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The Effect of Using Smart Boards in Science Lessons on Middle School Students' Attitudes Towards Smartboards and Reflective Thinking Skills

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Abstract

The aim of this study is to determine the demographic variables that affect middle school students' attitudes towards smart board and their reflective thinking skills and the relationship between these two variables. For this purpose, relational survey model, one of the quantitative research approaches, was used. The sample of the study, in which the appropriate sampling method was used, consists of 348 students studying in three different middle schools in Yakutiye district of Erzurum. Demographic information questionnaire, "Smart Board Attitude Scale" and "Reflective Thinking Scale" were used as data collection tools in the study. According to the findings of the research, it was determined that the students' smart board attitudes and reflective thinking skills did not change in terms of gender.. On the other hand, students 'smart board attitude levels and reflective thinking skills do not differ significantly in terms of parents' educational status. Finally, a medium positive correlation was found between students' smart board attitude levels and reflective thinking skills.

Keywords: Smart Board, Attitudes, Reflective Thinking Skills, Middle School, Survey Method

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Introduction

Technological developments in our age have supported the development of methods used in educational activities (Koşar & Çiğdem, 2003). In this respect, developments in technology have led to some changes in the learning environment of individuals (Doğan, 2000). Today, many technological devices have been used in educational environments and internet infrastructures have started to become widespread. As a matter of fact, this change in technology has increased international competition and reform movements have started in education programs. For this reason, countries are not satisfied with only local exams, but also update their programs by measuring the success of their own individuals with exams such as Program for International Student Assesment (PISA) and Trends in International Mathematics and Science Study (TIMSS) (Atar & Atar, 2012).

When technological tools are used as a tool rather than as a purpose in teaching environments, it can provide constructive learning environments (Rakes, Flowers, Casey & Santana, 1999). In this respect, students can use many methods with the help of technology while making sense of information. Especially the achievements in science subjects can cause misconceptions because they are abstract (Aydoğan, 2003; Kikas, 2004; Yıldız & Büyükkasap, 2006). For this reason, it is important to examine the effect of smart boards that enrich education environments in teaching science concepts. Turkey in particular has been especially smart boards began to be used widely in almost all schools with the support of the state. As a matter of fact, infrastructure services of all schools are provided and educational environments are equipped with smart boards in the Movement to Increase Opportunities and Improve Technology (FATİH) project (Türel, 2012). For this reason, studies have started to examine the effects of smart boards on teaching activities (Hebebci, Çelik & Şahin, 2016; Warnock, Boykin, & Tung, 2011). Most of the studies show that the use of smart boards positively affects students' achievements (Gençoğlu, 2013; Sarıkaya, 2015; Tunaboylu & Demir, 2017). When the literature is examined, studies have been conducted on the effects of using smart boards in many courses such as science (Özenç & Özmen, 2014), mathematics (Gündüz & Çelik, 2015; Wood & Ashfield, 2008), and foreign language (Sergievskaya, & Zharenkov, 2019). These studies focus on variables such as attitude, academic achievement and motivation of smart board use (Gündüz & Kutluca, 2019). Demir (2019) explained that more studies are needed to determine students' attitudes towards the use of smart boards, to increase the reliability of the research results and to generalize the results. The original value of this research and the point that has not been investigated before is the investigation of the effect of smart board use on students' reflective thinking skills.

In the science curriculum, it is aimed to raise individuals who can question the problem situation by asking the right questions, make plans for the solution of the problem situation, create and test hypotheses, and propose new ideas (Ministry of National Education [MoNE], 2018). In order for

these goals to be realized, students must be able to use the scientific process steps effectively. In addition to the skills such as questioning, researching and reaching accurate and reliable information, creating new knowledge, the students should also be able to reflect the experiences gained through life (Taşkoyan, 2008). When the relevant literature was examined, definitions regarding reflective thinking were made, and the relationships of this skill with other skill types were explained (Birney, Barry & OhÉigeartaigh, 2006; Eryaman, 2007; Lai & Land, 2009; Xie, Ke, & Sharma, 2008). Although reflective thinking skills are a skill that can be developed, the development of this skill type does not happen by itself and needs to be supported (Lai & Land, 2009). In this respect, it is important to determine the effects of using technological facilities to solve problem situations on reflective thinking skills.

On the other hand, it has been found that the materials used for the first time in education generally affect students' attitudes positively (Asmar, Khaled & Nabeel, 2012). Smart boards enable students to be enthusiastic and excited and affect their motivation positively (Oleksiw, 2007). As a matter of fact, Wall, Higgins, and Smith (2005) stated in their study on the use of smart boards that the process affects students' attitudes positively. Robinson (2004) found that the use of smart boards increases the voluntary participation of students in the lessons. Smart boards make students more active in the lesson, therefore, they facilitate their learning by positively affecting their attitudes towards the lesson (Clemens, Moore & Nelson, 2001). For this, they need to develop positive attitudes regarding the use of smart boards. In this context, the aim of this study is to determine the demographic variables that affect middle school students' attitudes towards smart board and their reflective thinking skills and the relationship between these two variables.

Answers to the following questions are sought in the research;

1. What are the students' attitudes towards the use of smart boards in science lessons?

2. Do middle school students' gender and education levels of their parents make a significant difference in terms of their smart board attitudes in science lessons?

3. What are the students' reflective thinking skills towards using smart boards in science lessons?

4. Do middle school students' gender and education levels of their parents make a significant difference in terms of their reflective thinking skills towards science lessons?

5. Is there a relationship between the smart board attitudes and reflective thinking skills of middle school students' in science lessons?

Method

This research was designed according to the relational scanning model, one of the experimental models. Relational survey model is a model used to discover events and facts and to reveal the relationship between them (Karasar, 2009).

Sample

The study group of the research consists of 348 students studying in the 6th, 7th and 8th grades of three middle schools in Yakutiye district of Erzurum in the 2019-2020 academic year. The sample of the study was created with the appropriate sampling method from non-random sampling methods (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2012). Appropriate sampling is a method that provides convenience to the researcher in cases where there are constraints in terms of money, time and labor (Yıldırım & Şimşek, 2011). In line with the investigations made by the researchers, it was observed that the students studying at the 5th grade could not adequately respond to the studies conducted with the scales and it was decided that these students were not included in the study. The characteristics of the study group of the study are presented in Table 1:

Table 1. Demographic Characteristics of the Study Group

Gender	**Frequency**	**Percent**
Female	189	54.4
Male	159	45.7
Grade Level		
6th grade	115	33.0
7th grade	118	33.9
8th grade	115	33.0
Mother's Education Level		
Never went to school	52	14.9
Primary school	74	21.3
Middle School	58	16.7
High school	62	17.8
University	54	15.5
Postgraduate education	48	13.8
Father's Education Level		
Never went to school	58	16.7
Primary school	48	13.8
Middle School	67	19.3
High school	58	16.7
University	62	17.8
Postgraduate education	55	15.8
Total	348	100

Data Collection Tools

In this study, "Smart Board Attitude Scale" and "Reflective Thinking Scale" were used as data collection tools. Also, "Demographic Information Questionnaire" developed by the researcher was

used. This form contains information about students' school numbers, gender, grade level, mother's education level and father's education level.

Smart Board Attitude Scale

5-point Likert type scale developed by Şad (2012) was used to determine the attitudes of middle school students towards smart board. Smart Board Attitude Scale (SBAS) 4.-8. It is a scale prepared for class students and consists of 10 items. The scale consists of two factors: negative attitude expressions and positive attitude statements. The 5-point Likert scale is answered in the format 1 = Strongly disagree, 5 = Strongly agree. The scale generally explains 60.46% of the total variance. The Cronbach Alpha coefficient of consistency of the scale was determined as α = .816 for the 1st factor and α = .821 for the 2nd factor. In this study, the cronbach alpha value for the whole scale was calculated as .80. The lowest score that can be obtained from each sub-dimension of the scale is 5, and the highest score is 25.

Reflective Thinking Scale

5-point Likert type scale developed by Yıldırım (2012) was used to determine the reflective thinking skills of the students. Reflective Thinking Scale (RTS) is a scale prepared for secondary school students and consists of 17 items. The scale has a single factor structure and is answered in a 5-point Likert format (1 = Strongly disagree, 5 = Strongly agree). The Cronbach Alpha coefficient of consistency of the scale was determined as α = .86. In this study, the cronbach alpha value for the whole scale was calculated as .83. The total and highest possible score from the scale is 85, while the lowest score is 17.

Collection of Data

After obtaining the necessary permissions for the research, data were collected based on the voluntary participation of the students. Orientation studies for the scales were carried out with the students. Students were informed about attitude and reflective thinking skills. It was evaluated whether the students had information about the scale studies. Fifth grade students were excluded from the study, as they were not familiar with this type of study. During the data collection, the researchers were present in the environment and students were prevented from encountering a problem. The application time of each scale took approximately 25 minutes.

Data Analysis

The data obtained from the test were analyzed with the SPSS 26 package program. Whether the data is normally distributed, skewness and kurtosis values and graphs were examined. After the descriptive analysis, it was observed that the data were distributed normally. In addition, since the sample size in the study was over 50, Kolmogrov-Simirnov test results were examined (Büyüköztürk,

2014) and it was determined that the data were normally distributed (p> .05). The data were analyzed by t-test and two-way analysis of variance (ANOVA). In addition, the relationship between SBAS and RTS was analyzed using the Pearson moments product correlation coefficient.

Findings

Findings Regarding the First Sub-Problem

The first sub-problem of the study, "What are the students' attitudes towards the use of smart boards in science lesson?" "Smart Board Attitude Scale (SBAS)" was applied to find an answer to the question. Inclusion ranges were found using the formula n -1 / n. As a result of the calculation, the gap width between 1 and 5 was determined as 0.8 (Ateş, 2010). The score ranges used for the positive statements in the questionnaire are given in Table 2.

Table 2. Score Ranges Used for the Expressions in the Scale

Participation Degree	Score Range
Strongly agree	4,20- 5,00
Agree	3,40- 4,19
Neutral	2,60- 3,39
Disagree	1.80- 2,59
Strongly disagree	1,00- 1,79

The general distribution of the scores of the students from SBAS within the scope of the research is given in Table 3.

Table 3. General Distribution of the Scores Obtained from SBAS

	N	Mean	sd	Min-Max
SBAS scores	348	4.07	.59	3.95-4.20

When Table 3 is examined, it is seen that the general ATTÖ mean score is 4.07 and the standard deviation is .49. This value corresponds to the "Agree" option in the scale. Findings show that students' attitudes towards the use of smart boards are positive. The reason for this situation may be the teacher factor, the level of student participation in the lesson or the demographic characteristics of the students.

Findings Regarding the Second Sub-Problem

The second sub-problem of the study, "Does the gender of middle school students and their parents' education level make a significant difference in terms of their smart board attitudes in science lesson?", "Smart Board Attitude Scale (SBAS)" was applied to find an answer to the question. Independent groups t test was conducted to test whether the total scores of smart board attitude in the science course of the students changed in terms of gender. It has been determined that the data set meets the analysis assumptions. In the analysis, it was determined that SBAS scores of the students

did not change in terms of gender. In Table 4, Independent t-test findings related to SBAS Scores are given in terms of students' gender.

Table 4. Independent T-test Results Related to SBAS Scores In Terms of Students' Gender

	Gender	$\overline{X}$	**sd**	**p**
SBAS scores	Female	40.91	6.07	.53
	Male	40.51	5.79	

When Table 4. is examined, SBAS scores do not show a statistically significant difference in terms of students' gender according to the results of the independent sample t test [t (346) = .62, p> .05]. This situation shows that the attitudes of male and female students towards using smart boards are similar.

Two-way analysis of variance (Two-way ANOVA) was conducted to examine whether SBAS scores of middle school students differ significantly depending on the common effect of parents' education level and grade level. In order to perform this analysis, the assumptions of normality and homogeneity of variances must be met (Tabachnick & Fidell, 2001). The control of univariate normality was done by examining the kurtosis and skewness coefficients of the values obtained from the class level and parents' education level scale and using the Kolmogorov-Smirnov hypothesis test. As a result, it was determined that the data were distributed normally. In addition, when the multivariate normality assumption was examined, it was found that the dependent variable of the study met the normality assumption in each combination of independent variables. It was determined that the data set also met the homogeneity of variances assumption, which is another assumption. (Levene's test, p> .05). Table 5 shows a Two-Way Analysis of Variance on SBAS Scores according to the mother's education level and grade level.

Table 5. Two-Way Anova Results for SBAS Scores According to Mother's Education Level and Grade Level

Source of Variance	**Sum of Squares**	**sd**	**Mean of Squares**	**F**	**p**
Mother Education	297.62	5	59.52	1.68	.13
Grade level	38.00	2	19.00	.53	.58
Mother Education*Class level	230.28	10	23.02	.65	.77
Error	11695.13	330	35.44		
Total	589659.00	348			

When Table 5. is examined, Two-Way Analysis of Variance was conducted to examine the effect of middle school students' mother's education level and grade level on their smart board attitude levels. The interaction effect between mother education level and grade level is not statistically significant, F (10,330) = .65, p> .05. Main effect for mother's education level, F (5.330) = 1.68, p> .05, is not statistically significant. Also, the main effect for grade level, F (2,330) = .53, p> .05, is not statistically significant.

Table 6. *Two-Way Anova Results Related to SBAS Scores According to Father's Education Level and Grade Level*

Source of Variance	Sum of Squares	sd	Mean of Squares	F	p
Father Education	283.11	5	56.62	1.60	.15
Grade level	30.22	2	15.11	.42	.65
Father Education*Class level	368.20	10	36.83	1.04	.40
Error	11634.80	330	35.25		
Total	589659.00	348			

When Table 6 is examined, Two-Way Analysis of Variance was conducted to examine the effect of middle school students' father's education level and grade level on their smart board attitude levels. The interaction effect between father education level and grade level is not statistically significant, F (10,330) = 1.04, p> .05. Main effect for father education level, F (5,330) = 1.60, p> .05, is not statistically significant. Also, the main effect for grade level, F (2,330) = .42, p> .05, is not statistically significant.

Findings Regarding the Third Sub-Problem

The third sub-problem of the study, "What are the students' reflective thinking skills for using smart boards in science lessons?", "Reflective Thinking Scale (RTS)" was applied to find an answer to the question. Inclusion ranges were found using the formula n -1 / n. As a result of the calculation, the gap width between 1 and 5 was determined as 0.8 (Ateş, 2010). Score ranges used for positive statements in the questionnaire are given in Table 2. The general distribution of the scores of the students in the scope of the study from RTS is given in Table 7.

Table 7. *General Distribution of the Scores Obtained from the RTS*

	N	Mean	Sd	Min.-Max.
RTS scores	348	4.10	.55	3.90-4.39

When Table 7 is examined, it is seen that the overall RTS score mean is 4.10 and the standard deviation is .55. This value corresponds to the "Agree" option in the scale. The findings show that the use of smart boards positively affects students' reflective thinking skills.

Findings Regarding the Fourth Sub-Problem

The fourth sub-problem of the study, "Do the gender of middle school students and their parents' education level make a significant difference in terms of their reflective thinking skills levels towards science lesson?", "Reflective Thinking Scale (RTS)" was applied to find an answer to the question. Independent groups t test was conducted to test whether the reflective thinking total scores of the students in the science course differ in terms of gender. It has been determined that the data set meets the analysis assumptions. In the analysis, it was determined that the RTS scores of the students

did not change in terms of gender. In Table 8, Independent t-test findings regarding RTS Scores of the students are given.

Table 8. Independent T-Test Results of Students' RTS Scores In Terms of Gender

	Gender	$\overline{X}$	**ss**	**p**
RTS scores	Female	70.34	9.32	.23
	Male	69.13	9.62	

When Table 8. is examined, SBAS scores do not show a statistically significant difference in terms of students' gender according to the results of the independent sample t test [t (346) = .23, p> .05]. This situation shows that the reflective thinking skills of male and female students are similar.Two-way analysis of variance (Two-way ANOVA) was conducted to examine whether the RTS scores of middle school students differ significantly depending on the common effect of parents' education level and grade level. In order to perform this analysis, the assumptions of normality and homogeneity of variances must be met (Tabachnick & Fidell, 2001). The control of univariate normality was done by examining the kurtosis and skewness coefficients of the values obtained from the class level and parents' education level scale and using the Kolmogorov-Smirnov hypothesis test. As a result, it was determined that the data were distributed normally. In addition, when the multivariate normality assumption was examined, it was found that the dependent variable of the study met the normality assumption in each combination of independent variables. It was determined that the data set also met the homogeneity of variances assumption, which is another assumption. (Levene's test, p> .05). In Table 9, a two-way analysis of variance is given regarding the RTS scores according to the mother's education level and grade level.

Table 9. Two-Way Anova Results for RTS Scores According to Mother's Education Level and Grade Level

Source of Variance	**Sum of Squares**	**sd**	**Mean of Squares**	**F**	**p**
Mother Education	892.81	5	178.56	2.02	.07
Grade level	3.27	2	1.63	.01	.98
Mother Education*Class level	1045.07	10	104.50	1.18	.30
Error	19163.95	330	88.37		
Total	1726115.00	348			

When Table 9 is examined, Two-Way Analysis of Variance was conducted to examine the effect of middle school students' mother's education level and grade level on their smart board attitude levels. The interaction effect between mother education level and grade level is not statistically significant, F (10,330) = 1.18, p> .05. Main effect for mother education level, F (5,330) = 2.02, p> .05, is not statistically significant. Also, the main effect for grade level, F (2,330) = .01, p> .05, is not statistically significant. Two-way analysis of variance is given in Table 10 for RTS scores according to father's education level and grade level.

Table 10. Two-Way Anova Results for RTS Scores According to Father's Education Level and Grade Level

Source of Variance	Sum of Squares	sd	Mean of Squares	F	p
Father Education	319.83	5	63.96	.70	.61
Grade level	7.58	2	3.79	.04	.95
Father Education*Class level	995.37	10	99.52	1.10	.36
Error	29847,61	330	90,45		
Total	485682.0	347			

When Table 10 is examined, Two-Way Analysis of Variance was conducted to examine the effect of middle school students' father's education level and grade level on reflective thinking skills. The interaction effect between father education level and grade level is not statistically significant, F (10,330) = 1.10, p> .05. Main effect for father education level, F (5,330) = .70, p> .05, is not statistically significant. Also, the main effect for grade level, F (2,330) = .04, p> .05, is not statistically significant.

Findings Regarding the Fifth Sub-Problem

The fifth sub-problem of the study, "Is there a relationship between the smart board attitudes of middle school students in science course and their reflective thinking skills?" for an answer to the question, the correlation results between SBAS and RTS scores were analyzed. In Table 11 analysis results is given:

Table 11. Pearson Correlation Results Between SBAS And RTS Scores of Experimental Group Students

Scale		SBAS	RTS
SBAS	Pearson Korelasyon Değeri p	1	.47 00**
RTS	Pearson Korelasyon Değeri p	.47 00**	1

** Significant at p <.001 level.

The relationship between the smart board attitudes of middle school students in the science course and their reflective thinking skills towards the science course was analyzed using the Pearson moments product correlation coefficient. Normality tests, linearity and co-variance assumptions were examined and checked. As a result of the analysis, it was seen that there was a medium and positive correlation between the two variables r = .47, n = 348, p <.001. According to Cohen (1988), these values indicate a medium correlation. According to these results, it is seen that the students whose attitudes towards the smart board increase, will also increase their reflective thinking skills.

Discussion, Conclusion and Recommendations

In this study, the attitudes of middle school students towards the smart board and demographic variables that affect their reflective thinking skills and the relationship between these two variables were determined. According to the findings of the research, it was determined that the

students' smart board attitudes and reflective thinking skills did not change in terms of gender.. In addition, SBAS and RTS do not differ significantly in terms of parents' educational status. Finally, a medium positive correlation was determined between the SBAS score and the RTS score of the students.

Birgin and Zengin (2016), Dhindsa and Emran (2006), Gündüz and Çelik (2015), Tataroğlu (2009) and Türkoğlu (2014) concluded that students' attitudes towards the smart board are not related to the gender variable, which is parallel to the results of this study. A similar situation is observed in the literature (Muhanna & Nejem, 2013; Zengin, Kırılmazkaya & Keçeci, 2011). In addition, Tüfekçi (2019) investigated the effect of smart board use on middle school students' attitudes and explained that the smart board attitude scores of the experimental and control group students did not change in terms of gender variable. Although it is seen in the literature that there is a relationship between student attitudes towards the smart board and grade level (Birgin & Zengin, 2016; Demircioğlu & Demircioğlu, 2015; Korucu, Usta & Toraman, 2016), in this study was not found significant difference between these variables. This may be due to reasons such as the characteristics of the sample group, subject area and applied scale. There are no studies explaining the attitude and reflective thinking skills of students in terms of the education level of parents in using smart boards. In addition, there is no study examining the effect of smart board use on students' reflective thinking skills in terms of gender variable.

In the literature, it is seen that the use of smart boards in science lessons increases the academic success of students (Akçayır, 2011; Dhindsa & Emran, 2006; Ekici, 2008; Nordness & Clarck, 2007; Önder, 2015; Solvie, 2004; Tekin, 2013; Tezer & Deniz, 2009). Beauchamp and Parkinson (2005) explained that the reason for this situation is that the smart board provides students with the opportunity to practice. Tercan (2012), on the other hand, stated that the smart board offers the opportunity to use time effectively and learn permanently. In addition, it has been reached as a result of various studies that students have a positive attitude towards the smart board. (Arıcı, 2015; Birgin & Zengin, 2016, Gürbüztürk, 2018; Özgen & Tum, 2018). It has been explained that the use of smart boards enables the concretization of abstract concepts encountered in daily life and improves students' problem solving skills (Loughlin & Krakowski, 2001). This situation is thought to explain the change in students' reflective thinking skills. In addition, it was explained that the smart boards that incorporate the computer infrastructure concretize abstract subjects (Painter, Whiting, Wolters & Park, 2005), offer students the opportunity to do it again (Levy, 2002), and make the lesson more enjoyable (Türel, 2010). Therefore, students' attitude towards the lesson (Tekin, 2013) and motivation (Robinson, 2004) have increased. In addition, this situation affected students' reflective thinking skills. As a matter of fact, within the scope of the research, an increase was observed in the reflective thinking skills of the students who developed a positive attitude towards the smart board.

Suggestions

Conducting this research with 101 students and grades 6, 7 and 8 is a limitation. Another limitation of the study is that the smart boards in the schools where the research was conducted are the first boards distributed throughout the country (Phase 1 model). In line with the results obtained from the research; It is recommended to conduct the research with a larger sample population, to include activities that support students' reflective thinking skills, and to plan the process student-centered so that students gain positive attitudes towards the smart board. In addition, it is recommended to give in-service seminars for teachers on using the smart board and to make plans in line with students' opinions.

References

Akçayır, M. (2011). Etkileşimli tahta kullanarak işlenen matematik dersinde sınıf öğretmenliği birinci sınıf öğrencilerinin başarı, tutum ve motivasyonları üzerine bir araştırma. Yayınlanmamış Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Arıcı (2015). Eğitimde etkileşimli tahta kullanımına yönelik ortaöğretim öğrencilerinin tutumları. Yüksek Lisans Tezi. Afyon Kocatepe Üniversitesi Fen Bilimleri Enstitüsü, Afyon.

Asmar M., Khaled, H., & Nabeel, A., (2012). The effect of smart board on students behavior and motivation. UGRU University Al Ain, UAE.

Atar, H.Y., & Atar, B. (2012). Examining the effects of Turkish education reform on students' TIMSS 2007 science achievements. Educational Sciences: Theory & Practice, 12(4), 2632-2636.

Ateş, M. (2010). Ortaöğretim coğrafya dersinde akıllı tahta kullanımı. Marmara Coğrafya Dergisi, 22, 409-427.

Aydoğan, S. (2003). Isı ve sıcaklık konusunda kavram yanılgıları, Gazi Eğitim Fakültesi Dergisi, 23, 111-124.

Beauchamp, G., & Parkinson, J. (2005). Beyond the 'WOW' factor: Developing interactivity with the interactive whiteboard. School Science Review, 86(316), 97-103.

Birgin, O., & Zengin, A. (2016). Ortaokul öğrencilerinin matematik dersinde akıllı tahta kullanımına yönelik tutumlarının incelenmesi. International Contemporary Educational Research Congress, 29 Eylül-02 Ekim 2016, Muğla Sıtkı Koçman Üniversitesi, Muğla. Uluslararası Çağdaş Eğitim Araştırmaları Kongresi Tam Metin Bildiri Kitabı, ss.388-396.

Birney, R., Barry, M., & OhÉigeartaigh, M. (2006) The use of weblogs as a tool to support collaborative learning and reflective practice in third-level institutions. In: E. Pearson and P. Bohman, Editors, Proceedings of world conference on educational multimedia, hypermedia and telecommunications, AACE, Chesapeake, VA (2006), s. 1047–1052.

Büyüköztürk, Ş. (2014). Bilimsel araştırma yöntemleri (18. Baskı). Pegem Akademi Yayıncılık

Büyüköztürk, Ş. Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş. & Demirel, F. (2012). Bilimsel araştırma yöntemleri. Ankara: Pegem.

Clemens, A. , Moore, T., & Nelson B. (2001). Math Intervention "Smart" Project Student Mathematical Analysis and Reasoning with Technology, Erişim tarihi: 21 Aralık 2019, http://downloads01.smarttech.com/media/sitecore/en/pdf/research_library/k12/math_intervention_smart_project%20_student_mathematical_analysis_and_reaso ning_with_technology.pdf

Demir, M. (2019). Fen bilimleri dersinde akıllı tahta kullanımının köy okullarında öğrencilerin akademik başarılarına, öğrendikleri bilgilerin kalıcılığına ve derse yönelik tutumlarına etkisi. Yayımlanmamış yüksek lisans tezi. Niğde Ömer Halis Demir Üniversitesi Eğitim Bilimleri Enstitüsü, Niğde.

Demircioğlu, G., & Demircioğlu, H. (2015). Öğrencilerin kimya derslerinde akıllı tahta kullanımına yönelik tutumlarının farklı değişkenler açısından incelenmesi. Eğitim ve Öğretim Araştırmaları Dergisi, 4(2), 387-395.

Dhindsa, H.S., & Emran, S.H. (2006). Use of the interactive whiteboard in constructivist teaching for higher student achievement. Proceedings of the Second Annual Conference for the Middle East Teachers of Science, Mathematics, and Computing, (pp. 175-188). Abu Dhabi.

Doğan, H. (2000). Bilgi teknolojileri ve eğitimi. Adım bilimsel düşüncenin ürünü. KKTC: Ateş Matbaası.

Ekici, F. (2008). Akıllı tahta kullanımının ilköğretim öğrencilerinin başarılarına etkisi. Yüksek Lisans Tezi. Marmara Üniversitesi, Eğitim Bilimleri Enstitüsü, İstanbul.

Eryaman, M. Y. (2007). From reflective practice to practical wisdom: Toward a post-foundational teacher education. *International Journal of Progressive Education, 3*(1), 87-107

Gençoğlu, T. (2013). Geometrik cisimlerin yüzey alanları ve hacmi konularının öğretimde bilgisayar destekli öğretim ile akıllı tahta destekli öğretimin öğrenci akademik başarısına ve matematiğe ilişkin tutumuna etkisi. Yayımlanmamış Yüksek Lisans Tezi, Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Gündüz, S., & Kutluca, T. (2019). Matematik ve fen bilimleri öğretiminde akıllı tahta kullanımının öğrencilerin akademik başarılarına etkisi üzerine bir meta-analiz çalışması. Journal of Computer and Education Research, 7(13), 183-204.

Gündüz, S., & Çelik, C.H (2015). Öğrencilerin matematik dersinde akıllı tahta kullanımına yönelik tutumlarının çeşitli değişkenler açısından incelenmesi. Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 25,157-174.

Gürbüztürk, O. (2018). Investigation of elementary education students' attitudes towards the use of smart boards. International Electronic Journal of Elementary Education, 11(1), 55-61.

Hebebci, M. T., Çelik, İ., & Şahin, İ. (2016). Eğitim ortamlarında etkileşimli tahta kullanımı: Araştırmalar ve eğilimler. Eğitim, Bilim ve Teknoloji Araştırmaları Dergisi, 1(1), 55-76.

Karasar, N. (2009). Bilimsel araştırma yöntemi: kavramlar-ilkeler-teknikler. Ankara: Nobel Yayın Dağıtım.

Kikas, E. (2004). Teachers Conceptions and Misconceptions Concerning Three Natural Phenomena. Journal of Research in Science Teaching, 41, 432-448.

Korucu, A.T., Usta, E., & Toraman, L. (2016). Ortaokul öğrencilerinin etkileşimli tahta kullanımına yönelik tutumlarının farklı değişkenler açısından incelenmesi. Bartın Üniversitesi Eğitim Fakültesi Dergisi, 5(3), 690-717.

Koşar, E. & Çiğdem, H. (2003). Öğretim teknolojileri ve materyal geliştirme. Ankara: Pegem A.

Lai, T., & Land, S.M. (2009). Supporting reflection in online learning environments. Educational Media and Technology Yearbook, (page 141-154). Springer US.

Levy, P. (2002). Interactive whiteboards nn learning and teaching in two Sheffield schools: A developmental study. http://dis.shef.ac.uk/eirg/projects/wboards.htm sayfasından erişilmiştir.

Loughlin, C., & Krakowski, K. (2001). Technological tools for visual thinking: What does the research tell us? N. Smythe. In Apple University Consorfium Academic and Developers Conference Proceedings of the Apple University Consorfium Conference (pp. 127-138).

Milli Eğitim Bakanlığı [MEB], (2018). İlköğretim fen bilimleri dersi (6,7 ve 8. sınıflar) öğretim programı. Ankara: MEB.

Muhanna, W., & Nejem, K. M. (2013). Attitudes Of Mathematics Teachers Toward Using Smart Board In Teaching Mathematics. Contemporary Issues In Education Research – Fourth Quarter 6(4).

Nordness, P., & Clark, J. (2007). Enhacing Emergent Literacy Skills with Smart Board Interactive Whiteboard Technology. Erişim adresi: http://downloads01.smarttech.com/media/sitecore/en/pdf/research_library/k12/enhn cing%20emergent_literacy

Oleksiw, T. (2007). Increasing math test scores with the smart board ınteractive whiteboard. Erişim tarihi: 23 Ekim 2019, http://downloads01.smarttech.com/media/sitecore/en/pdf/research_library/k-12/the_effect_of_the_smart_board_interactive_whiteboard_on_raising_state_test_scores.pdf

Önder, R. (2015) Biyoloji dersinde akıllı tahta kullanımının öğrencilerin akademik başarılarına, akıllı tahta kullanımına ve derse yönelik tutumlarına etkisi. Yayınlanmamış Yüksek Lisans Tezi. Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü, İzmir.

Özenç, E. G., & Özmen, Z. K. (2014). Akıllı tahtayla işlenen fen ve teknoloji dersinin öğrencilerin başarısına ve derse karşı tutumlarına Etkisi. Türkiye Sosyal Araştırmalar Dergisi, 182(182), 137-152.

Özgen, K., & Tum, A. (2018). Ortaokul öğrencilerinin matematik derslerinde akıllı tahta kullanmaya yönelik tutumlarının bazı değişkenlere göre incelenmesi. Cumhuriyet International Journal Of Education, 7(1),16-39. DOI: 10.30703/Cije.380702

Painter, D. D., Whiting, E., & Wolters, B. (2005). The use of an interactive whiteboard in promoting interactive teaching and learning. VSte Journal, 19(2), 31-40.

Rakes, G. C., Flowers, B. F., Casey, H. B., & Santana, R. (1999). An analysis of đnstructional technology use and constructivist behaviors đn k-12 teachers. International Journal of Educational Technology. 1(2).

Robinson, M.C. (2004). The impact of the interactive electronic white board on student achievement in middle school mathematics. Master's Thesis. The Florida State University College Of Education.

Sarıkaya, S. (2015). Akıllı tahta kullanımının ortaöğretimde işlenilen canlıların sınıflandırılması konusunun öğrenimi üzerine etkisi. Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Sergievskaya, I. L., & Zharenkov, A. D. (2019). SMART-board for creating communicative situation while listening to a foreign language text. Международный журнал гуманитарных и естественных наук, (4-1).

Solvie, P. A. (2004). The digital whiteboard: A tool in early literacy instruction. Erişim adresi: http://downloads01.smarttech.com/media/sitecore/en/pdf/research_library/k12/the_digital_whiteboard_as_a_tool_in_increasing_student_attention_during_early_literacy_instruction.pdf

Şad, S. N. (2012). An attitude scale for smart board use in education: Validity and reliability studies. Computers & Education, 58(3), 900-907.

Taşkoyan, S. N. (2008). Fen ve teknoloji öğretiminde sorgulayıcı öğrenme stratejilerinin öğrencilerin sorgulayıcı öğrenme becerileri, akademik başarıları ve tutumları üzerindeki etkisi. Doctoral dissertation, DEÜ Eğitim Bilimleri Enstitüsü, İzmir.

Tataroğlu, B. (2009). Matematik öğretiminde etkileşimli tahta kullanımının 10. sınıf öğrencilerinin akademik başarıları, matematik dersine karşı tutumları ve öz-yeterlik düzeylerine etkileri. Yayınlanmamış Yüksek Lisans Tezi. Dokuz Eylül Eğitim Bilimleri Enstitüsü, İzmir.

Tekin, Y. (2013). Fizik eğitiminde akıllı tahta kullanımının öğrencilerin fizik başarılarına ve fiziğe karşı tutumlarına etkisinin incelenmesi. Yüksek Lisans Tezi, Yüzüncü Yıl Üniversitesi, Eğitim Bilimleri Enstitüsü, Van.

Tercan, İ. (2012). Etkileşimli tahta kullanımının öğrencilerin fen ve teknoloji dersi başarı, tutum ve motivasyonuna etkisi. Yayınlanmamış Yüksek Lisans Tezi. Necmettin Erbakan Üniversitesi Eğitim Bilimleri Enstitüsü, Konya.

Tezer, M., & Deniz, A.K. (2009). Matematik dersinde interaktif tahta kullanarak yapılan denklem çözümünün öğrenme üzerindeki etkisi. 9th International Educational Technology Conference, Ankara.

Tunaboylu, C., & Demir, E. (2017). The effect of teaching supported by interactive whiteboard on students' mathematical achievements in lower secondary education. Journal of Education and Learning, 6(1), 81- 94.

Tüfekçi, N. (2019). Akıllı tahta kullanımının öğrencilerin fen başarısı-tutumu üzerine etkileri ve akıllı tahtaya yönelik tutumlarının belirlenmesi: 7. sınıf insan ve çevre ünitesi örneği. Yayınlanmamış Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

Türel, Y. K. (2010). Developing Teachers' Utilization of Interactive Whiteboards. In D. Gibson & B. Dodge (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference 2010,Chesapeake, VA: AACE. (pp.3049-3054)

Türel, Y. K. (2012). Öğretmenlerin akıllı tahta kullanımına yönelik olumsuz tutumları: Problemler ve ihtiyaçlar. Elementary Education Online, 11(2), 423-439, 2012.

Türkoğlu, T. (2014). Fen ve teknoloji öğretiminde akıllı tahta kullanımının 6. sınıf öğrencilerinin akademik başarı, tutum ve görüşleri üzerine etkileri. Yayımlanmamış Yüksek Lisans Tezi. Celal Bayar Üniversitesi Fen Bilimleri Enstitüsü, Manisa.

Wall, K., Higgins, S., & Smith, H. (2005). The visual helps me understand the complicated things': pupil views of teaching and learning with interactive whiteboards. British Journal of Eductional Technology, 36(5), 851-867.

Warnock, S. H., Boykin, N. J., & Tung, W. C. (2011). Assessment of the Impact of Smart Board Technology System Use on Student Learning, Satisfaction, and Performance. Journal of Research in Education, 21(1), 1-20.

Wood, R., & Ashfield, J. (2008). The use of the interactive whiteboard for creative teaching and learning in literacy and mathematics: a case study. British Journal of Educational Technology, 39(1), 84-96.

Xie, Y., Ke, F., & Sharma, P. (2008). The effect of peer feedback for blogging on college students' reflective learning processes. The Internet and Higher Education, 11, 18-25.

Yıldırım, A., & Şimşek, H. (2011). Sosyal bilimlerde araştırma yöntemleri. Ankara: Seçkin Yayınları.

Yıldırım, C. (2012). Bilimsel süreç becerileri etkinliklerinin ilköğretim 7. sınıf öğrencilerinin yansıtıcı düşünmelerine etkisi. Master's thesis. Pamukkale Üniversitesi Fen Bilimleri Enstitüsü, Denizli.

Yıldız, A., & Büyükkasap, E. (2006). Fizik Öğrencilerinin Kuvvet ve Hareket Konusundaki Kavram Yanılgıları ve Öğretim Elemanlarının Bu Konudaki Tahminleri, Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 30, 268 – 277.

Zengin, F., Kırılmazkaya, G., & Keçeci, G. (2011). Etkileşimli tahta kullanımının ilköğretim öğrencilerinin fen ve teknoloji dersindeki başarı ve tutuma etkisi. 109 5th International Computer & Instructional Technologies Symposium, 22- 24 September 2011, Fırat University, Elazığ- Turkey.