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The Effect of Teaching Supported by Interactive Whiteboard on Students' Mathematical Achievements in Lower Secondary Education

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Abstract

The aim of this study is to investigate the effect of using the interactive whiteboard in mathematics teaching process on the 7th-grade students' achievement. This study was conducted as experimental design. Experimental and control groups were composed of 58 7th-grade students from one school in the 2015-2016 educational year in Ankara. As a measurement tool, an achievement test developed by the researchers was used as the pre-test and post-test. An education program which included the activities with the interactive whiteboard was developed by researchers. And, this program was implemented to the experimental group 12 hours over 3 weeks. On the other hand, activities for the control group were limited to the blackboard usage. In the analysis of the data, "analysis of covariance (ANCOVA)" was used by defining the pre-test scores as "covariate" variable.

According to the findings, it was observed that there was a significant difference between experimental and control groups pre-test average scores. When the difference of pre-test scores under control, it was observed the significant difference between the average post-test scores in favor of the experimental group. These findings show that using the interactive whiteboard in mathematics teaching process has positive effects on the students' mathematical achievement. These results are supported by some other researchers' findings.

Keywords: education technology, interactive whiteboard, mathematical achievement

1. Introduction

The new developments in technology, computers, and communications lead to changes even in the understanding of teaching. In today's world, the production and use of information and technologies of communication are spreading rapidly, and areas of these new applications, including education, are rapidly developing. Teaching concept is toward to technology-aided teaching (Alakoç, 2003). There are two approaches to the use of technology in schools. These are learning from technology and learning with technology. In the approach to learning from technology, the content is offered through technology and it is assumed that it will result in learning. In the approach to learning with technology, technology is used as a tool that helps to critical thinking and high-level learning (Jonassen, Peck, & Wilson, 1999).

Today, the schools are expected to raise individuals who reach the knowledge, can use technology effectively and are equipped with the skills of usage (Seferoğlu, 2009). To achieve this expectation, it needs to be given a place of teaching technologies in their classroom. In this context, it focuses on different technologies for students to interact with the content and the effects of these technologies on the teaching and learning process are investigated. According to Adıgüzel, Gürbulak, and Sarıçayır, the interactive boards come from the very beginning of renewed these technologies.

Interactive whiteboards are one of the most important tools of information technology as part of adaptation to the classroom (Türel, 2012). The interactive whiteboards which are also known by names such as "smart board", "electronic board", "interactive whiteboard" provide persistence in learning providing visual materials supported with sound and animation (Yıldızhan, 2013). Generally, the interactive board consists of a combination of a computer, an interactive board, an interactive pen, a projector and with the use of some software (Tercan, 2012).

Studies reveal that the use of interactive whiteboards in the education creates a rich learning environment in terms of visual and auditory (Beeland, 2002; Levy, 2002), increase the quality of education and improves student achievement (Thompson & Flecknoe, 2003), increases motivation, attention span, focus, and class participation (Kennewell & Beauchamp, 2007). For the interactive board is the possibility of an easy and rapid update of information, it is expected to replace regular books in the future and it is considered as a class technology for tomorrow (Minor, Bracken, Geisel, & Unger, 2006).

The use of interactive whiteboard has been tried to spread in Turkey with Fatih (Increase Opportunities and Technology Improvement Act) Project carried out together with The Ministry of Education and the Ministry of Transport; it is intended to transition from "area of computer in every school" to "an era of computer in every classroom". Within the scope of this project, It was targeted installation of the 347.367 interactive whiteboards in 41.996 schools, the installation of 101 644 interactive whiteboards took place and it was stated that the entire installation would be completed by the end of 2015 (Kurumsal Mali Durum ve Beklentiler Raporu, 2015). The mechanism placed in the classrooms consists of fixed traditional hardwood where chalk is used, mobile whiteboard where writing pen is used and fixed the interactive whiteboard. The duty of the teacher in such an environment is to make time management (Kent, 2004). During the lecture, if necessary, or if additional resources with the relevant subject are needed, it can be obtained an opportunity to benefit from new sources connecting to the Internet easily with the help of interactive whiteboard (Starkings & Krause, 2008). One of the most important contributions of the interactive whiteboard is that it can provide an opportunity to teachers to use them again when needed saving what is written on the board during the course and share with students. This opportunity provides practicality to students and teachers in terms of both cost and time (Adıgüzel et al., 2011).

Interactive whiteboards, while it offers individual learning and study such as personal computers through interaction, on the other hand, it allows the use of different classroom teaching models in order to provide effective and efficient learning. In teaching, since there is not a single method that can be applied to all learning situations, the teacher should be able to apply more than one method considering the purpose of teaching and individual differences in the class (Alıcıgüzel, 1975). At this point, the use of interactive whiteboard from educational technology offers the opportunity to facilitate the learning process in point of providing multimedia to students (Beachamp & Miller, 2007). In particular, it is important that these issues should be told to students with concrete materials in courses such as math and science which students need to develop their skills practically because some issues are abstract (Feasy, 2004). In an environment where the attention of student is not exactly taken the course, combining of their existing learning with the new information does not seem easy in terms of meaningful learning (Harlan & Rivkin, 2000). With the help of this board, a teacher can enhance interaction in education and provide converting the abstract topics to concrete by using a combination of elements such as audio, video, graphic (Preston & Mowbray, 2008). Interactive whiteboards help to increase student's interaction with the lesson more effectively (Kent, 2004).

The usage of interactive whiteboards in education and its effect on achievement have been the subject of many research studies. According to Adıgüzel and his friends' studies (2011) which measure effectiveness on students at various age levels such as kindergarten, primary and secondary school and university in the field of mathematics, science and language learning and how educational environment, enriches support benefits of the interactive board. According to Peker (1985) the benefits of using new technologies in mathematics education as well as increasing the success, are seen as important in respect to positive attitudes towards math, increasing attention, unease towards mathematics courses and fear reduction and, more importantly, analytical and effective thinking habits (e.g., Alakoç, 2003). On the other hand, Moffat (2000) lectured the 7th-grade geometry topics with educational games on the interactive whiteboard and investigated the effect in the understanding of the issues and he found that using of interactive whiteboard makes it easy to grasp and understanding of geometry. Erduran and Tataroğlu (2009) has determined that use of interactive whiteboard increases students' interest, participation and motivation in their study in order to determine the views of teachers who used interactive whiteboards in science and mathematics education. Akçayı (2011) claims that the use of an interactive whiteboard in the teaching and learning process has an important influence on mathematics achievement of students, attitudes toward mathematics, motivation and also more problems have been solved in classes where the interactive whiteboard technology is used. Ekici (2008) concluded that mathematics education conducted with the interactive whiteboard has a positive impact on mathematics achievement of students, epistemological beliefs and their level of remembrance as compared with mathematics education conducted by conventional methods. Yorgancıoğlu and Terzioğlu (2013) examined the impact of using the interactive whiteboard on attitudes towards mathematics and achievement, and they reached the conclusion that using the interactive whiteboard in mathematics lesson increases achievement in mathematics lesson and attitude towards mathematics.

On the other hand, Tataroğlu (2009) has explored how the use of the interactive whiteboards in mathematics education effects math achievements of secondary school students, attitudes towards mathematics course and their level of self-sufficiency. The findings have shown that the use of the interactive whiteboard does not have an impact on academic achievement and self-efficacy but it has a positive impact on levels of attitudes toward mathematics lesson. In the result of his study related to Effect of Smart Board on Math Success in Basic Education, Yıldızhan (2013) has determined that students often have difficulty when they take notes and follow lessons during the use of the interactive whiteboard beside the interactive whiteboard increase the interest of students and this situation leads to difficulty in gripping courses and subjects. He has also proposed that the interactive whiteboard should not be used throughout the lesson.

Even though studies have shown that has a positive impact on especially attitudes toward lessons, motivation and self-sufficiency perception of students; there are various results with respect to the effect of the use of technology in the classroom to student achievement. As a result, research in this area did not reach a definitive conclusion on how the interactive whiteboards teaching affects student achievement conflicting and contradictory results in the literature show that enough data was not collected on this subject. Completion of missing the points and making data pragmatically by interpreting will increase the importance of experimental work to be done in this area. Therefore, conducting research on the effects of the interactive whiteboards teaching to students' mathematics achievement has been identified as the primary requirement.

The aim of this study was to explore the effect of using the interactive whiteboard in mathematics teaching process in the 7^{th}-grade students' achievement in the context and limitations of some certain skills ("Problem Solving" and "Conservation of Equality" and "Equation" and "Equation Solving"). For this purpose, it is intended to provide an answer to the question whether there is a meaningful difference at 0.05 level in favor of the experimental group between the latest test scores when the pre-test scores are taken under control. In this study, the interactive whiteboard teaching process is limited with 7^{th}-grade math lesson "Equality and Equations" subject and achievements which are defined for this topic.

2. Method

2.1 Research Model

This study was carried out in pre-experimental design that pre-test/post-test experimental and control groups. In the experimental designs, it is intended to explore the cause-effect relationships between variables (Büyüköztürk, 2011). The aim of the pre-experimental design is same with experimental design however, the execution differs in that control and experimental groups are not random but ready groups (Büyüköztürk, 2011). The presence of pre-test in the model helps to know the degree of group similarity in the pre-experimental process and adjust the results of post-test accordingly this (Karasar, 2010, p. 97). "Pre-test/post-test and control group design" is applied whereby subjects are subjected to measures related to dependent variable both before and after study. The subjects are divided into as experimental and control groups (Karasar, 2005, p. 87). The design of research is given in Table 1.

Table 1. The design of research

Groups	Assignment Method	Pre-test	Application	Post-test
E	R*	MPreE	X	MPE
C	R*	MPreC		MPC

*Ready group.

In Table 1 it is shown that E: experimental group, C: control group; R: ready group, MPreE and MPreC measurement of achievement test of pre-test of experimental and control group, MPE and MPC measurement of achievement of post-test of experimental and control group; X subject variable of using the interactive whiteboard applied to experimental group. It was determined that the dependent variable is students' mathematics achievement, the independent variable is teaching method (normal teaching, interactive whiteboards teaching) and experiment variable (covariate variable) is as a pre-test achievement test scores. In experimental and control groups, lessons were carried out by math teacher of students within the context and guidance of documents prepared by the researcher. The reason for this is to eliminate the effect of the factor caused by differences of the teacher.

2.2 Sample

In this research, students who study in the two different classes of 7^{th} grade secondary school in the 2015-2016 educational year in Ankara were determined as experimental and control group. Both control and experimental groups consist of 29 students and totally research consists of 58 students.

2.3 Data Collection Tool

In this study, "Math Equation Equality and Achievement Test" developed by the researchers were used as the data collection instrument for a pre-test and post-test. "Equation and Equality" is one of the important mathematical subjects in the process of math learning. With this subject, students are tried to learn to define facts with variables and to understand the relations and to determine these relations in a systematic manner. Also, this subject includes the way of analytic thinking and reasoning.

When preparing an achievement test, 4 achievements were determined that are related to equality and equation topic located curriculum of 7th grade and indicator chart was created. By considering achievements in the indicator chart and examining questions from textbook and ancillary sources, 26-item question bank, where original items are at the level of knowledge, comprehension and application were created by researchers. To ensure content and face validity, necessary arrangements have been carried out by taking opinions of six field experts and one evaluation-measurement expert. Reliability and validity workout of the test were done with pre-application which is carried out by 146 students in the 8^{th} and 9^{th}-grade level. Internal consistency reliability of the test is calculated by Kr 20 and Kr 21 method. When item difficulties of K 21 and K 20 get closer, they indicate similar value because K 21 is calculated assuming that item difficulties are equal. Kr 20: 0.75; Kr 21: 0.70 and they are found reliable. First of all item analysis was made and then Exploratory Factor Analysis (EFA) based on tetrachoric correlation, Confirmatory Factor Analysis (CFA) and descriptive statistical techniques were used. Results at 0.05 significance level have been tested. The final version of the test consists of 12 items. In Table 2, item difficulty and discrimination values of measurements for questions in the 26-item test that have an alternative for each other and item analysis related to these values were given.

Table 2. Item difficulties and discrimination indexes

Item	Groups	Alternatives				Difficulty	Discrimination	Item	Groups	Alternatives				Difficulty	Discrimination
		A	B	C	D	(p)	(r_{pbs})			A	B	C	D	(p)	(r_{pbs})
i1	Lower	.95	.00	.01	.00	0,99	0,19	i14	Lower	.29	.12	.32	.20	0,45	0,26
	Upper	1.00	.00	.05	.00				Upper	.00	.00	.63	.35		
i2	Lower	.07	.02	.85	.05	0,90	0,18	i15	Lower	.15	.20	.24	.29	0,63	0,63
	Upper	.00	.00	.98	.02				Upper	.00	.96	.00	.00		
i3	Lower	.10	.02	.80	.05	0,84	0,15	i16*	Lower	.24	.17	.15	.29	0,49	0,46
	Upper	.00	.00	.93	.07				Upper	.00	.02	.04	.87		
i4*	Lower	.15	.34	.27	.17	0,41	0,35	i17*	Lower	.44	.10	.15	.27	0,77	0,56
	Upper	.02	.30	.02	.61				Upper	1.00	.00	.00	.00		
i5*	Lower	.17	.10	.24	.49	0,74	0,45	i18	Lower	.27	.32	.24	.12	0,66	0,50
	Upper	.00	.00	.04	.96				Upper	.00	.93	.04	.00		
i6*	Lower	.05	.51	.32	.12	0,62	0,41	i19	Lower	.20	.32	.10	.37	0,37	0,17
	Upper	.00	.15	.85	.00				Upper	.37	.43	.07	.04		
i7	Lower	.29	.22	.34	.07	0,39	0,08	i20*	Lower	.20	.29	.22	.20	0,53	0,51
	Upper	.02	.46	.41	.02				Upper	.07	.00	.02	.91		
i8*	Lower	.12	.17	.29	.34	0,51	0,54	i21*	Lower	.27	.20	.24	.20	0,42	0,34

	Upper	.78	.15	.02	.02				Upper	.72	.15	.07	.00		
i9	Lower	.24	.22	.39	.12	0,58	0,56	i22	Lower	.37	.07	.20	.32	0,58	0,40
	Upper	.91	.02	.07	.00				Upper	.02	.04	.11	.80		
i10*	Lower	.20	.24	.24	.15	0,42	0,43	i23	Lower	.29	.20	.32	.15	0,51	0,53
	Upper	.13	.09	.04	.61				Upper	.11	.87	.02	.00		
i11	Lower	.20	.20	.12	.41	0,16	0,12	i24*	Lower	.07	.27	.37	.24	0,73	0,58
	Upper	.04	.00	.17	.74				Upper	.00	.00	1.00	.00		
i12	Lower	.20	.24	.22	.24	0,27	0,12	i25	Lower	.34	.17	.34	.07	0,43	0,16
	Upper	.02	.28	.30	.37				Upper	.48	.09	.30	.13		
i13*	Lower	.41	.22	.22	.12	0,75	0,47	i26*	Lower	.20	.32	.24	.17	0,54	0,39
	Upper	.98	.00	.02	.00				Upper	.13	.76	.04	.07		

*Items for the final version.

It is defined that if item difficulty is between 0:00 to 0:2, the item is "very difficult", if between 0:20 to 0:4, item is "difficult", if between 0.40-0.60, item is "medium difficulty", if between 0.60-0.80, item is "easy" and if between 0.80-1.00, item is "very easy" (Crocker & Algina, 1986). The easiest question of our test is item1 with 0.99 difficulty and the most difficult question is item11 with 0.16 difficulty. The presence of medium item increases the sensitivity of our test. Since items in the test are easy and medium, the discrimination levels of items were examined in terms of the point-biserial correlation coefficient. It is interpreted that if the discrimination difficulty of item is between -1.00 and -0.20, this item is negative and item is eliminated; if between -0.19 and +0.19, item is not distinctive and item is eliminated; if between 0.20 and 0.29, item is partially distinctive (valid) and item can be taken into test by making adjustment; if between 0.30 and 0.39, item is distinctive and if it is adjusted, it will be correct however item can be taken into without adjustment; if between 0.40 and 1.00, item is highly distinctive and there is no need to make any adjustment to take into test (Ebel, 1972). The average item difficulty of the achievement test is 0.56. Detection of individual differences is essential for desired features to be measured and therefore it should be considered that configuring achievement tests set out a wide range distribution in a way that covers all skill levels (Tekindal, 2009). Item measurements obtained from pre-test application confirm that test is medium difficulty. Average item discrimination index is 0.37. It is meant that discrimination strength is high (Tekin, 1996; Tekindal, 2009).

To determine the construct validity of the test, factor analysis was conducted that is based on tetrachoric correlation and is applied to 1-0 achievement test. Factor analysis based on the tetrachoric correlation was conducted using Factor 10.3 Program. Then Confirmatory Factor Analysis (CFA) was applied to prove the accuracy of formed structure. Kaiser-Meyer-Olkin (KMO) and Bartlett Sphericity tests were used to determine whether data suitable for factor analysis. KMO is .773 and it shows that a number of samples is adequate. Results of Bartlett (X^2=562,9; sd=153; p=0,00) indicate that there is high rate correlation between at least a portion of valuables at 0.05 significant level. These findings suggest that the assumptions of factor analysis are met. For the test was built on 4 achievements and assumed that may be 4-dimensional, analyses have confirmed this construction. In the first phase i1, i2, i3, i7, i11, i12, i19 and i25 of the 26-item test were removed from test since they do not take place within the boundaries of acceptability of the test by examining item difficulties and discriminations. In the second stage, Exploratory Factor Analysis (EFA) was conducted to remain 18 items using the varimax technique from rotation method. Total explained variance was found 56%. Item14 and item22 are removed one by one respectively for they did not load any factor. When item14 was removed, explained variance increased to 60% and when item22 was removed, explained variance increased to 63%. Since i9, i15, i23 and i18 have overlapped items, they were removed from test respectively and individually and explained variance was calculated as 70%.

Values of Eigenvalue explained variance and cumulative explained variance as to four-factor structure emerged in the result of Exploratory Factor Analysis (EFA) based on tetrachoric correlation belonging to the test of Equality and Equations are given Table 3.

Table 3. Eigenvalue and explained variance

Factors	Eigenvalue	Explained Variance	Cumulative Explained Variance
F1	4.01	%33.48	%33.48
F2	1.64	%13.67	%47.16
F3	1.48	%12.39	%59.55
F4	1.28	%10.68	%70.23

As seen in Table 3, a structure with four factors whose eigenvalue is more than 1 was acquired in the result of Exploratory Factor Analysis (EFA) based on the tetrachoric correlation. This structure is also matched with the achievements of Equality and Equations topic. The first factor explains 33.48% of the total variance, and respectively others explain 13.67%, 12.39% and 10.68% of the total variance. Total explained variance is 70.23%. Factor loadings of items according to factors in the result of Exploratory Factor Analysis (EFA) based on tetrachoric correlation and following orthogonal rotation technique are given in Table 4.

Table 4. Results of Exploratory Factor Analysis (EFA) based on the tetrachoric correlation

Item	Factor1	Factor2	Factor3	Factor4
	AFA*	AFA*	AFA*	AFA*
M4	0.997			
M6	0.616			
M5		0.612		
M8		0.562		
M10		0.561		
M21			0.770	
M20			0.648	
M16			0.580	
M24				0.751
M26				0.743
M17				0.593
M13				0.506

*Factor values of exploratory factor analysis (EFA) based on the tetrachoric correlation.

As seen in Table 4, in the result of factor analysis based on the tetrachoric correlation, a structure is defined that consists of 12 items and 4 sub-dimensions. Sub-dimensions are named as “Problem Solving”, “Establish Equation”, “Conservation of Equality” and “Solve Equation”. According to Tabachnick, to name for a factor, at least 2 items are needed. If there are 2 variable (item), it should be careful. The 2 items can be accepted as one dimension when the correlation between these variables is high (r>0.70) and the correlations between other factors are not significant or lower. The contribution of total explained variance of items ranges from 1.000 to .353. The load values in the result of factor analysis based on the tetrachoric correlation matrix range from .997 to .616 in the first factor; from .561 to .612 in the second factor; from .580 to .770 in the third factor and from .751 to .506 in the fourth factor. Model-fit indices were tested by using Confirmatory Factor Analysis to verify structure which emerged after Exploratory Factor Analysis (EFA) studies. Tested model is given in Figure 1.

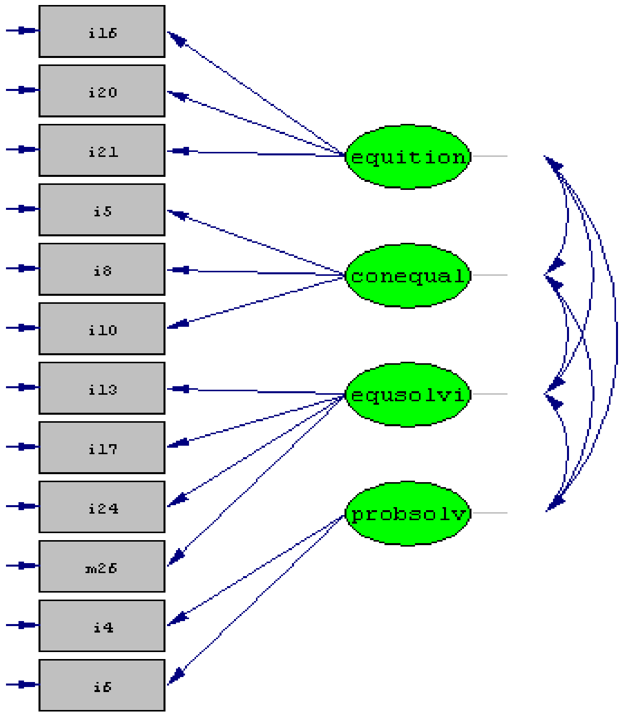

Figure 1. Conceptual diagram

As seen in the Figure 1, tested structural model contains 12 observed and 4 primary level latent variables. Since Model-fit indices test, $\chi 2$ statistics ($\chi 2=64.56$, df=48 and $p<0.05$) is additive statistics and it changes according to number variables, it can be evaluated alone. It is evaluated with $\chi 2$ degree of freedom by proportion. $\chi 2/df=1,345$. If this value is below 2, it indicates that there is an excellent fit. Predicted model-data goodness of fit indicesare given in Table 5.

Table 5. Goodness of fit statistics for structural model

Indices	Statistics
Root Mean Square Error of Approximation (RMSEA)	0.049
Root mean Square residual (RMR)	0.013
Standardized RMR	0.060
Normed Fit Index (NFI)	0.83
Non-Normed Fit Index (NNFI)	0.91
Comparative Fit Index (CFI)	0.93
Incremental Fit Index (IFI)	0.93
Relative Fit Index (RFI)	0.77
Goodness of Fit Index (GFI)	0.93
Adjusted Goodness of Fit Index (AGFI)	0.89

*All statistics are significant at the 0.01 significance level.

The results obtained from the calculated model-data fit indexes are given in Table 5 when this model is tested. When four-factor model which is tested for accuracy is examined, it is seen that model is excellent in terms of the error terms and fit indices values have acceptable model-fit indices. “Estimates” and “standard solution” values for items obtained result from CFA are given in Table 6. In addition, there are t values that give the significance of the factor loadings estimated with CFA.

Table 6. Results of confirmatory factor analysis

Item	Problem Solving Estimates	Problem Solving Standardadised values	Equation Estimates	Equation Standardadised values	Conservation of Equality Estimates	Conservation of Equality Standardadised values	Solve Equation Estimates	Solve Equation Standardised values	t*
i4	0.31	0.63							4.87
i6	0.35	0.72							5.12
i5			0.23	0.52					5.29
i8			0.30	0.59					5.95
i10			0.25	0.50					5.08
i21					0.22	0.44			4.49
i20					0.37	0.73			6.93
i16					0.26	0.53			5.35
i24							0.30	0.66	7.16
i26							0.20	0.41	4.30
i17							0.27	0.47	6.97
i13							0.20	0.65	4.99

*$p<0.01$.

When t values which give the significance of load factors estimated with Confirmatory Factor Analysis (CFA) are examined, it is seen that road coefficient is significant at 0.01 level in Table 6. Estimated values (unstandardised road efficient) are between 0.20 and 0.37, error scores are between 0.1 and 0.21. Standardised factor loading are between 0.41 and 0.73; error scores are between 0.46 and 0.43. When model-fit indices are standardized, it is seen that balance is broken down. This is the indication that we studied in homogeneous groups. The distribution of the achievement of test to items, course time and item number distribution are given in Table 7.

Table 7. The distribution of the achievement of test to items

	Achievement of Test	Course time (hour)	Item Number	Items
Problem Solving	Solve problems that require establishing an equation with unknown from the first degree-equation	2	2	M4, M6
Conservation of Equality	Conservation principle of equality in the equation.	3	3	M5, M8, M10
Equation	Establish an equation with the unknown from the first degree-equation comply with real-life situations.	3	3	M16, M20, M21
Equation Solving	Solve equation with unknown from the first degree-equation	4	4	M13, M17, M24, M26
	TOTAL	12	12	M4, M5, M6, M8, M10, M13, M16, M17, M20, M21, M24, M26

According to Table 7, factors have been named by considering the content of items. The first factor consists of 2 items located in the achievement “solve problems that require establishing an equation with the unknown from the first degree-equation” and is named as “Problem Solving”. The second factor consists of 3 items located in the achievement “conservation principle of equality in the equation” and is named as “Conservation of Equality”.

The third factor consists of 3 items located in the achievement establish an equation with the unknown from the first degree-equation comply with real-life situations and is named as “Equation”. The fourth factor consists of 4 items located in the achievement “solve equation with unknown from the first degree-equation” and is named as “equation solving”. According to the analysis results, it is seen that all working items match with the fictionalized structure. Final test form was created by making some corrections in some distractors according to the subject item of ranking, regulations relating to options with a balanced distribution of answers and item analysis results. As a result, 12 items accounted for the final version of the test were prepared as an appropriate measurement tool to determine whether they belong to achievements regarding “Equality and Equation” subject of 7^{th}-grade students.

2.4 Experimental Process and Data Collection

Planning and implementation process of the interactive whiteboard teaching are among the most important stages of the research. According to Keser and Çetinkaya (2013), initial problems of teachers and students for the interactive whiteboards are that there are not suitable materials for lessons, restrictions (software, content, and the internet), inadequate information-skills and problems resulted from the physical environment. Several variables related to the problems encountered in the interactive whiteboards teaching process is under control by researchers. Within the context of the experimental course process, lessons were carried out by their own mathematics teachers in the framework of plans prepared by the researchers and guidance of researchers with regard to compliance of the students. Thus, mixer variable factors which may arise from teacher differences were aimed to control. It is determined that math teacher continues the master program in elementary mathematics education, she has the knowledge and skills of the interactive whiteboard application and she is adequately equipped. To control effect of “over-reaction” in teaching, practices of the interactive whiteboard teaching was started one week before implementation. It is known that the first encounter with a status of students (over-reaction) will increase the student’s interest and motivation and indirectly facilitate learning.

The research was scheduled 12 hours for 3 weeks course during the fall period of the 2015-2016 academic year. The distribution of course time in terms of achievements is organized in the framework of the Ministry of Education 7^{th}-grade math annual plan. Mathematics achievement test prepared by the researchers was implemented before application to determine the level of knowledge of students. This test was executed simultaneously to experimental and control group students as 1 hour (40 minutes) period. Lectures of experimental group students were carried out as the interactive whiteboard teaching instead of the blackboard. It was planned the implementation of activities that appeal to multiple senses by creating an interactive environment in the class using the interactive whiteboards.

In this context, the application process is designed as a five-part process in general. Parts of the lesson was planned with steps: The first part is presenting visual videos associated with achievements to attract students’ attention (approximately 5-7 minutes), the second part is a review of the relevant new concepts (5 minutes), third part is comprehension of subject through workbook and textbook with examples in line with subject, aims, and achievements as the interactive whiteboards (15 minutes), fourth part is for exercises (10 minutes) and last part is summarizing, reviewing of learned lessons (approximately 3-5 minutes). The planned course of at least 80% was realized with the interactive whiteboard. During the teaching phase of the lesson; picture, photography, animated films and animations likely to be interested have been used before definitions have been given students. Thus, students are expected to both think and have a curiosity about the subject. Thanks to the touch feature of the board, forward and backward transition between pre-prepared documents about the course can save time by providing more opportunity to practice more exercises. In addition, writing can be made in different colors with a pen on prepared digital documents and important points can be marked to take students’ attention. For example; the interactive whiteboard can mark the image by stopping video or animation during watching video or animation and can provide an opportunity for saving images independently. Thus, newly created images can be used again to recall information.

Lessons in the control group have been processed in accordance with the constructivist approach in the light of the mathematics curriculum. The only difference from experimental groups is that materials that would be implemented in the interactive whiteboard teaching process have not been used. All activities have been carried out in the framework of using the interactive whiteboard in terms of achievements and doing same as or similar exercises were projected in this process. After application, the math achievement test was implemented simultaneously to experimental and control groups of students as a final test.

2.5 Analysis of Data

Depending on the research problem, ANCOVA was used that compares corrected post-test scores of groups by controlling the impact of pre-test scores in the post-test score in the testing of the pretest-posttest average success of the experimental and control group. ANCOVA is a valid method to increase the statistical power of analysis in order to reveal group differences in the dependent variables (e.g., Büyüköztürk, 2011). Pre-test and post-test results of the study were tested at 0.05 significance level. During the analyses, it was utilized from IBM SPSS Statistic 22 and LISREL 8.80 software.

3. Results

In this section, the findings derived from pre-test and post-test of experimental and control group students are given. Covariance analysis (ANCOVA) was implemented in order to test the effectiveness of the quasi-experimental procedure in the pre-test and post-test control group design and, whether there are differences at 0.05 significance level between achievement test scores of post-test adjusted for pre-test scores of students with and without the interactive whiteboard or not is tested. Descriptive statistics of experimental and control groups based on the pre-test and the post-test comparision are given in Table 8.

Table 8. Descriptive statistics of experimental and control groups based on the pre-test and the post-test comparision

	Group	N	Average	Standard Error	Standard Deviation
Pre-Test	Experimental	29	4,3448	.385	2,07495
	Control	29	4,6552	.337	1,81808
	Total	58	4,5000		1,93989
Post-Test	Experimental	29	5,8621	,300	1,61961
	Control	29	4,7931	,286	1,54410
	Total	58	5,3276		1,65845

According to Table 8, scores belong to score of post-test are interval scale, data are continuous and number of data is sufficent. Shapiro-Wilk test was implemented to determine whether distributions of conducted pre-test and post-test score have normal distribution. When the results of Shapiro-Wilk test that applied to scores of pre-test (χ^2_{exp}=0.958, p=0,293; χ^2_{cont}=0.958, p=0,298), post-test (χ^2_{exp}=0.890, p=0,006; χ^2_{cont}=0.943, p=0,119) and difference (χ^2_{exp}=0.957, p=0,272; χ^2_{cont}=0.959, p=0,319) in the experimental and control groups were examined, it is determined that scores are normal distribution at 0.05 significance level.

Variance shows homogeneous distribution at 0.05 significance level in terms of Levene's Test in the pre-test data of experimental and control groups. Thus, it was interpreted that diversification of students in the experimental and control groups into pre-teaching groups are similar. Covariance analysis results of posttest scores in terms of the pretest score of achievement test are given in Table 9.

Table 9. Covariance analysis results of post-test scores in terms of the pre-test score of the achievement test

Source of variance	Sum of Squares	df	Average of Squares	F	p	Eta-Square
Model	43,183	2	21,592	10,454	,000	,275
Pre-Test	26,615	1	26,615	12,886	,001	,190
Group	20,012	1	20,012	9,690	,003	,150
Error	113,592	55	2,065			
Total	156,776	57				

According to Table 9, it was found that difference between adjusted average test scores of post-test of experimental and control groups according to the pretest is significant [$F(1, 55)=9.69$, $p<0.05$]. It is determined that applied experimental procedure caused a difference in the success of students at the 0.05 significance level. Adjusted average test scores of posttest of the experimental group according to the pre-test are 5.917 and for the control group is 4.738. In this case, it is understood that students who were taught the lesson with an interactive whiteboard got more positive results in the subject of the mathematical equation.

Effect size eta-squared (η^2) values were investigated in case of emergence of a significant difference between the groups. Commonly used methods for the interpretation of the effect size is to separate effect size as "small", "medium" and "large" (Cohen, 1988). If the effect size index is 0.10, it is interpreted as "small", if 0.25, it is "medium" and if 0.45, it is "large" (Cohen, 1988). If research has experimental design and controlled data collection is the possible, effect size will be much greater. Pretest scores of achievement test are an important predictor of posttest scores [$F(1, 55)=12.886$, $p<0.05$] and they alone explain 19% of the post-test score. Participation of the pre-test in the model has been significant. ANCOVA model that defines effect size of post-test scores with group variables and pre-test scores of the achievement test is significant [$F(2, 55)=10.454$, $p<0.05$].

4. Discussion

In this research that was implemented in the two different classes of 7th grade secondary school in the 2015-2016 educational year in Ankara with 58 students it was determined as a fundamental finding that mathematics teaching with the interactive whiteboard has a significant impact on the academic achievement of the students and it improves the success of students. These results are similar to results of other research on this issue (Yorgancı & Terzioğlu, 2013; Tercan, 2012; Öztan, 2012; Kennewell & Beauchamp, 2007). When used correctly and appropriately, it refers that technology will enrich learning environment and it will be efficient tool to develop motivation, retainment, problem-solving and critical thinking skills of students (Yıldırım, 2000).

Providing access to planned achievements to be reached in education without learning environment where technology is not taken place will not be possible in desired degree (Alakoç, 2003). When technology and technology classroom is called, the interactive whiteboards are helping us in this teaching process.

On the other hand, Szabo and Hastings (2000), in the study they investigated the effect of the interactive whiteboard technology on student achievement, they have stressed that regardless of how efficient method it can not replace the blackboard. In his description study to examine the impact of the interactive board on mathematics achievement in primary education, Yıldızhan (2013) determined that using the interactive board throughout course has a negative impact on mathematics achievement. In this study at least 80% of planned course were realized with the interactive whiteboard activities and it was found that it has a positive contribution to mathematics achievement of students. The fact that Permanence test was used to determine the continuity of the positive impact on success constitutes the limitation of this study.

The biggest problem using the interactive is that students have been distracted for the curiosity of this procedure. But then it was observed that their curiosity increased their participation to the course in order to come into contact with the interactive whiteboard and use it. The first meeting for something may be caused by an increase in the motivation of the students towards learning. It must be taken into consideration that difference between the experimental and control group may decrease in case of longer-term research. Because the first encounter of the experimental group students with the interactive whiteboard may have led to getting ahead of the control group in the post-test application, while their average was lower in the result of pre-test with respect to control group. Research explains that initial enthusiasm for the use of the interactive whiteboards is lost after a while (Türel, 2011). However, it is thought that the interactive whiteboard teaching will bring a positive contribution and provide long-term motivation since it contains activities that appeal to multi-sensory of students, offers different learning environments and gives the opportunity to do more exercises. Research reveal that the interactive whiteboard teaching in education provides rich learning environments in terms of visual and audio aspects (Altınçelik, 2009; Beeland, 2002), motivation increases participation in class and attention span (Ermiş, 2012; Akbaş & Pektaş, 2011).

As a result, it can be said that math teaching with the interactive whiteboard is effective in improving students' success. In this context, it is proposed that in the classroom teaching mathematics teachers should give place to the interactive whiteboard activities. It is thought that this study which is carried out in primary school can be an example in terms of experimental research which will be done in this field and can give an idea regarding different applications. As for research that can be done in the future, the impact of the interactive whiteboard teaching on students for effect of the durability level as longitudinal can be searched in different lessons and different class level. And also this effect can be investigated whether it will change according to variables such as gender, socioeconomic level, etc.

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