yavuzaslan 2016; Özarslan, 2013; Shelton and Hedley, 2002; Şahin, 2017) also apply to social studies education. Multiple explanations for the positive effect of AR applications on the success of the experimental group are proposed. AR, which is a new and interesting technology, may have increased the students' interest in the course and thus increased their success (Küçük, 2015; Sırakaya, 2015). AR technology possesses advantages in increasing the success of the course using AR applications. In the experimental group, AR applications increased the active participation of the students in the lesson, creating a sense of curiosity for the students about a new technological material. Thus, AR applications represent an effective learning tool. In addition to the test results, students in the experimental group exhibited higher thinking and questioning skills than students in the control group, which is important for social studies education (Kiriş Avaroğulları and Vurgun, 2018).

3.4.2 The effects of AR applications on motivation and attitude

Within the scope of the study, the existence of significant differences in motivation and attitudes towards the course were examined between the experimental group who were taught with AR technology-supported materials and the control group who used regular textbooks. While the pre-test scores for the motivation and attitude scales were similar in the experimental and control groups before the intervention, a significant difference in the post-test scores was observed, as the experimental group achieved higher scores. When the pre-test and post-test scores of the experimental group were compared, a significant increase in the post-test results was observed. Therefore, AR technology-supported materials significantly increased the motivation and attitude towards the social studies course. Studies showing that AR technology applications increase the motivation level for the course (Cai, Wang and Chiang, 2014; Di Serio at, al., 2013; Erbaş, 2016; Ersoy at al., 2016; Squire ve Klopfer, 2007; Şahin, 2017; Buluş ve Şentürk, 2018) are confirmed by the findings of the present study.

3.4.3 Students' attitudes towards the use of AR applications

Students were satisfied with the AR applications after use, were willing to use the AR applications, and did not experience anxiety while using the AR applications. Similar results are observed for AR applications in published studies. In the study by Küçük at al., (2014), students developed positive attitudes towards AR practice, and the explanation was that AR practices provide an effective learning environment for the student and increase the motivation of the students towards the course. According to Yusoff and Dahlan (2013), AR technology has the characteristic of attracting attention, and students are willing to use AR applications. Çetinkaya and Akçay (2013) emphasized that AR applications, which are appealing to different senses and are an interesting technology, have an effect on obtaining the desired behaviours. The potential explanation for why students develop a positive attitude towards AR applications may undoubtedly be the unique features of AR technology. Moreover, the use of a new technology in the classroom environment is interesting, thus revealing the desire for students to use the application. This effect was observed in previous studies by various researchers, including the authors of this study (Avaroğulları and Çapar, 2016; Dönmez and Tangülü, 2012; Sidekli and Karaca; Yorulmaz and Can, 2016).

4 Conclusions and recommendations

According to the findings of the study, a logical conclusion is that the use of AR applications supported

education in a social studies course and produced positive results. Students in the experimental group who used AR technology exhibited significantly increased academic achievement, attitudes and motivation towards the course. In addition, the students receiving AR-supported education exhibited extremely positive attitudes towards the materials supported by AR technology and the use of AR technology in the classroom. According to the results, the use of AR applications in social studies courses should be expanded. However, students need mobile devices for these applications to be used in the classroom. This problem should be solved as soon as possible. During this study, the physical conditions of the classroom might have negatively affected the outputs of AR applications. Therefore, the classroom conditions should be regulated when implementing AR practices. Teachers must acquire technical knowledge to prepare AR materials that are suiTable for achieving the course objectives. Most teachers have not received any training on this subject. A lack of knowledge increases professional concerns (Uygun, Avaroğulları, and Oran, 2016). Therefore, training or technical support should be provided to teachers. Finally, the integration of AR applications into the new textbooks is proposed based on the results of this study.

5 Limitations

This article has several limitations. The first is the limited sample size. As educational research is generally conducted with very few financial resources, a study examining a large sample group is impossible to conduct. In the present study, a sample group of the desired size was unable to be established. Another limitation of this study is the technical knowledge of the researchers. Second, the textbook used in the experimental groups is not written with the goal of using augmented reality technology. Therefore, the authors should add the necessary augmented reality applications to this textbook, and augmented reality elements were unable to be added to any desired location. Neither of the researchers are experts in computer technology. They have learned to use augmented reality applications through their personal efforts. Nevertheless, they did not completely reveal the products they visualized. Finally, the duration of the study is another limitation. The study was completed in only two weeks, because the teachers must also teach other subjects in the course, and the researchers were unable to produce augmented reality elements for the entire textbook due to time and technical constraints.

6 References

Abdüsselam, M. S. 2014. *Artırılmış gerçeklik ortamı kullanılarak fizik dersi manyetizma konusunda öğretim materyallerinin geliştirilmesi ve değerlendirilmesi,* (Unpublished doctoral thesis). Karadeniz Teknik University,Institute of Educational Sciences: Trabzon, Turkey

Abdüsselam, M. S. 2014b. Fizik öğretiminde artırılmış gerçeklik ortamlarının kullanımlarına ilişkin öğretmen ve öğrenci görüşleri: 11. sınıf manyetizma konusu örneği. *Pegem Eğitim ve Öğretim Dergisi, 4*(1): 59-74. doi:10.14527/pegegog.2014.004

Abdüsselam, M. S. and Karal, H. 2012. Fizik öğretiminde artırılmış gerçeklik ortamlarının öğrenci akademik başarısı üzerine etkisi: 11. Sınıf manyetizma konusu örneği. Eğitim ve Öğretim Araştırmaları Dergisi, 1(4): 170-181

Akbaba, S. 2006. Eğitimde motivasyon. *Atatürk Üniversitesi Kazım Karabekir Eğitim Fakültesi Dergisi, 0*(13): 343-361. Erişim adresi http://dergipark.gov.tr/ataunikkefd/issue/2774/37170

Akçayır, M. and Akçayır, G. 2016. Üniversite öğrencilerinin yabancı dil eğitiminde artırılmış gerçeklik teknolojisi kullanımına yönelik görüşleri. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi*, *18*(2): 1169-1186. doi:10.17556.jef.86406

Altınpulluk, H. 2015. Artırılmış gerçekliği anlamak: kavramlar ve uygulamalar [Kitap tanıtımı: Understanding augmented reality: concepts and applications by A. B. Craig]. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi, 1*(4): 123-131. Erişim adresi http://auad.anadolu.edu.tr/yonetim/icerik/makaleler/109-published.pdf

Atasoy, B., Tosik-Gün, E. and Kocaman-Karoğlu, A. 2017. İlköğretim öğrencilerinin artırılmış gerçeklik uygulamalarına karşı tutumlarının ve güdülenme durumlarının belirlenmesi. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD), 18*(2): 435-448.

Avaroğulları, M. and Çapar, Z. 2016. Tatihte Türk kadınları ve ilkler. *Araştırma Temelli Etkinlik Dergisi* 2016, 6 (1) 27-49

Azuma, R. T. 1997. A survey of augmented reality. *Presence, 6*(4): 355-385. doi:10.1162/pres.1997.6.4.355

Balak, M. V. and Kısa, M. 2016. Artırılmış gerçeklik teknolojisinin teknik resim eğitimi üzerindeki etkilerinin araştırılması. *Harran Üniversitesi Mühendislik Dergisi, 1*(2): 17-26. Erişim adresi http://dergipark.gov.tr/humder/issue/28977/309951

Baştürk, S. and Taştepe, M. 2013. Evren ve örneklem. Baştürk, S. (Ed.), Bilimsel Araştırma Yöntemleri (s. 129-159). Ankara: Vize Yayıncılık.

Billinghurst, M. 2002. Augmented reality in education. New Horizons For Learning

Billinghurst, M. Clark, A. and Lee, G. 2014. A survey of augmented reality. Foundations and Trends in Human Computer Interaction, 8(2): 73-272, doi:10.1561/1100000049

Buluş Kırıkkaya, E., and Şentürk, M. 2018. Güneş Sistemi ve Ötesi Ünitesinde Artırılmış Gerçeklik Teknolojisi Kullanılmasının Öğrenci Akademik Başarısına Etkisi. (Turkish). *Kastamonu Education Journal*, *26*(1): 181–189. https://doi.org/10.24106/kefdergi.375861

Büyükkaragöz, S. 1997. *Program geliştirme kaynak metinler.* Konya: Kuzucular Ofset

Cai, S., Wang, X. and Chiang, F. K. (2013). Using the augmented reality 3D technique for a convex imaging experiment in a pyhsics course. *International Journal of Engineering Education, 29*(4): 856-863.

Cai, S., Wang, X. and Chiang, F. K. 2014. A case study of augmented reality simulation system application in a chemistry course. *Computers in Human Behavior, 37*: 31-40. doi:10.1016/j.chb.2014.04.018

Caudell, T. and Mizell, W. 1992. Augmented reality: an application of heads-up displays technology to manual manufacturing proceses. *IEEE.* doi:10.1109/HICSS.1992.183317

Cheng, K. H. and Tsai, C. C. 2013. Affordances of augmented reality in science learning: Suggestions for future research. *Journal of Science Education and Technology. 22*(4): 449-462.

Çakal, M. A. and Eymirli, E. B. 2012. Artırılmış gerçeklik teknolojisi. *Kuzeydoğu Anadolu Kalkınma Ajansı (KUDAKA).* Retrieved from: http://www.kudaka.org.tr/ekler/fa254-artirilmis_gerceklik_teknolojisi.pdf

Çakır, R., Solak, E. and Tan, S. S. 2015. Artırılmış gerçeklik teknolojisi ile İngilizce kelime öğretiminin öğrenci performansına etkisi. *Gazi Eğitim Bilimleri Dergisi, 1*(1): 45-58 retrieved from: http://gazipublishing.com/media/uploads/images/GEBD_MAKALELER/SAYI_1/4.%20makale%20recep_cakir-2.pdf

Çetinkaya, H. H., and Akçay, M. 2013. Eğitim Ortamlarında Arttırılmış Gerçeklik Uygulamaları. Paper presented at Akademik Bilişim Symposium, Akdeniz University, Antalya, Turkey. January, 23-25, 2013

Demirel, Ö. and Ün, K. 1973. *Eğitim terimleri.* Ankara: Şafak Matbaası.

Demirer, V. and Erbaş, Ç. 2015. Mobil artırılmış gerçeklik uygulamalarının incelenmesi ve eğitimsel açıdan değerlendirilmesi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, *11*(3): 802-813.

doi:10.17860/efd.29928

Di Serio, A., Ibanez, M. B. and Kloos, C. D. 2012. Impact of an augmented reality system on students' motivation for a visual art course. *Computers and Education, 68*: 586-596. doi:10.1016/j.compedu.2012.03.002

Dönmez, C., and Tangülü, Z. 2012. *Investigating Turkish Republic Revolution History and Kemalism Teacher Attitude toward Using Newspaper in the Class in Term of Some Variable*. Gazi Üniversitesi. Retrieved from http://search.ebscohost.com/login.aspx?direct=trueanddb=ir00559aandAN=tuda.article.90540andlang=trandsite=eds-live

Erbaş, Ç. 2016. *Mobil artırılmış gerçeklik uygulamalarının öğrencilerin akademik başarı ve motivasyonuna etkisi,* (Yayımlanmamış Yüksek Lisans tezi). Süleyman Demirel Üniversitesi, Eğitim Bilimleri Enstitüsü: Isparta

Ersoy, H., Duman, E. and Öncü, S. 2016. Artırılmış gerçeklik ile ilgili motivasyon ve başarı: deneysel bir çalışma. *Öğretim Teknolojileri ve Öğretmen Eğitimi Dergisi, 5*(1): 39-44. Erişim adresi http://dergipark.gov.tr/jitte/issue/25089/264804

Fleck, S., and Simon, G. 2013. An augmented reality environment for astronomy learning in elementary grades: An exploratory study. *IHM 2013 - Actes de La 25ieme Conference Francophone Sur l'Interaction Homme-Machine*, 14–22. https://doi.org/10.1145/2534903.2534907

Gömleksiz, M. N. and Kan, A. Ü. 2012. Sosyal bilgiler dersi motivasyon ölçeğinin geçerlik ve güvenirlik çalışması. *Fırat Üniversitesi Sosyal Bilimler Dergisi, 22*(2): 116-125.

Gömleksiz, M. N. and Kan, A. Ü. 2013. Sosyal bilgiler dersi tutum ölçeğinin geçerlik ve güvenirlik çalışması. *Fırat Üniversitesi Sosyal Bilimler Dergisi, 23*(2): 139-148. Erişim adresi http://dergipark.ulakbim.gov.tr/firatsbed/article/view/5000175411

Gurjar, S. and Somani, H. 2016.. A survey on use of augmented reality in education, *International Journal of Engineering Development and Research, 4*(4): 650-654. Retrieved from http://www.ijedr.org/viewfull.php?andp_id=IJEDR1604097

Gün, E. 2014. *Artırılmış gerçeklik uygulamalarının öğrencilerin uzamsal yeteneklerine etkisi,* (Yayımlanmamış Yüksek Lisans tezi). Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü: Ankara.

Gün, T. E. and Atasoy, B. 2017. The effects of augmented reality on elemantary school studensts' spatial ability and academic achievement. *Eğitim ve Bilim Dergisi 42*(191): 31-51. doi:10.15390/EB.2017.7140

Gungor, C., and Kurt, M. 2014 . Improving visual perception of augmented reality on mobile devices with 3D red-cyan glasses. *2014 22nd Signal Processing and Communications Applications Conference, SIU 2014 – Proceedings*: 1706–1709. https://doi.org/10.1109/SIU.2014.6830577

Ivanova, M. and Ivanov, G. 2011. Enhancement of learning and teaching in computer graphics through marker augmented reality technology. *International Journal on New Computer Archihectures and Their Applications, 1*(1): 176-181.

İbili, E. 2013. *Geometri dersi için artırılmış gerçeklik materyallerinin geliştirilmesi, uygulanması ve etkisinin değerlendirilmesi*, (Yayınlanmamış Doktora tezi). Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü: Ankara.

İçten, T. and Bal, G. 2017. Artırılmış gerçeklik üzerine son gelişmelerin ve uygulamaların incelenmesi. *Gazi Üniversitesi Fen Bilimleri Dergisi, Part C: Tasarım ve Teknoloji. 5*(2): 111-136. Erişim adresi

http://dergipark.gov.tr/download/issue-file/5671

Karasar, N. 1994. *Bilimsel Araştırma Yöntemi: Kavramlar, İlkeler, Teknikler.* Ankara: 3A Araştırma Eğitim Danışmanlık Ltd.

Kaufmann, H. and Schmalstieg, D. 2003. *Mathematics and geometry education with collaborative augmented reality.* Computers and Graphics, 27: 339-345.

Kiriş Avaroğulları, A., and Vurgun, A. 2018. Tarih Öğretmenleri, Tarih Öğretmen Adayları ve Lise Öğrencileri Tarafından Yazılan Tarih Sorularının Analizi. (Turkish). *Kastamonu Education Journal*, *26*(1): 135–142.

Korucu, A. T., Usta, E. and Yavuzaslan, İ. F. 2016. Eğitimde artırılmış gerçeklik teknolojisinin kullanımı: 2007-2016 döneminde Türkiye'de yapılan araştırmaların içerik analizi. *ALEG, 2*(2), 81-92. Erişim adresi http://dergipark.ulakbim.gov.tr/aleg/article/view/5000193254/5000171121

Küçük, S. 2015. *Mobil artırılmış gerçeklikle anatomi öğreniminin tıp öğrencilerinin akademik başarıları ile bilişsel yüklerine etkisi ve öğrencilerin uygulamaya yönelik görüşleri,* (Unpublished doctoral thesis). Atatürk University, Institute of Educational Sciences: Erzurum.

Küçük, S., Yılmaz, R. M., Baydaş, Ö. and Göktaş, Y. 2014. Ortaokullarda artırılmış gerçeklik uygulamaları tutum ölçeği: geçerlik ve güvenirlik çalışması. *Eğitim ve Bilim Dergisi,* 39(176): 383-392. doi:10.15390/EB.2014.3590

Küçük, S., Yılmaz, R. M. and Göktaş, Y. 2014. İngilizce öğreniminde artırılmış gerçeklik: öğrencilerin başarı, tutum ve bilişsel yük düzeyleri. *Eğitim ve Bilim Dergisi, 39*(176): 393-404. Retrieved from: http://egitimvebilim.ted.org.tr/index.php/EB/article/view/3595/884

Lee, K. 2012. Augmented reality in education and training. *Techtrends. 56*(2): 13-21. doi:10.1007/s11528-012-0559-3

Li, Y. 2010. Augmented reality for remote education. *3rd International Conference on Advanced Computer Theory and Engineering,* 187-191.

Özarslan, Y. 2013. Genişletilmiş gerçeklik ile zenginleştirilmiş öğrenme materyallerinin öğrenen başarısı ve memnuniyeti üzerindeki etkisi. Unpublished doctoral thesis. Eskişehir, Turkey, Anadolu University.

Özdemir, M. 2017. Artırılmış gerçeklik teknolojisi ile öğrenmeye yönelik deneysel çalışmalar: sistematik bir inceleme. *Mersin Üniversitesi Eğitim Fakültesi Dergisi, 13*(2): 609-632. doi:10.17860.mersinefd.336746

Özel, E. 2014. Sosyal bilgiler öğretmenlerinin öğretim teknolojilerine yönelik tutum ve davranışları. *Doğu Coğrafya Dergisi, 19*(31): 129-144. doi:10.17295/dcd.53769

Shelton, B. E. and Hedley, N. R. 2002. Using augmented reality for teaching earth-sun relationships to undergraduate geography students. *Augmented Reality Toolkit, The First IEEE International Workshop.* doi:10.1109/ART.2002.1106948

Sırakaya, M. 2015. *Artırılmış gerçeklik uygulamalarının öğrencilerin akademik başarıları, kavram yanılgıları ve derse katılımlarına etkisi,* (Yayınlanmamış Doktora tezi). Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü: Ankara.

Sırakaya, M.(2016. Artırılmış gerçekliğin uygulamalı eğitimde kullanımı: ana kart montajı. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, *17*(3): 301-316. Erişim adresi https://kefad.ahievran.edu.tr/makaleler/xqw2vb_tammetin.pdf

Sidekli, S., and Karaca, L. 2013. *Sosyal Bilgiler Öğretiminde Yerel, Kültürel Miras Öğelerinin Kullanımına İlişkin Öğretmen Adayı Görüşleri*. Gaziosmanpaşa Üniversitesi. Retrieved from http://search.ebscohost.com/login.aspx?direct=trueanddb=ir00559aandAN=tuda.article.319557andlang=trandsite=eds-live

Somyürek, S. 2014. Öğrenme sürecinde Z kuşağının dikkatini çekme: artırılmış gerçeklik. *Eğitim Teknolojisi Kuram ve Uygulama 4*(1): 63-80. Erişim adresi http://dergipark.gov.tr/etku/issue/6268

Squire, K. and Klopfer, E. 2007. Augmented reality simulations on handheld computers. *The Journal Of The Learning Sciences, 16*(3): 371-413. doi:10.1080/10508400701413435

Sumadio, D. D. and Rambli, D. R. A. 2010. Preliminary evaluation on user acceptanse of the augmented reality use for education. Proceedings of Second International Conference on Computer Engineering and Applications. 461-465. doi:10.1109/ICCEA.2010.239.

Şahin, D. 2017. *Artırılmış gerçeklik teknolojisi ile yapılan fen öğretiminin ortaokul öğrencilerinin başarılarına ve derse karşı tutumlarına etkisi,* (Unpublished master's thesis). Atatürk University, Institute of Educational Sciences: Erzurum, Turkey.

Turgut, M. F. 1990. *Eğitimde ölçme ve değerlendirme metotları.* Ankara: Seydam Matbaacılık

Uluyol, Ç. and Eryılmaz, S. 2014. Examining pre-service teachers' opinions regarding to augmented reality. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi, 34*(3): 403-413. doi:10.17152/gefad.88379

Uygun, K., Avaroğulları, M., and Oran, M. 2016. Sosyal bilgiler öğretmen adaylarının mesleki kaygı düzeylerinin incelenmesi. (Turkish). *Electronic Turkish Studies*, *11*(21): 417.

Wojciechowksi, R. and Cellary, W. 2013. Evaluation of learnes attitude toward learning in ARIES augmented reality environments. *Computers and Education,* 68: 570-585. doi:10.1016/j.compedu.2013.02.014

Yılmaz, R. M. 2014. *Artırılmış gerçeklik teknolojisiyle 3 boyutlu hikaye canlandırmanın hikaye kurgulama becerisine ve yaratıcılığa etkisi,* (Unpublished doctoral thesis). Atatürk University, Institute of Educational Sciences: Erzurum.

Yılmaz, Z. A. and Batdı, V. 2016. Artırılmış gerçeklik uygulamalarının eğitimle bütünleştirilmesinin meta-analitik ve tematik karşılaştırılmalı analizi, *Eğitim ve Bilim Dergisi, 41*(188): 273-289. doi:10.15390/EB.2016.6707

Yiğit, N. 2009. *Öğretim teknolojileri ve materyal tasarımı.* Trabzon: Akademi Kitabevi.

Yoon, S. A., Elinich, K., Wang, J., Steinmeier, C. and Tucker, S. 2012. Using augmented reality and knowledge-building scaffolds to improve learning in a science museum. *International Journal of Computer-Supported Collaborative Learning, 7*(4): 519-541. doi:10.1007/s11412-012-9156-x

Yorulmaz, A., and Can, S. 2016. The Technology Leadership Competencies of Elementary and Secondary School Directors. *Educational Policy Analysis and Strategic Research*, *11*(1) : 47–61.

Yusoff, Z and Dahlan, H. M. 2013. Mobile based learning: An integrated framework to support learning engagement through Augmented Reality environment. (2013). *2013 International Conference on Research and Innovation in Information Systems (ICRIIS), Research and Innovation in Information Systems (ICRIIS), 2013 International Conference On*, 251. https://doi.org/10.1109/ICRIIS.2013.6716718

Yusoff, Z. and Sunar, M. S. 2014. Augmented reality: a survey in educational environment. *International*

Journal of Interactive Digital Media, 2(1) : 1-8. Retrieved from http://magicx.my/ijidm/wp-content/uploads/2014-2-1-1-Zarwina.pdf