The Investigation of Relation Between The Attitude of Students Towards Interactive Board in Education Process and Technological, Pedagogical and Content Knowledge of Teachers

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Abstract

The aim of this study is to indicate the relationship between teachers' technologic pedagogical content knowledge level and students' attitudes towards the usage of interactive whiteboards. The research was carried out with 45 teachers who were working in a private school attached to National Education Ministry and 632 elementary and secondary school students who were studying in the same school in the education year between 2015-2016 Spring terms. The research is a correlational study. As a correlational tool, "Technologic Pedagogical Content Knowledge Scale" was applied to teachers and "Interactive Board Attitude Scale" was used for students. While analysis of the data obtained from applied scales was being carried out, descriptive statistics, independent groups t-test, single direction variance and correlation analyses were utilized. As a result of the research, it was determined that students' attitudes towards interactive whiteboards are high; female students' attitudes are meaningfully higher than male ones' statistically; students' attitudes towards interactive white boards do not alter in accordance with class grades and also teachers' technologic pedagogical content knowledge level is high. It is also indicated that there is not any encountered meaningful relationship statistically between points of students' attitudes towards interactive white board and teachers' technologic pedagogical content knowledge.

Keywords: Interactive Board, Attitude, Basic Education, Technologic Pedagogical Content Knowledge

1. Introduction

One of the most used fields in the scope of education-teaching technologies currently is interactive board technology. For the name of interactive boards, smart whiteboard and electronic board have been also used (Şad, 2012). In general, interactive whiteboards consists of touch screen, computer and projector technologies (Shenton and Pagett, 2008). England is the first country to have launched the usage of interactive whiteboards in education and a great deal of investment was funded in order for these schools to be equipped with interactive boards (Armstrong, Barnes, Sutherland, Curran, Mills and Thompson, 2005). At present time, interactive boards have been used as digital learning environments widely (Somyürek, Atasoy and Özdemir, 2009; Littleton, 2010). In the scope of national education programs, they have been presented to the school by countries such as England, The United States of America, Taiwan, Australia and South Africa (Slay, Siebörger, and Hodgkinson-Williams, 2008; Holmes, 2009; Lai, 2010). Also in our country, it is aimed to provide more efficient teaching in equipped environments with advanced technology and present equal opportunities by supplying computers, interactive white boards, visual presenter, fast and powerful web for each class and giving table to each student as well as providing multifunctional printers for each school within the scope of FATIH Project (Enhancing Opportunities and Developing Technology Movement) (FATIH Project, 2012).

Interactive whiteboards ensure permanence in learning through presenting visual materials with sounds and animations (Mechling, Gast and Krupa, 2007; Altınçelik, 2009; Yıldızhan, 2013). When interactive board is used with appropriate and correct methods decently and adapted to lessons, it helps learners comprehend some fields including abstract subjects such as Science and Maths (Ekici, 2008; Tataroğlu, 2009; Riska, 2010; Zengin, Kırılmazkaya and Keçeci, 2011), and be motivated better in the classes as well as enhancing language learning (Lopez, 2010; Schmid, 2008; Xin and Sutman, 2011) since it enables different methods and techniques to be implemented (Elaziz, 2008; Adıgüzel, Gürbulak and Sarıçayır, 2011).

Interactive board technology constitutes junction point between pedagogy and technology (Smith, Higgins, Wall and Miller, 2005; Hırça and Şimşek, 2013). Nevertheless, there are some disadvantages of interactive whiteboard technology. For instance, it is unable to integrate this technology into curriculum and it makes students passive and also teachers become dependent on computer (Shenton and Pagett, 2008; Türel, 2012).

Bransford, Brown and Cocking (2002) indicate that how much countries invest in education is not important; on the contrary, how individuals adapt to these technologies and teacher use them carry more importance. On the other hand, no matter how much current lesson materials there are in the classroom, if teacher doesn't use these appropriately and effectively, these materials do not have any efficacy and meaning (Tondeur, Valcke and Van Braak, 2008; Bayrak and Hırça, 2013). Therefore, teachers should give importance to students' needs and

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expectations while arranging teaching and learning atmosphere and they need to know how to benefit from technology (Aşkar and Işıksal 2003; Akpınar, 2004).

With the development of technologies, technological, pedagogic and content knowledge (TPCK) is derived from the thought that content and pedagogy should be also included in technology after technological devices have started to be used more often and taken place in education (Niess, 2005; Schmidt, Baran, Thompson, Mishra, Koehler and Shin, 2009). TPCK is defined as the knowledge of choosing appropriate pedagogic methods and technological tools while teaching a subject, solving problems, which students have experienced while learning, with the help of technology and enhancing students' knowledge and comprehension correctly via technology (Koehler and Mishra, 2009). Seven fields of information including the integration of technology, pedagogy and content knowledge appear in TPCK. These are; Content Knowledge, Pedagogy Knowledge, Technology Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogy Knowledge and Technological and Pedagogical Content Knowledge (Koehler and Mishra, 2009).

It is found out that thanks to the usage of educational technologies in the body of literature and education-teaching field, the motivation and success of students have been increased (Delen and Bulut, 2011), their thinking process have been made easier and their interpretation skills have been also enhanced (Newton and Rogers, 2003; Simpson, 2010; Spiezia, 2010), their misconceptions have been erased and meaningful learning have been provided (Metcalf and Tinker, 2003) the concept "self-respect" in students has been influenced positively (Sivin-Kachala and Bialo, 2000; Sünkür, Şanlı and Arabacı, 2011). Nonetheless, the usage and efficacy of interactive boards, which are one of the tools integrating educational technologies into education, in many different lessons such as Math (Dill, 2008; Ekici, 2008; Wood and Ashfied, 2008; Tataroğlu, 2009; Riska, 2010), Science (Newton and Rogers, 2003; Zengin, Kırılmazkaya and Keçeci, 2011), Biology (Schut, 2007), Foreign Language (Glover, Miller, Averis and Door, 2007; Elaziz, 2008), Geography (Akdemir, 2009; Kaya and Aydın, 2011), Reading-Writing (Reaume, 2006) have also been researched.

In the studies fulfilled within the scope of TPCK, there are some researchers in which competence of teachers and students towards TPCK (Schmidt and et.al., 2009; Bulut, 2012; Bal and Karademir, 2013; Jang and Tsai, 2013; Tokmak, Yelken, and Konokman, 2013), the attitudes of teacher candidates towards technology and their TPCK competence (Bilgin, Tatar and Ay, 2012; Bayrak and Hırça, 2016), TPCK of classroom teacher candidates and instructors (Öztürk, 2013; Şimşek, Demir, Bağçeci and Kınay, 2013) have been evaluated according to some factors. However, Graham (2011) also investigated TPCK from the point of theoretic view in his research titled as "Theoretical Discussions to Understand Technological, Pedagogic and Content Knowledge" and put forward that TPCK has a potential for future to integrate technology and education. Isman, Abanmy, Hussein, Saadany and Abdelrahman (2012) stated that teachers need a professional support so as to use interactive boards more effectively.

When the indicated researches are analysed, it is viewed that there is not any sufficient study about the relationship between TPCK levels of teachers and attitudes of students towards interactive boards in education process. From this aspect, it can be said that investigation of relationship between TPCK level of teachers working in different fields at elementary and secondary schools and attitudes of students towards interactive boards studying at the same schools will have contributions into literature. Therefore, the study aims to indicate the relationship between technological and pedagogical knowledge level of teachers in education process and students' attitudes towards interactive boards in learning environment. With this aim, the general problem of the study is "Do technological and pedagogical content knowledge levels of teachers have an effect on students' attitudes towards using interactive boards?"

In order to achieve this primary goal, these sub-problems are tried to answer:

1. How is the attitude of students towards using interactive boards in learning environments?
2. Is there a meaningful statistical variation in points of students' attitudes towards using interactive boards in learning environment in terms of their gender?
3. Is there a meaningful statistical variation in points of students' attitudes towards using interactive boards in learning environment in terms of their grades?
4. How is technological and pedagogical field knowledge level of teachers?
5. Is there a meaningful relation statistically between teachers' technological and pedagogical field knowledge and students' attitudes towards using interactive boards?

2. Method

In the study, correlational research method is used. In this research method, the purpose is to determine relations between two or more variables and obtain hints related to cause and result (Büyüköztürk, Çakmak, Akgün, Karadeniz and Demirel, 2011).

2.1 Study Group

Study group consists of all of the teachers who work at a private elementary and secondary school in the Marmara Region of Turkey and all students of these schools. Study group is determined according to purposive sampling method (Yıldırım and Şimşek, 2008). The main reason why these schools were chosen with purposive

method is that all teachers almost in every field use interactive boards efficiently in these schools. Totally 50 teachers in different fields of study attending to the study were given Technological and Pedagogical Content Knowledge Scale (TPCK) to answer, but 45 teachers responded. On the other hand, totally 651 students were delivered Interactive Board Attitude Scale to answer; 632 students' answers were included into the study after some incorrect answers from students were omitted. Totally 45 teachers from Social Sciences (3), English (4), Science Technology/Science (5), Classroom (23), Mathematics (6), Turkish (3), Religion (1) and Technology and Design (1) as well as 632 students in different grades participated in the study. Demographic Features about students and teachers attending into the study are presented in Table 1.

Table 1. Demographic features of teachers and students

Participants	School Grade	Class Grade	Gender		Total
			Male	Female	
Teachers	Primary School	Between 1-8	16	29	45
Students	Elementary	3th Grade	54	52	106
		4th Grade	60	53	113
	Secondary	5th Grade	56	55	111
		6th Grade	51	58	109
		7th Grade	55	47	102
		8th Grade	53	38	91
		Total	339	303	632

Scales implemented in the research were asked to be filled voluntarily; and it is stated in the instructions that teachers and students who are not willing may not respond and give it back.

2.2 Data Collection Tools

Data is obtained through application of TPCK Scale for teachers and Interactive Board Attitude Scale for students in education-teaching period of 2015-2016.

2.3 Technological Pedagogical Field Knowledge Scale

In order to determine technological and pedagogical field knowledge level of teachers, "Technological Pedagogical Content Knowledge Scale" prepared in five Likert and consisted of 47 items is used in the study. Scale related to the concept "TPCK" has been developed by Schmidt and others (2009) and adapted to Turkish by Ozturk and Horzum (2011). Scale comprises of 7 factors: "F1: Technology Knowledge", "F2: Content Knowledge", "F3: Pedagogy Knowledge", "F4: Pedagogical Content Knowledge", "F5: Technological Content Knowledge", "F6: Technological Pedagogy Knowledge", "F7: Technological Pedagogy Content Knowledge". For the whole scale, Cronbach Alpha (α) reliability co-efficient is determined as 0.96. Cronbach Alpha reliability co-efficient of the scale in the study is found as 97.

2.4 Interactive Board Attitude Scale

In the study, "Interactive Board Scale" prepared in the type of five Likert and consisted of 24 items is used in order to determine students' attitudes towards using interactive boards in the lessons. The scale is developed via relating to the concept "Interactive Board" by Celik and Atak (2012). As a result of factor analysis which is fulfilled after investigation of developed scale's validity and reliability, it is ascertained that the scale includes 3 factors and it is also found that reliability co-efficient (α) is 0.83 for the whole scale. Detected factors are: "F1: Facilities of Interactive Boards", "F2: Difficulties of Interactive Boards", "F3: Teacher's usage of Interactive Board". In this study, Cronbach Alpha reliability co-efficient is also found as.

2.5 Data Analysis

Kolmogorov-Smirnow (Sampling Size: $N > 50$) and Shapiro Wilk (Sampling Size: $N \leq 50$) tests are taken into consideration for compliance test with normal distribution of data collected from teachers and students voluntarily (Büyüköztürk, 2010). After the analysis of students, it is detected that distribution is normal ($p > .05$). Descriptive, statistical and independent groups t-test as well as single variance (ANOVA) analyses are carried out respectively so as to determine general attitude of students to interactive board and whether their attitude show meaningful difference according to their grades. Afterwards, correlation analysis is made with the purpose of measuring the relations between TPCK Scale points implemented on teachers and Interactive Board Attitude Scale points applied for students.

3. Findings and Conclusion

This study is fulfilled with the aim of confirming whether teachers' Technological Pedagogy Content Knowledge level has an effect on students' attitudes towards using interactive boards or not.

3.1 The attitude of Students Towards Using Interactive Boards in Leaning Environments

Descriptive analysis results related to students' attitudes towards interactive boards are presented in Table 2.

Table 2. Descriptive analysis results of students' attitudes towards interactive boards

Attitude	N	$\bar{X}$	Ss
Interactive Board Usage Attitude	632	3.63	.51
Facilities of Interactive Board Sub-dimension	632	3.63	.49
Difficulties of Interactive Board Sub-dimension	632	3.51	.70
Teachers' usage of Interactive Board Sub-dimension	632	3.88	.75

According to Table 2, it is seen that students' attitudes towards usage of interactive boards is really high ($\bar{X}$=3.63). In the attitudes of students, it is decided that "facilities of interactive boards ($\bar{X}$=3.63)", "difficulties of interactive board ($\bar{X}$=3.51)" and "teachers' usage of interactive board ($\bar{X}$=3.88)" sub-dimensions are also high.

3.2 The attitude of students towards using interactive board according to their gender

The findings belonging to students' attitudes points for usage of interactive board are displayed in Table 3.

Table 3. The Attitude points t-test results of students towards using interactive board in terms of their gender

Attitude	Gender	N	$\bar{X}$	Ss	t	Importance Degree
Interactive Board Usage Attitude	Male	329	3.60	.55	-1.247	p=.001* Significant Difference
	Female	303	3.65	.46		
Facilities of Interactive Board Sub-dimension	Male	329	3.61	.51	-.856	p=.053 Insignificant Difference
	Female	303	3.64	.46		
Difficulties of Interactive Board Sub-dimension	Male	329	3.48	.74	-1.238	p= .024* Significant Difference
	Female	303	3.55	.64		
Teachers' usage of Interactive Board Sub-dimension	Male	329	3.86	.77	-1.238	p=.100 Insignificant Difference
	Female	303	3.91	.74		

According to Table 3, when students' attitude points towards usage of interactive board is analysed, it is confirmed that there is a meaningful difference statistically between male and female students' points ($t_{(630)}$= -1.247; $p < .01$). This result put forwards that female students have higher attitudes towards using boards than male ones meaningfully. Besides, when sub-dimensions of attitude scale of interactive board usage are investigated, it is determined that female students' attitudes towards difficulties of interactive board usage differentiate from male ones statistically for the benefit of female students ($t_{(630)}$= -1.238; $p < .05$). As a consequence, it is seen that female students' attitudes are higher.

3.3 The attitudes of Students Towards Using Interactive Board in Terms of Their Grades

The findings about students' attitudes towards interactive boards with respect to their gender are presented in Table 4.

Table 4. Single variance analysis results of students' attitudes towards using interactive boards

Attitude Scale sub-dimensions	Resources of Variance	Sum of Squares	Sd	Average of Squares	F	p
Interactive Board Usage	Intergroup	2.003	5	.401	1.568	.167
	Intragroup	159.906	626	.255		
	Total	161.909	631			
Facilities of Interactive Board Sub-Dimension Average	Intergroup	2.245	5	.449	1.879	.096
	Intragroup	149.630	626	.239		
	Total	151.875	631			
Difficulties of Interactive Board sub-dimension Average	Intergroup	3.876	5	.775	1.604	.157
	Intragroup	302.603	626	.483		
	Total	306.480	631			
Teachers' usage of Interactive Board sub-dimension Average	Intergroup	1.693	5	.339	.598	.701
	Intragroup	354.360	626	.566		
	Total	356.053	631			

$p > .05$

When sub-dimensions of attitude scales and attitude points towards using interactive boards in lessons with respect to students' grades in Table 4, it is found that there is not any meaningful variation statistically between points of students' attitudes to using interactive boards ($F_{(5-626)}= 1.568$, $p > .05$). Nevertheless, it is also viewed that there is not any meaningful difference between points of attitude scale sub-dimensions "facilities of using interactive boards" ($F_{(5-626)}= 1.879$, $p > .05$), "difficulties of interactive board" ($F_{(5-626)}= 1.604$, $p > .05$), "teachers' usage of interactive boards" ($F_{(5-626)}= .598$, $p > .05$). Consequently, students' grades do not have any effect on their attitudes towards using interactive boards.

3.4 Technological Pedagogy Content Knowledge Level of Teachers

The findings related to teachers' attitude points of technological pedagogy field knowledge are displayed in Table 5.

Table 5. Descriptive analysis results of teachers' technological pedagogy content knowledge levels and their sub-dimensions

TPCK Level	N	$\bar{X}$	Ss
Technological Pedagogic Content Knowledge (TPCK)	45	3.74	.58
Technology Knowledge Sub-dimension (TK)	45	3.41	.76
Content Knowledge Sub-dimension (CK)	45	3.56	.71
Pedagogic Knowledge Sub-dimension (PK)	45	4.06	.73
Pedagogic Content Knowledge Sub-dimension(PCK)	45	3.81	.71
Technological Content Knowledge Sub-dimension(TCK)	45	3.70	.64
Technological Pedagogic Knowledge Sub-dimension (TPK)	45	3.78	.79
Technological Pedagogic Content Knowledge Sub-dimension (TPCKS)	45	3.83	.66

According to Table 5, when teachers' technological pedagogic content knowledge levels are examined, it is determined that TPCK levels of teachers are high in general ($\bar{X}= 3.74$). It is specified that the highest points are in the sub-dimension of "pedagogic knowledge" ($\bar{X}= 4.06$); however, the lowest one is ($\bar{X}= 3.41$) in the sub-dimension of "technology knowledge" obtained from teachers' TPCK levels.

3.5 The Relationship between Teachers' Technological Pedagogic Content Knowledge Level and Students' Attitudes towards Interactive Board.

Whether there is a relationship between teacher' TPCK levels with its sub-dimensions and students' usage of interactive boards is presented in Table 6 via analysis with Pearson product-moment correlation coefficient.

Table 6. Correlation results showing the relationship between teachers TPCK levels and students' attitudes towards using interactive boards

Variables	1	2	3	4	5	6	7	8	9
TK	1	.517**	.622**	.427**	.440**	.750**	.582**	.771**	-.058
CK		1	.605**	.496**	.575**	.534**	.577**	.753**	-.183
PK			1	.690**	.488**	.843**	.793**	.889**	-.077
PCK				1	.649**	.537**	.766**	.794**	-.069
TCK					1	.527**	.591**	.737**	-.013
TPK						1	.727**	.872**	.006
TPCKS							1	.881**	-.011
TPCK								1	-.071
Attitude*									1

*Attitude: Attitude towards using interactive board
**$p < .05$

According to Table 6, there is not any encountered relationship statistically between teachers' TPCK levels and students' attitude towards interactive board ($r_{(TPCK)}$= .-071, $p > .01$). Nonetheless, there is not also any discovered relation between sub-dimensions of technological pedagogic content knowledge scale and students' attitudes to using interactive boards ($r_{(TK)}$= -.058, $p > .01$; $r_{(CK)}$= -.183, $p > .01$; $r_{(PK)}$= -.077, $p > .01$; $r_{(PCK)}$= -.069, $p > .01$; $r_{(TCK)}$= -.013, $p > .01$; $r_{(TPK)}$= .006, $p > .01$; $r_{(TPCKS)}$= -.011, $p > .01$). These conclusions emphasize that teachers' TPCK levels do not have a meaningful effect on students' attitudes.

4. Conclusion and Discussion

In the study, it is purposed to determine the relationship between teachers' technological pedagogic knowledge levels in education process and students' attitudes towards using interactive boards.

In the conclusions of research, it is decided that students' attitudes to interactive boards are high. This result overlaps with the research results in which students have positive attitudes and thoughts towards using interactive boards in lessons included in literature (Akgün and Yücekaya, 2015; Elaziz, 2008; Sünkür et.al. 2011; Vural and Kırkbeş, 2015). Students' thoughts and attitudes to interactive boards are considered to be high because of the fact that interactive whiteboards are often used at private schools and almost in every lesson. Because, it is stated that students get familiar with education technologies closer and enjoy them more as they use interactive boards more frequently (Akgün and Yücekaya, 2015; Elaziz, 2008). Moreover, it is thought that the fact that families of students have high financial standards makes students access technology easier and they use technology in their lives actively. Because, in the body of literature it is stated that students' attitudes towards using interactive boards in lessons increase as financial income of students' families rises up (Demircioğlu and Demircioğlu, 2015). In addition to this, there are researches in the literature putting forward that students have negative or medium-level attitudes towards using interactive boards in lessons (Gündüz and Çelik, 2015; Tataroğlu, 2009).

In the research, it is confirmed that students' attitudes towards usage of interactive boards in lessons do not display any meaningful differentiation statistically. This conclusion coincides with the research results in body of literature in which students' views about using interactive boards in courses do not differentiate with respect to their grades (Bağcı, 2013). Due to the fact that students have high interest in technology currently and their families' financial situations are well enough, students are able to reach information and communication technologies easily. Additionally, in the school where study was conducted, the fact that interactive boards are used in each grade effectively enhances students' interaction with information and communication technologies as well as developing all students' attitudes in each class grade (Gündüz and Çelik, 2015). However, there are not any found researches which assert that students' attitudes to interactive boards differentiate meaningfully with regard to their grades (Demircioğlu and Demircioğlu, 2015).

In the research, it is appointed that teachers' TPCK levels are high. From this conclusion, it is understood that teachers' technological pedagogic content knowledge is really good in general. It is possible to obtain similar results in the body of literature (Bal and Karademir, 2013). The reason of this conclusion might be the fact that the school where study is conducted carry out its function as a private school. These institutions aim high standards for the choice of teachers and their competence, support on the basis of our present day requirements and teachers' knowledge and skill levels with in-service activities, and also supply their developments. On the other hand, in the literature, it is likely to encounter research results in which teachers regard themselves sufficient about pedagogic knowledge; on the contrary, they do not think they are well-equipped in terms of technologic knowledge (Bal and Karademir, 2013).

In the research, a meaningful relationship is not encountered statistically between teachers' technological pedagogy field knowledge and students' attitude points of using interactive boards. This conclusion is interpreted in a way that teachers' TPCK levels do not have an impact on students' attitudes to usage of interactive boards. Presently, students are able to use many technological devices similar to interactive boards easily and constantly. Students' attitudes are thought to stem from the fact that they are capable of accessing and using technological devices easily, rather than its relation with teachers' TPCK levels.

5. Suggestions

These suggestions can be conducted with parallel to results of this research:

1. Teachers should be encouraged to exhibit their content knowledge with technologic knowledge in this age when technologic knowledge has started to be used everywhere.
2. As in private schools, TPCK level of all teachers in National Education Ministry should be identified; their knowledge, skills and competence about new developments in this field should be supported at certain intervals.
3. With in-service trainings, not only teachers' knowledge and skills related to interactive board should be improved, but also informative education about these devices need to be given to students.
4. Within the scope of FATIH Project, interactive boards aimed for all schools and other compositions ought to be activated rapidly.
5. In order for students to have positive attitudes towards interactive boards, many different activities and applications suitable with these devices should be developed. Applications demonstrating different features of interactive boards need to be planned.
6. Not only teachers should use interactive boards in lessons, but also students should be familiar with these devices and use them actively.
7. Opportunities for accessing technological devices should be provided equally to the students. Because, as technological interaction increases, students' attitudes in this field can be improved, too.
8. The effect of students' attitudes towards using interactive boards on their success, motivation, permanence of learning and technology literacy etc. can be researched.
9. The factors such as individual differences influencing students' attitudes towards usage of interactive boards in lessons can be also researched.

References

Adıgüzel, T., Gürbulak, N. ve Sarıçayır, H. (2011). Akıllı tahtalar ve öğretim uygulamaları. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. *2*,*8*, 457-471.

Akdemir, E. (2009). *Akıllı tahta uygulamalarının öğrencilerin coğrafya ders başarıları üzerine etkisinin incelenmesi.* Yüksek Lisans Tezi, Zonguldak Karaelmas Üniversitesi, Sosyal Bilimler Enstitüsü, Zonguldak.

Akgün, M. ve Koru, G. (2015). Akıllı tahta kullanımına yönelik öğrenci tutumu ve öğretmen görüşlerinin incelenmesi (Ankara ili örneği). *Qualitative Studies*, (1), 1-12.

Akpınar, Y. (2004). Eğitim teknolojisiyle ilgili öğrenmeyi etkileyebilecek bazı etmenlere karşı öğretmen yaklaşımları. *The Turkish Online Journal of Educational Technology- TOJET.* 3(3), 124-134.

Altınçelik, B. (2009). İlköğretim düzeyinde öğrenmede kalıcılığı ve motivasyonu sağlaması yönünden akıllı tahtaya ilişkin öğretmen görüşleri. *Yayınlanmamış yüksek lisans tezi, Sakarya Üniversitesi Sosyal Bilimleri Enstitüsü, Sakarya*.

Armstrong, V., Barnes, S., Sutherland, R., Curran, S., Mills, S., & Thompson, I. (2005). Collaborativeresearchmethodologyforinvestigatingteachingandlearning: The use of interactive white board technology. *Educational Review*, 57(4), 457-469.

Aşkar, P. ve Işıksal, M. (2003). İlköğretim öğrencileri için matematik ve bilgisayar öz-yeterlik algısı ölçekleri. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 25, 109-118.

Bağcı, H. (2013).*Fatih projesi çerçevesinde ortaöğretim öğrencilerinin etkileşimli tahtaya yönelik görüşlerinin incelenmesi*. Yayınlanmamış Doktora Tezi, Okan Üniversitesi, İstanbul.

Bal, M.S. ve Karademir, N. (2013). Sosyal bilgiler öğretmenlerinin teknolojik pedagojik alan bilgisi (TPAB) konusunda öz-değerlendirme seviyelerinin belirlenmesi, *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, (34), 15-32.

Bayrak, N. ve Hırça, N. (2013). Bilişim teknolojileri rehber öğretmenlerine göre fatih projesine yönelik hizmet içi eğitim gören öğretmenlerinin yeterliklerinin ve ihtiyaçlarının değerlendirilmesi: Erzurum ili Örneği, *7th International Computer & Instructional Technologies Symposium*, 6-8 Haziran, Erzurum, 399-401.

Bilgin, İ., Tatar, E. ve Ay, Y. (2012), Sınıf öğretmeni adaylarının teknolojiye karşı tutumlarının teknolojik pedagojik alan bilgisi (TPAB)'ne katkısının incelenmesi, 10. Fen Bilimleri ve Matematik Eğitimi Kongresi, 27-30 Haziran 2012, Niğde.

Bransford, J.D., Brown, A.L., & Cocking, R.R. (2002). H*ow peoplelearn: brain, mind, experience and school*. Washington, DC: National Academy Press.

Bulut, A. (2012). *Investigating perceptions of preservice mathematics teachers on their technological pedagogical content knowledge (TPCK) regarding geometry*, Doctoral dissertation, Middle East Technical University, Ankara.

Büyüköztürk, Ş. (2010). *Sosyal bilimler için veri analiz kitabı*. Ankara: Pegem Akademi Yayınları, 11. Baskı, 42.

Büyüköztürk, Ş., Çakmak, E.K., Akgün, Ö.E., Karadeniz, Ş. ve Demirel, F. (2011). *Bilimsel araştırma yöntemleri*. 8. Baskı, Ankara: Pegem Yayınları.

Çelik, S. ve Atak, H. (2012). Etkileşimli tahta tutum ölçeğinin geçerlik ve güvenirlik çalışması.*AnadoluJournal of Educational Sciences International*, *2*(2), 43-60.

Delen, E. ve Bulut, O. (2011). The relationship between students' exposure to technology and their achievement in science and math. *Turkish Online Journal of Educational Technology - TOJET*, *10*(3), 311–317.

Demircioğlu, G. ve Demircioğlu, H. (2015). Öğrencilerin kimya derslerinde akıllı tahta kullanımına yönelik tutumlarının farklı değişkenler açısından incelenmesi. *Journal of Research in EducationandTeaching*, 4 *(2),* 387-395, ISSN: 2146-9199.

Dill, M.J. (2008). *A Tool to improve student achievement in math: An interactive whiteboard.* Unpublished DoctoralThesis, Ashland University, Ohio.

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

Elaziz, F.M. (2008). *Attitudes of students and teachers towards the use of ınteractive whiteboards in EFL classrooms*. Unpublished Master Thesis. TheDepartment of Teaching English as a Foreign Language, Bilkent University. Ankara.

FATİH Project (2012). [Online] RetrievedJune, 06, 2016 from http://fatihprojesi.meb.gov.tr/

Glover, D., Miller, D., Averis, D., & Door, V. (2007). The evolution of an effective pedagogy for teachers using the interactive whiteboard in mathematics and modern languages: An empirical an alysis from the secondarysector. *Learning, Media and Technology*, 32(1), 5-20.

Graham, C.R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPCK). *Computers & Education*, (57), 1953-1960.

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

Hırça, N. ve Şimşek, H. (2013). Öğretmen adaylarının fen konularına yönelik tekno-pedagojik bilgi bütünleştirmelerinin geliştirilmesi ve değerlendirilmesi, *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 7*(1), 57-82.

Holmes, K. (2009). Planning to teach with digitaltools: Introducing the interactive whiteboard to pre-service secondary mathematics teachers. *Australasian Journal of Educational Technology*, 25(3), 351-365.

Isman, A., Abanmy, F.A.A., Hussein, H. B., Saadany, A., & Abdelrahman, M. (2012). Saudi secondary school teachers attitudes' towards using interactive whiteboard in classrooms. *TheTurkish Online Journal of Educational Technology-TOJET*,11(3), 286-296.

Jang, S.J., & Tsai, M.F. (2013). Exploring the TPCK of Taiwanese secondary school science teacher susing a new contextualized TPCK model. *Australasian Journal of Educational Technology*, 29(4), 566-580.

Kaya, H. ve Aydın, F. (2011). Sosyal bilgiler dersindeki coğrafya konularının öğretiminde akıllı tahta uygulamalarına ilişkin öğrenci görüşleri. *Journal of World of Turks*,*3*(1), 179-189.

Koehler, M.J., & Mishra, P. (2009). What is technological pedagogical content knowledge. *Contemporary Issues in Technology andTeacherEducation*, *9*(1), 60-70.

Lai, H.J. (2010). Secondary school teachers' perceptions of interactive whiteboard training workshops: A case study fromTaiwan. *Australasian Journal of Educational Technology*, 26, 511-522.

Littleton, K. (2010). Research into teaching with whole-class interactive technologies: Emergent themes. *Technology, Pedagogy andEducation*, 19, 2, 285-292.

Lopez, O. (2010). The digital learning classroom: Improving English language learners academic success in mathematics and reading using interactive whiteboard technology. *Computers & Education,. 54,* 901-915.

Mechling, L.C., Gast, L.D., & Krupa, K. (2007). Impact of smart board technology: an investigation of sigh tword reading and observational learning. *Journal of Autismand Development al Disorders*. *37*, 18-27.

Metcalf, S.J., & Tinker, R. (2003). TEEMSS: Technologyenhancedelementaryandmiddleschoolscience. In*Annual Meeting of theNationalAssociation forResearch in ScienceTeaching*, 23-26, Philadelphia.

Newton, L., & Rogers, L. (2003). Thinking frame Works for planning ICT in science lessons. *School Science Review*. *84*(309), 113-119.

Niess, M. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and TeacherEducation: An International Journal of Research and Studies*, *21*(5), 509-523.

Öztürk, E. (2013). Sınıf öğretmeni adaylarının teknolojik pedagojik alan bilgilerinin bazı değişkenler açısından değerlendirilmesi, *Uşak Üniversitesi Sosyal Bilimler Dergisi*, 6(2), 223 – 238.

Öztürk, E. ve Horzum, M.B. (2011). Teknolojik pedagojik içerik bilgisi ölçeğinin Türkçe'ye uyarlaması.*Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, *12*(3), 255-278.

Reaume, M.M. (2006). *Enhancing boys' literacy through the use of interactive whiteboards*. Unpublished Master Thesis, Faculty of Education Nipissing University.

Riska, P. (2010). *The impact of smart board technology on growth in mathematicsachievement of giftedlearners.* Unpublished Doctorial Dissertation. LibertyUniversity USA.

Schmid, E.C. (2008). Using a voting system in conjunction with interactive whiteboard technology to enhance learning in the English language classroom. *Computers & Education*. 5*(1),* 338–356.

Schmidt, D.A., Baran, E., Thompson, A.D., Mishra, P., Koehler, M.J., & Shin, T.S. (2009). Technological pedagogical content knowledge (TPCK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 27.

Schut, C.R. (2007). *Student perceptions of interactive whiteboards in a biology classroom.* Unpublished Master Thesis, CedarvilleUniversity, B.A. Life ScienceEducation.

Shenton, A., & Pagett, L. (2008). From 'Bored' toscreen: theuse of the interactive whiteboard for literacy in six primary classrooms in England. *Literacy*, 41*(3),* 129-136.

Simpson, A. (2010). Integrating technology with literacy: Using teacher-guided collaborative online learning to encouragecritical thinking. *ALT-J: Research in Learning Technology*, 18*(2),* 119–131.

Sivin-Kachala, J., & Bialo, E. (2000). *Research report on the effective ness of technology in schools*(7th ed.). Washington, DC: Software and Information IndustryAssociation.

Slay, H., Siebörger, I., & Hodgkinson-Williams, C. (2008). Interactive whiteboards: Real beauty or just "lipstick"?. *Computers & Education, 51*(3), 1321-1341.

Smith, H.J., Higgins, S., Wall, K., & Miller, J. (2005). Interactive whiteboards: Boonorb and wagon? A critical review of the literature. *Journal of Computer Assisted Learning.* 21, 91-101.

Somyürek, S., Atasoy, B., & Özdemir, S. (2009). Board's IQ: Whatmakes a board smart? *Computers & Education*, 53*(2),* 368-374.

Spiezia, V. (2010). Does computer use increase educational achievements? Student-levelevidencefrom PISA. *OECD Journal: Economic Studies*, 127–148.

Sünkür, M., Şanlı, Ö. ve Arabacı, İ.B. (2011). *Akıllı tahta uygulamaları konusunda ilköğretim II. kademe öğrencilerinin görüşleri (Malatya İli Örneği).* 5th International Computer

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

Şimşek, Ö., Demir, S., Bağçeci, B. ve Kınay, İ. (2013). Öğretim elemanlarının teknopedagojik eğitim yeterliliklerinin çeşitli değişkenler açısından incelenmesi, *Ege Eğitim Dergisi*, 14*(1),* 1–23

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

Tokmak, H.S., Yelken, T.Y., & Konokman, G.Y. (2013). Pre-service Teachers' Perceptions on Development of Their IMD Competencies through TPACK-based Activities. *Educational Technology & Society*, *16*(2), 243-256.

Tondeur, J., Valcke, M., & Van Braak, J. (2008). A multidimensional approach to determinants of computer use in primary education: Teacher and school characteristics. *Journal of Computer Assisted Learning, 24*(6), 494-506.

Türel, Y.K. (2012). Teachers' negativeattitudestowardsinteractivewhiteboarduse: Needsandproblems. *Elemantary Education Online,11(2),* 323-439.

Vural, Ö. F. ve Kırkbeş, H. (2015). Orta öğretimdeki öğrencilerin akıllı tahta hakkındaki görüşlerinin incelenmesi. *Akademik Sosyal Araştırmalar Dergisi,* 3*(18),* 214-230.

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.

Xin, J.F., & Sutman, X.F. (2011). Using the smart board in teaching social stories to students with autism. *Teaching Exceptional Children. 43*(4), 18-24.

Yıldırım, A. ve Şimşek, H. (2008). *Nitel araştırma yöntemleri*. 7. Baskı. Ankara: Seçkin Yayıncılık.

Yıldızhan, Y.H. (2013). Temel eğitimde akıllı tahtanın matematik başarısına etkisi. *Middle Eastern & African Journal of Educational Research*, 5, 110-121.

Zengin, F.K., Kırılmazkaya, G. ve Keçeci, G. (2011). Akıllı tahta kullanımının ilköğretim öğrencilerinin fen ve teknoloji dersindeki başarı ve tutuma etkisi. *5. Uluslararası Bilgisayar ve Öğretim Teknolojileri Sempozyumu.* 22-24 Eylül, Fırat Üniversitesi Elazığ.