ISSN: 2148-9955

International Journal of Research in Education and Science (IJRES)

www.ijres.net

Investigation of the Reasons for Students' Attitudes towards the Interactive Whiteboard Use in Mathematics Classrooms

Kevser Erdener[1], Mehmet Ali Kandemir[2]
[1]Turkish Ministry of National Education
[2]Balikesir University

To cite this article:

Erdener, K. & Kandemir, M.A. (2019). Investigation of the reasons for students' attitudes towards the interactive whiteboard use in mathematics classrooms. *International Journal of Research in Education and Science (IJRES), 5*(1), 331-345.

IJRES International Journal of Research in Education and Science
Volume 5, Issue 1, Winter 2019 ISSN: 2148-9955

Investigation of the Reasons for Students' Attitudes towards the Interactive Whiteboard Use in Mathematics Classrooms

Kevser Erdener, Mehmet Ali Kandemir

Article Info

Article History

Received:
25 July 2018

Accepted:
30 November 2018

Keywords

Interactive whiteboard
Attitude
Features of innovation
Math anxiety
ICT integration

Abstract

The aim of this study is to investigate the reasons of the students' attitudes towards interactive whiteboard (IWB) use in mathematics classrooms in middle schools and high schools. For this purpose the effect of IWB's features, students' mathematics anxiety, teachers' ICT integration, students' mathematics achievement and gender to students' attitudes towards use of interactive whiteboard were investigated. This study is a descriptive research designed as a relational survey method. The research sampling consisted of 350 students in middle schools and 557 students in high schools in Balikesir. The Attitude and Characteristics of IWB scale to measure the students' attitudes and the perceived features of IWB was used. Also the Mathematics Anxiety scale that consists of five items was used to measure students' mathematics anxiety. To determine the students' opinions about the teachers' technology integration approaches, the ICT integration approaches scale was used. In order to determine the structural validity of scales, confirmatory factor analysis was conducted. In order to determine the relation between the students' attitudes toward IWB use and independent variables, multiple regression analysis was conducted separately for the data collected from middle schools and high schools. According to the results of regressions analysis of the data collected from middle school students, IWB's characteristics, traditional ICT integration and math achievement are positive predictors and mathematics anxiety is negative predictor of students' attitudes. The results for high school students show that features of IWB and gender are predictors of students' attitudes. This study has several implications for teachers about reasons of students' attitudes towards IWB use in mathematics classrooms, so that they could have effect on students' attitudes and organize their classroom environment. Also that kind of studies leads the use of information and communication technologies and help to plan the future investments for educational technologies effectively.

Introduction

The progress of technology day by day is showing an effect in the field of education as it is in every field of life. Interactive whiteboards and tablets are at the top of the educational technology products in the classroom. The main purpose of the use of these products is to facilitate learning and to actualize permanent learning. To ensure permanent learning, students must actively participate in class and be responsible for their own learning. Student-centered education approach sees IT technology products as a learning tool and enables students to participate actively in class (Yorgancı & Terzioğlu, 2013). Students' attitudes and opinions about the use of interactive whiteboards in mathematics lessons that will play a role in ensuring student-centered learning environments in classrooms need to be revealed. The reactions students will have to these technological products in their classes depend on their attitudes. Kağıtçıbaşı (2008) stated that attitudes are not observable but the factors—behaviors, feelings and thoughts—that attitudes lead to are observable and these factors lead to measurable responses.

With the use of interactive whiteboards in the classrooms, studies have been done abroad and in our country to examine the attitudes of students and teachers towards the interactive whiteboards (Akgün & Yücekaya, 2015; Başıbüyük, Erdem, Şahin, Gökkurt, & Soylu, 2014). The results of the studies show that the students' attitudes towards the interactive whiteboards are positive, they have a positive effect on the motivation of the students, and they provide permanent learning. Given the studies that examine students' and teachers' attitudes and views on interactive whiteboard use, it is seen that there is a positive relationship between attitudes towards interactive whiteboards use and student success and their attitudes towards the course (Yorgancı & Terzioğlu, 2013). In a

study investigating the effect of interactive whiteboard use on motivation, it has been found that interactive whiteboard have slightly increased students' motivation towards the course (Torf & Tirotta, 2009).

A small number of studies investigating the factors that affect students' perceptions of the interactive whiteboard have examined various independent variables. There were no significant differences between gender, computer ownership and computer literacy variables and students' attitudes towards interactive whiteboard in mathematics classes (Gündüz & Çelik, 2015). The attitude scores in the study in which high school students' attitudes towards using interactive whiteboard in chemistry classes were examined in terms of different variables showed significant differences in terms of class level, income levels of their families, and technology proficiency levels, while showing no difference in terms of gender (Demircioğlu & Demircioğlu, 2015). In the study in which middle school students' attitudes towards interactive whiteboard use were examined in terms of different variables, Korucu, Usta and Toraman (2016) found that attitude did not change according to having tablet computer, weekly Internet usage time and mobile device usage duration, but changed according to the classes and mobile device usage proficiency levels.

Attitudes, factors affecting attitude and consistency of attitudes in social psychology have been studied and significant results have been achieved. Heider, from the forerunner of consistency theory, developed the balance theory. The balance theory arises from the change of attitude and forms the basis for a variety of theories explaining the relevance of adaptation of attitudes to technological innovations (Kağıtçıbaşı, 2008). The theories of attitudes that put forward the effect of attitude on the technology adaptation as an innovation and on the diffusion of technology once again emphasize the importance of the attitude. For example, the Technology Acceptance Model (TAM) developed by Davis (1986) and Rogers' Diffusion of Innovation Theory (DIT) are important studies examining the effect of attitude on technology adaptation.

Technology Acceptance Model

The technology acceptance model (TAM) is a model that is based on Fishbein and Ajzen's (1975) "Theory of Reasoned Action" and reveals what effects on choice of people to use or not to use technology. Davis (1989), in his model, stated that beliefs about affect attitude towards use were perceived usefulness and perceived ease of use. The attitude towards use affects behavioral intention and intention affects behavior.

Components of the Technology Acceptance Model

Perceived Usefulness is the belief of people regarding to which degree using a particular technology results in their performance at work. In a sense, it is the belief in the utility of usefulness capacity and the existence of a positive relationship between performance and use (Davis, 1989). Perceived Ease of Use is the belief regarding to which degree people can use a technology effortlessly. User-friendly technologies are more accepted by users than other technologies (Davis, 1989). Intention is the determining factor that directly affects the use (behavior). Attitudes influence intention, and intention affects behavior (Davis, 1989). In other words, behavior is the result of the intention to reach a preconceived conclusion (Kağıtçıbaşı, 2008). Attitude, "Attitude is the tendency which is attributed to the individual and which includes one's thoughts, feelings and behavior about a psychological object" (Smith, 1968). Attitude is a kind of mental evaluation that is consistent in itself (Kağıtçıbaşı, 2008). According to Davis (1993), attitude towards use is a function of perceived usefulness and perceived ease of use beliefs.

Research has been conducted explaining the acceptance or rejection of educational technologies by students and teachers based on the "Technology Acceptance Model". In the study conducted to determine the factors affecting the technology acceptance and use behaviors of primary school teachers, it was seen that the perceived usefulness, perceived ease of use, intention and attitude towards behavior were found to be effective on technology acceptance (Turan & Haşit, 2014). Teo (2011), who investigated the factors affecting teachers' intentions to use technology, tested Davis's technology adoption model using structural equation modeling by adding new variables to the model. According to the study results, perceived usefulness, perceived ease of use, facilitating situations and attitude toward technology have an effect on the intention to use technology. In the study of students' perceptions of interactive whiteboard use based on TAM, according to Önal (2017), students have a positive attitude towards the whiteboard because it is easy to use, contributes to meaningful learning, and saves time. Therefore, they accepted the use of interactive whiteboards.

Diffusion of Innovations Theory

In the Diffusion of Innovations Theory (DIT) about the diffusion of innovations, Rogers explained the society's acceptance or rejection of innovation and the influence of perceived characteristics of innovation on adaptation. Innovation has been defined by Rogers as an idea, practice, or object perceived as new by an individual or by other units of adoption. The reaction of an individual changes according to how new the idea is; if the idea is new to the individual, then it is an innovation (Rogers, 1995). Rogers (1983) defined diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system." Diffusion is a type of special communication where messages include new ideas. In communication, individuals produce new ideas and share mutually to achieve multiple meanings, so they are not unilateral. In Rogers' model, the four main components of diffusion are defined as innovation, communication channels, time and social system.

Innovation begins with the recognition of an idea or information among potential adaptive individuals in social systems, resulting in a decision to adapt or reject. Rogers stated that technology and innovation are often used in the same sense when ideas regarding innovation are analyzed. Technological innovations have the potential to be useful for potential adapters, as technology, like new knowledge, has reduced uncertainty among individuals. Communication channels are the means by which innovation messages can be transmitted from one individual to another. While mass media are more effective in creating new information, interpersonal communication is more effective in shaping and changing attitudes toward a new idea, and therefore in accepting or rejecting ideas (Rogers, 1995).

The social system consists of interrelated units that come together to solve a problem in order to achieve a common goal in the process of a new idea diffusion (Rogers, 1995). Social systems are made up of individuals, informal groups, organizations and subsystems. Another factor that influences the diffusion of innovation in the social system is norms. Norms are behavior patterns and standards that guide people; it is often seen as an obstacle to the diffusion of innovation (Rogers, 1983).Time plays a role as a mental process in the process of innovation-decision-making, from the perception of innovation knowledge for the first time to the attitude towards innovation, to the decision of acceptance and rejection, to the application of new idea and the approval of decision. Another role of time is the acceptance of individuals at different times (Rogers, 1995).

The qualities of innovation in the diffusion of innovations theory are described as the perceived characteristics of innovation. These are the relative advantages, suitability, testability, complexity and observability (Rogers, 1995). The qualities of innovation constitute the basis of behavioral beliefs in the individual, and these beliefs affect the individual's attitude toward innovation, affecting the acceptance of innovation in attitude. In other words, the qualities of innovation perceived by members of the social system determine the pace of diffusion (adoption) of innovation (Rogers, 1983).

Studies that investigate the factors affecting the individuals' decision to adapt to the innovation have been carried out based on the diffusion of innovations theory by perceiving the information technology as innovation. Demir (2006), in his study conducted to investigate factors that affect education faculty students' decision to adopt online course registration, found that the effect of online course registration's relative advantage, visibility, and compatibility on attitude was positive and significant, while effect of its complexity on attitude was negative and significant. In the study that investigated the effects of characteristics of the social system and the diffusion of innovation on teachers' adaptation of e-school application, it has been determined that the type of authoritarian decision, change agent, perceived benefit, and experience are effective in adopting e-school application by teachers. Okur, Salar, Süral and Güneş (2009) support the diffusion of innovations theory with their research on the use of mobile 3G technologies in distance education. In the study that investigated the effect of diffusion of innovation on the attitude of lecturers towards ICT use, Ntemana and Olatokun (2012) have found the effect of relative advantage, complexity and observability.

Integration means combining two or more things together into one whole. Technology and education will be an integral part of the teaching and learning process when we integrate technology education. Effective use of technology products requires accurate technology integration. Maddux, Johnson, and Willis (2001) classify technology integration as Type 1 and Type 2 technology integration in the classroom. The use of Type 1 requires passive user participation because it is considered as a traditional integration approach. Teachers who adopt the Type 1 approach use technology as a means to present information in their classroom. Type II technology integration has been defined as an approach that transforms technological tools into tools that enhances learning by allowing learners to construct knowledge, lead the learning process, and play an active role (Maddux, Johnson and Willis, 2001). According to Tezci (2016), there are three different approaches to the

integration of information and communication technologies: traditional integration, cognitive constructivism and socio-cultural integration. Teachers' technology integration approaches affect the attitude of students to these technologies (Tezci, 2016).

According to Freud, who defines anxiety as a concept for the first time in psychology, anxiety is an unpleasant feeling that is experienced anytime and anywhere (Freud, 1936). When the literature is examined, many definitions of mathematics anxiety can be reached. According to Fennema and Sherman (1976), mathematics anxiety is defined as feelings of anxiety, fear and nervousness when dealing with mathematics. According to another definition, mathematics anxiety is increasing panic, desperation, dysfunction and mental confusion in those who solve the mathematical problem (Tobias & Weissbrod, 1980). Mathematics anxiety is not only an exam anxiety, but it can be defined as negative feelings in both mathematics and mathematics exams (Erktin, Dönmez, & Özel, 2006). When the studies about mathematics anxiety are considered, it is seen that the relationship between reasons of mathematics anxiety, academic achievement, gender, and school type and mathematics anxiety are examined in general (Alkan, 2011; Kurbanoğlu & Takunyacı, 2012; Erktin et al., 2006). There have been no studies investigating whether the mathematics anxiety affects students' acceptance of the interactive whiteboards, but there are studies investigating whether the technology use anxiety affects the intention to use the technology (Beckers & Schmidt, 2001; Çizel & Akgün, 2012; Koca & Usluel, 2007). Koca and Usluel (2007) investigated the factors that affect teachers' use of ICT and found those factors as intention, perceived usefulness, perceived ease of use, social impact, volunteering, self-efficacy, and anxiety. Çizel and Akgün (2012) found a negative correlation between anxiety and ease of use in their study that investigated the factors that affect the intention of tourism students accepting and using communication and information technologies in their professions.

The use of interactive whiteboard in our country is increasing day by day. The use of interactive whiteboard is thought to have a positive effect on students' mathematical success, motivation and attitudes (Yorgancı & Terzioğlu, 2013). Studies on how student use of interactive whiteboard in mathematics lectures affects student achievement, attitude towards school and motivation have been carried out (Akgün & Yücekaya, 2015; Torf & Tirotta, 2010; Yorgancı & Terzioğlu, 2013). However, there are very few studies in the literature that examine the reason for the student's attitudes towards interactive whiteboard use in mathematics lessons (Gündüz, 2015; Tatar, Kağızmanlı, & Zengin, 2015). This work is based on Davis' Technology Acceptance Model and Rogers' Diffusion of Innovation Theory. In the light of these theories, it was investigated whether students' attitudes toward the use of interactive whiteboards in mathematics lessons were affected by the characteristics of interactive whiteboards, mathematics anxiety, mathematical achievements at school, and the use of technology by mathematics teachers in the eyes of students.

Purpose of the Research

The aim of this research is to investigate some factors that affect student attitudes towards interactive whiteboard use in middle school and high school mathematics lessons. For this purpose, the answers for the following research questions were sought.

1. Is there a significant relationship between students' mathematics anxiety and attitudes toward interactive whiteboard use in mathematics lessons?
2. Is there a significant relationship between students' mathematical achievements and attitudes toward interactive whiteboard use in mathematics lessons?
3. Is there a significant relationship between the perceived characteristics of interactive whiteboard by students and their attitudes toward interactive whiteboard use in mathematics lessons?
4. Is there a significant relationship between the teachers' technology integration approaches in the eyes of the students and students' attitude towards the interactive whiteboard?
5. Is there a significant relationship between students' gender and attitudes toward interactive whiteboard use in mathematics lessons?

Method

This research is a descriptive research and has been carried out using relational screening model. Screening research is a survey of participants' opinions, interests, abilities, or attitudes about a topic (Büyüköztürk et al., 2014: 177). Relational screening model aims to determine the relationship between two or more variables, the extent of change or the degree of change (Karasar, 2005). In this study, students' attitudes towards interactive

whiteboard use in mathematics lessons with testability, observability, compatibility and complexity characteristics of interactive whiteboards, and again their attitude with students' mathematics anxiety and the teachers' technology integration approaches in the eyes of the students were investigated by using correlational type of relational screening model.

Study Group

The sample of the research consists of 557 high school students and 350 middle school students in two high schools and two middle schools located in the province of Balikesir in the academic year of 2015-2016 in Balıkesir province.

Data Collection Tools

A 17-item questionnaire on Attitudes and Characteristics of Innovation Scale (ACIS) developed by authors (2017) was used in determining students' attitudes towards interactive whiteboard use in mathematics lessons and their perceptions of characteristics of innovation. A five-item anxiety scale developed by authors was used to measure students' anxiety about mathematics lessons. Four items, which includes traditional approach and constructivist approach, from the teachers' technology integration approach questionnaire developed by Tezci (2016) were used to determine teachers' technology integration approaches in the eyes of the students. In order to determine the success levels of students in mathematics, scores from 0 to 100 were scaled up to 1 to 5 and students were asked to indicate the number of the mathematical grade in the previous semester.

Data Analysis

In the research, it has been investigated whether the perceived characteristics of interactive whiteboard by students, teachers' technology integration approaches in the eyes of the students, and students' mathematics anxiety and mathematical achievement affect students' attitudes towards the interactive whiteboard. Confirmatory factor analysis was carried out using the LISREL 8.54 program to measure the validity of the ACIS and the technology integration approach survey used in the study. Maximum likelihood estimation method and covariance matrix were used during analysis. Multiple imputation method is used to correct missing data.

Data collected from middle and high school students were analyzed separately. Firstly, it has been attempted to determine whether the multiple regression analysis of the data meets the assumptions of normality, multicollinearity and uniqueness (Akbulut, 2010; Büyüköztürk, 2010; Pallant, 2005). For this purpose, it was examined whether the scores of attitude and characteristics of innovation scale, mathematics anxiety scale and technology integration approach scale were normally distributed. Next, it is checked whether there is a linear relationship between the independent variables and the dependent variable. For this, a scattering diagram and a correlation analysis showing the relationship between the variables were used. Once the data obtained from the study were found to meet the assumptions of multiple regression analysis, stepwise regression analysis was applied to determine the power of independent variables in predicting the attitude towards interactive whiteboard.

The effect size of the model was calculated according to the results of the stepwise regression analysis. The multiple correlation coefficient R^2 is used while the effect size is calculated in the regression analysis. Cohen (1988) proposed the calculation of the value f^2 for the calculation of the effect size for multiple regression analysis. The effect size formula calculated in the multiple regression analysis by taking multiple correlation coefficients into account is:

$$f^2=\frac{R^2}{1-R^2}$$

Findings

Findings obtained from the research are presented under the two headings as confirmatory factor analysis results and stepwise regression analysis results.

Findings for Confirmatory Factor Analysis

Confirmatory factor analysis was applied to ACIS for middle school students' data and it was found that the factor loadings were over 0.40. According to Harrington (2009), this is an acceptable fit. According to the analysis results, χ^2 was 287.5 and *sd* was 109. When these values were divided, χ^2 / *sd* = 287.5 / 109 = 2.63 was obtained. When this ratio is below 3, that mean it is perfect fit; when it is between 3 and 5, it corresponds to moderate fit (Jöreskog & Sorbom, 1993; Sümer, 2000). Accordingly, it can be said that the ratio of χ^2 / *sd* shows perfect fit. When the fit indices of the model were examined, the values for confirmatory factor analysis were found to be RMSEA = 0.069, SRMR = 0.05, GFI = 0.91, AGFI = 0.88, NFI = 0.95, CFI = 0.97, and RFI = 0.94. Although the values obtained did not show perfect fit, they appear to be within acceptable limits according to standard fit criteria (Tabachnick & Fidell, 2007).

Looking at the results of the confirmatory factor analysis applied to high school students' data for ACIS, it was seen that all other factor load values except for one factor load value (G3) were over 0.48. The fit indices of the scale was χ^2 = 419.83 and *sd* = 106. When these values were divided, χ^2 / *sd* = 419.83 /106 = 3.96 corresponds to moderate fir. When the other fit indices of the model were examined, the values for confirmatory factor analysis were found to be RMSEA = 0.073, SRMR = 0.05, GFI = 0.92, AGFI = 0.88, NFI = 0.97, CFI = 0.98, and RFI = 0.96. It can be said that the results of the analysis are within acceptable limits according to the standard fit criteria.

There was no discrepancy between the observed variables and the latent variables, as the *t* value regarding observed values of the latent variables for the two data groups were observed to be greater than 1.96 and significant at the 0.05 the significance level. The resulting model confirmed the theoretical model and a five-factor model has been formed, namely attitude, testability, ease of use, compatibility and observability. It has been determined that the standardized correlations between the factors were significant and that not all of the standardized values were greater than 1 in the analysis model. According to the confirmatory factor analysis results for the technology integration survey, items were grouped under two factors, the constructivist and the traditional, in both data groups. The fit index of the scale was within acceptable limits.

Findings for Stepwise Regression Analysis

In order to check the normality hypothesis tested before the multiple regression analysis, Skewness and kurtosis values can be examined in the "Descriptive" table as a result of the normality test, which should be between -1.5 and +1.5 (Hair, Anderson, Tatham, & Black, 1995). When the normality test results are examined, it is seen that the data are normally distributed. In addition, the scatter plot and the normal probability plot obtained as a result of multiple regression analysis give information on the normal distribution of the data (Pallant, 2015). Looking at the normal probability plot, it is seen that the points approach a straight diagonal line and when the scatter plot is examined, it is seen that the majority of the points are concentrated in the center. According to these results, it can be said that the data are normally distributed.

When the "Correlations" table obtained from the result of the correlation analysis was examined, it was seen that there was a correlation value of 0.30 and above between the independent and dependent variables. A statistically significant relationship was found between attitudes towards interactive whiteboard and independent variables. There is no significant correlation only between attitudes and independent variable 'gender'. Therefore, gender variation was not included in the regression analysis.

One of the assumptions of multiple regression analysis is that there are no multicollinearity (high correlation coefficients) and uniformity among independent variables. The uniformity is that an independent variable is a combination of other independent variables (Pallant, 2015). When the correlation coefficients between the independent variables are 0.80 and above, it indicates that there may be multicollinearity between these variables; 0.90 and above indicates that there may be a serious multicollinearity problem (Büyüköztürk, 2010). When the "Correlations" table was examined, it was seen that there was no multicollinearity between the independent variables and there was no high correlation coefficients even though there was significant correlational relationships. According to Akbulut (2011), when the "Coefficients" table is examined in the regression analysis, the "tolerance" value should not be less than 0.10 and the "VIF" value should be less than 10. Accordingly, the relationship between the attitude toward interactive whiteboard and the independent variables provides the condition that there are no high correlation coefficients among the independent variables for the multiple regression analysis.

Another assumption is that there is no correlation between the error terms of the independent variables in the regression model, that is, there is no autocorrelation. For this, the Durbin-Watson value is examined in the output of the model summary as a result of the regression analysis. This value is expected to be between 1 and 3 (Seçer, 2015). In the stepwise regression analysis for middle school students' data, it was seen that this Durbin-Watson value was 1.832 and autocorrelation was absent. The ANOVA table should be consulted to evaluate the statistical significance of the model created by dependent variables and independent variables in the stepwise multiple regression analysis (Pallant, 2015). When the ANOVA table was analyzed, it was seen that the regression model was statistically significant (F = 45.159, p = 0.000) in order to determine the power of the independent variables to predict student attitudes towards the interactive whiteboard.

The stepwise regression analysis takes the independent variables that have the most effect on the dependent variable and the other variables are subtracted from the equation. According to the results of stepwise regression analysis, 7 steps have been included in the multiple regression analysis. In the summary table of the regression analysis that summarizes the results of the statistical evaluation of the model, it was seen which variable was included at which step in the model (Table 1). According to the results of the regression analysis, the independent variables predicted 48% of the variance in the attitude as a whole. Ease of use alone predicted 35%, and all other variables predicted 12% of the attitude. The ease of use variable traded in the first step of the regression analysis can account for 35% of the total variance associated with the attitude. [R = 0.598, R^2 = 0.357]. In the second step of the stepwise regression analysis, the comp ability variable has been modeled as well as the ease of use variable. The ease of use and the comp ability variables together can account for 42.6% of the attitude towards the interactive whiteboard [R = 0.653, R^2 = 0.426]. In this case, it can be said that the compatibility variable contributed 7% to the equation. The Beta coefficient for the ease of use variable with the other variables being fixed was found to be 0.395 and the Beta coefficient for the compatibility variable was calculated as 0.331. The t values for both variables were statistically significant (t = 7.65, t = 6.41, p <.05, respectively).

In the third step of the stepwise regression analysis, the anxiety variable was included in the model. The ease of use, the compatibility and the anxiety together can account for 45% of the total variance associated with attitude [R = 0.669, R^2 = 0.448]. Accordingly, it can be said that the anxiety variable contributed 2.2% to the regression equation. In this step, the Beta coefficient for the ease of use variable was 0.355, the Beta coefficient for the compatibility variable was 0.330, and the Beta coefficient for the anxiety variable was -0.154. The t values of all three variables were found to be statistically significant (t = 6.85, t = 6.50, t = -3.71, p <0.05, respectively).

In the fourth step of the stepwise regression analysis, the traditional variable entered the model and provided a contribution of 7% to the regression equation. Thus, in the fourth model formed, the independent variables accounted for 45.5% of the total variance associated with attitude [R = 0.675, R^2 = 0.455]. In this step, the Beta coefficient for the ease of use variable was 0.348, the Beta coefficient for the compatibility variable was 0.307, the Beta coefficient for the anxiety variable was 0.155, and the Beta coefficient for the traditional variable was 0.091. The t values of all four variables were found to be statistically significant (t = 6.73, t = 5.94, t = -3.75, t = 2.164, p <0.05, respectively).

In the fifth step of the stepwise regression analysis, success5 variable was included in the model. The success5 variable provided a contribution of 14% to the equation. The fifth model explained the 47% of the change in the attitude variable [R = 0.69, R^2 = 0.469]. When the other variables were kept constant, the regression coefficient of the attitude for success5 variable was 0.128. The five variables mentioned predicted the attitude as significant (p <.05). In the sixth step of the stepwise regression analysis, the success1 variable was included in the model. The success1 variable provides approximately 7% contribution to the equation. The variables in the sixth model accounted for 47.6% of the attitude towards the interactive whiteboard [R = 0.69, R^2 = 0.476]. The six variable in the model significantly predicted the attitude toward interactive whiteboard (p <.05).

In the final step of the regression analysis, success3 was included in the model. When the other variables that affect the attitude toward the interactive whiteboard were kept constant, it was seen that the seven variables significantly predict the attitude. The variables in the seventh model accounted for 48.3% of the attitude toward the interactive whiteboard. In this step, regression coefficient for the ease of use variable was 0.338, for the compatibility variable was 0.049, for the anxiety variable was -0.097, for the traditional variable was 0.071, for the success5 variable 0.082, for the success1 variable -0.103, and for the success3 variable -0.088. The t values for each of the seven variables were found to be statistically significant (t = 6.606, t = 6.212, t = -2.232, t = 1.714, t = 1.789, t = -2.517, t = -2.016, p <0.05, respectively].

Table 1. Summary of stepwise regression analysis for independent variables for middle school students' data

Model	R	R^2	ΔR^2	sr^2	Beta	t
Model 1	.598[a]	.357	.355			
Ease of use				.046	.598	13.843
Model 2	.652[b]	.426	.422			
Ease of use				.055	.395	7.653
Compatibility				.050	.331	6.410
Model 3	.669[c]	.448	.443			
Ease of use				.056	.355	6.855
Compatibility				.049	.330	6.507
Anxiety				.032	-.154	-3.712
Model 4	.675[d]	.455	.449			
Ease of use				.055	.348	6.737
Compatibility				.050	.307	5.942
Anxiety				.032	-.155	-3.757
Traditional				.031	.091	2.164
Model 5	.685[e]	.469	.461			
Ease of use				.055	.339	6.622
Compatibility				.050	.319	6.233
Anxiety				.034	-.109	-2.495
Traditional				.031	.075	1.795
Achievement5				.085	.128	2.993
Model 6	.690[f]	.476	.467			
Ease of use				.055	.328	6.422
Compatibility				.050	.316	6.216
Anxiety				.034	-.106	-2.448
Traditional				.031	.078	1.881
Achievement5				.086	.115	2.676
Achivement1				.167	-.086	-2.143
Model 7	.695[g]	.483	.472			
Ease of use				.055	.338	6.609
Compatibility				.049	.315	6.212
Anxiety				.034	-.097	-2.232
Traditional				.031	.071	1.714
Achivement5				.091	.082	1.789
Achievemet1				.170	-.103	-2.517
Achievement3				.101	-.088	-2.016

The results of the stepwise regression analysis show that the ease of use, compatibility, anxiety, traditional, success5, success1, and success3 statistically significantly predicted attitudes towards interactive whiteboards. The effect size of the model was calculated by using multiple correlation coefficients obtained according to the results of multiple regression analysis. According to the results of the regression analysis, the independent variables predicted 48% of the variance in the attitude as a whole. According to this, the effect size of the model obtained for the middle school students' data was calculated as follows, that is, the power of determining the attitude of all the independent variables in the model. Effect size according to Cohen's (1988) formula was calculated as:

$$f^2=\frac{0.48}{1-0.48} = 0.92$$

The effect size of the model was 0.92. This value indicates a high effect size. The local effect size values for each independent variable are also calculated. The effect size of ease of use was found to be .69. The magnitude of the effect size of the variables of compatibility, anxiety, traditional, success5, success1, and success3 was found to be very low. According to Cohen's (1988) categorization, $0.02 \leq f^2 < 0,15$ shows a small effect, $0.15 \leq f^2 < 0.35$ moderate effect, and $0.35 \leq f^2$ indicates wide effect. Accordingly, ease of use has a wide effect on attitude and the other variables have small effect.

As a result of the correlation analysis to determine whether the data obtained from high school students met the assumptions of multiple regression analysis, a statistically significant relationship was found between the independent variables and the attitude toward the interactive whiteboard. Among the independent variables,

there was no statistically significant correlation between the success variables and the attitude toward the interactive whiteboard. For this reason, success variable was not included into the stepwise regression analysis to be applied for high school students' data. For high school students' data, as in the middle school students' data, the relation between the attitude toward the interactive whiteboard and the independent variables provides the condition that there were no high correlation coefficients among the independent variables for the multiple regression analysis.

For another assumption, "Durbin-Watson" value was checked in the model summary table to determine whether there is no autocorrelation in the regression model. This value was 1,658 for high school students' data, so the assumption was valid. For normality test that is another assumption of multiple regression analysis, in other words, to determine whether the scores of the attitude and characteristics of innovation scale, mathematics anxiety scale, and the teachers' technology integration approach questionnaire that is obtained from the high school students were normally distributed, values of Skewness and Kurtosis were examined. Since these values were between -1.5 and +1.5, it appeared that the data were normally distributed. It is seen that only some of the skewness and kurtosis values of success variables were not between -1.5 and +1.5.

When the findings in the ANOVA table related to the regression model were examined, it is seen that the regression model constructed to determine the power of the independent variables to predict student attitudes towards the interactive whiteboard was statistically significant (F = 91.075, p = 0.000). According to the results of stepwise regression analysis applied for high school students' data, five steps were included in the multiple regression analysis. The regression analysis summary table summarizing the results of the statistical evaluation of the model shows which variables included in the model at which step (Table 2). The ease of use included in the first step of the regression analysis can account for 35.6% of the total variance associated with the attitude. [R = 0.598, R^2 = 0.357].

In the second step of the stepwise regression analysis, the compatibility variable was included in the model as well as the ease of use variable. The ease of use and compatibility variables together accounted for 41.2% of the attitude toward the interactive whiteboard [R = 0.642, R^2 = 0.412]. In this case, it can be said that the compatibility variable contributes a 5.5% to the equation. The Beta coefficient for the ease of use variable was calculated as 0.412 and the Beta coefficient for the compatibility variable was calculated as 0.299. The t values for both variables were statistically significant (t = 9.81, t = 7.12, p <.05, respectively). The significant t values means that the change in the independent variable makes a significant effect on the dependent variable (Seçer, 2015).

Table 2. Summary of stepwise regression analysis for variables that predict attitudes for high school students' data

Model	R	R^2	ΔR^2	sr^2	Beta	t
Model 1	.598[a]	.357	.357			
Ease of use				.040	.598	17.397
Model 2	.642[b]	.412	.055			
Ease of use				.048	.412	9.819
Compatibility				.046	.299	7.126
Model 3	.657[c]	.431	.019			
Ease of use				.049	.374	8.832
Compatibility				.048	.245	5.662
Trialability				.038	.162	4.263
Model 4	.667[d]	.445	.013			
Ease of use				.050	.336	7.769
Compatibility				.052	.171	3.595
Trialability				.038	.149	3.965
Observability				.053	.158	3.562
Model 5	.671[e]	.451	.006			
Ease of use				.050	.320	7.359
Compatibility				.052	.177	3.739
Trialability				.038	.152	4.050
Observability				.053	.169	3.814
Gender				.061	.081	2.503

In the third step of the stepwise regression analysis, the testability variable was included in the model. The ease of use, the compatibility and the testability variables together accounted for 43.1% of the total variance associated with the attitude [R = 0.657, R^2 = 0.431]. Accordingly, it can be said that the testability variable contributed 1.9% to the regression equation. In this step, the Beta coefficient of the ease of use variable was 0.374, the Beta coefficient of the compatibility variable was 0.245, and the Beta coefficient of the testability variable was 0.162. The t values of all three variables were found to be statistically significant (t = 8.83, t = 5.66, t = 4.26, p <0.05, respectively).

In the fourth step of the stepwise regression analysis, the traditional variable was included in the model and provided a contribution of 1.3% to the regression equation. In the fourth model thus formed, the independent variables accounted for 44.5% of the total variance associated with the attitude [R = 0.667, R^2 = 0.445]. In this step, the Beta coefficient for the ease of use variable was 0.336, the Beta coefficient for the compatibility variable was 0.171, the Beta coefficient for the testability variable was 0.149, and the Beta coefficient for the traditional variable was 0.158. The t values of all four variables were found to be statistically significant (t = 7.76, t = 5.95, t = 3.96, t = 3.56, p <0.05, respectively).

In the last step of the stepwise regression analysis, gender variable was included in the model. Gender variable provides a contribution of 6% to the equation. The fifth model explains 45% of the change in the attitude variable [R = 0.67, R^2 = 0.45]. When the other variables were kept constant, the regression coefficient of the gender variable was 0.081. The five variables mentioned significantly predicted the attitude (t = 7.359, t = 3.739, t = 4.050, t = 3.814, t = 2.503, p <0.05].

The results of the stepwise regression analysis show that ease of use, compatibility, testability, traditional, and gender variables statistically significantly predicted the attitude toward the interactive whiteboard, respectively. According to the results of the regression analysis, the independent variables predicted 45% of the variance in the attitude as a whole. Ease of use alone predicted 35%, and all remaining variables predicted 10% of the attitude. For high school students' data, the effect size of the model in general terms was calculated as follows, the effect size of all independent variables on attitude entering the model was calculated as:

$$f^2=\frac{0.45}{1-0.45} = 0.82$$

This value indicates a large effect. The local effect size values for each independent variable are calculated as following. The effect size of ease of use was found to be .65. This value shows a large effect. Compatibility, testability, observability and gender variables have very small effect sizes. According to Cohen's (1988) categorization, $0.02 \leq f^2 < 0{,}15$ shows a small effect, $0.15 \leq f^2 < 0.35$ moderate effect, and $0.35 \leq f^2$ indicates wide effect. Accordingly, ease of use has a wide effect on attitude and the other variables have small effect.

Conclusion and Recommendations

In this research based on Rogers' Diffusion of Innovation Theory and Davis' Technology Acceptance Model, it was examined whether the students' perceptions of ease of use, compatibility, testability, and observability among the characteristics of interactive whiteboard as an innovation and students' mathematics anxiety have an effect on students' attitudes towards the interactive whiteboard. In addition, it was investigated whether or not the mathematical achievements of the students and their gender as categorical variables were associated with their attitudes. For this, by taking the attitude as a dependent variable and the perceived characteristics of innovation, mathematics anxiety, teachers' technology integration approaches, mathematics achievement and gender as independent variables, two separate stepwise multiple regression analyzes were performed for the data collected from middle and high school students. Teachers' technology integration approaches in the eyes of students were identified as two separate independent variables by naming the traditional integration (TI) and cognitive constructivism (CC) factors in the scale development work regarding ICT integration approaches of teachers by Tezci (2006) as traditional and constructivism. The mathematics achievement of the students was evaluated at five levels and they were included in the regression analysis as independent variables such as success5, success4, success3, success2, and success1, from high level of achievement through low achievement.

The analysis of the middle school students' data revealed that ease of use, compatibility, mathematics anxiety, and traditional approach of technology use, and achievement had a significant effect on the attitude towards the interactive whiteboard. There is a positive significant relationship between ease of use and attitude. Students who think that the use of interactive whiteboards is easy have a more positive attitude. This finding is consistent

with both Rogers' theory and Davis' technology acceptance model. According to Rogers, there is a negative relationship between the complexity of innovation perceived by the individual in the social system and the rate of innovation spread (Rogers, 1983). In a study of students' attitudes toward online enrollment in the education faculties, it was reported that there was a negative relationship between the complexity of enrollment on the Internet and the attitudes of students, and as beliefs about the complexity of the innovation increase, beliefs on proficiency to use or apply it will decrease (Demir, 2006). In a doctoral dissertation study examining the factors that affect teachers 'acceptance of information technology based on Davis' technology acceptance model, Park (2004) stated that teachers have a more positive attitude toward information technology that is easy to use.

According to Rogers (1983), compatibility is the consistency level of the needs, past experience, and values of potential adaptors with innovation. In the stepwise multiple regression analysis applied to middle school students' data, there is a positive correlation between compatibility and attitude. This result is consistent with Rogers' theory. It is also consistent with the conclusion that the compatibility of computer technology has a positive effect on the acceptance of computer technology by teachers in the work of Hoerup (2001). These results support our conclusion about the compatibility variable. In this study, questions regarding the compatibility of innovation are those that measure whether it meets the needs of the students: *13) the characteristics of the interactive whiteboard (shape, coloring, checkered background, etc.) allow the mathematics course to be better handled, 14) In the mathematics course, we can solve more questions thanks to the interactive whiteboard, and 15) In the mathematics course, we have access to the resources related to the subject matter In the mathematics course*. As long as interactive whiteboards used in the classroom meet the needs of the student, students will develop a positive attitude toward the interactive whiteboards.

Another variable that can be included in the model in stepwise regression analysis in terms of predictive power was mathematics anxiety. According to the results of the research, there was a negative relation between mathematics anxiety and attitude towards the interactive whiteboard. In other words, the attitudes of students with mathematics anxiety were more negative. Similar results have been achieved in some studies investigating the effect of anxiety on the acceptance of technological innovations. Koca and Usluel (2007), who investigated teachers' intentions to accept and use ICT, also found anxiety among the factors affecting ICT acceptance. In addition, they point out that the anxiety was also among the factors affecting tourism students' intention to accept professional communication and information technologies (Çizel & Akgün, 2012). Beckers and Schmidt (2001) found that computer use anxiety negatively affects the intention to use a computer.

The variable that was included in the fourth step of the stepwise regression analysis was the traditional use that was one of the teachers' technology integration approaches. There is a positive significant correlation between traditional integration approach and attitude. In the model, although the traditional approach has been found to predict attitude, the predictive power was less than the other variables. The beta value in the Coefficients table was 0.091, in other words, the traditional approach variable gave a contribution of 9% to the attitude dependent variable. Tezci (2016) stated that the basic rule in the traditional ICT integration approach was that students learn from the technology. According to this approach, teachers use technology as a tool for presenting information, so traditional teaching methods and techniques are preferred. In the regression model, the fact that the traditional approach had a positive predictive power on the attitude may show that interactive whiteboard use in the classrooms positively affect students' attitude towards this use. The reason why the constructivist approach could not be included in the model can be explained by that teachers generally use the interactive whiteboard in line with the traditional approach and students do not see the constructivist approach examples of the interactive whiteboard use. There was no quantitative study of how teachers' technology integration approaches affect students' attitudes towards the interactive whiteboard in literature. However, in studies regarding the views of the students and teachers about the interactive whiteboard, it has been determined that students have positive attitudes towards the interactive whiteboard, but they found to be the lesson boring when the teachers use the interactive whiteboard as a presentation tool (Akgün, Yücekaya, 2015; Başıbüyük et al., 2014; Keser & Çetinkaya, 2013).

In Rogers' diffusion of innovation theory, observability is the degree to which the result of innovation use can be observed by the individuals around and communicated to the other individuals. Testability is a measure of the ability of individuals to test innovation (Rogers, 1995). In the stepwise multiple regression analysis applied to the middle school students' data, the regression model obtained in the last step did not include the testability and observability variables. As a reason to this, it can be shown that students in the selected middle schools as sample were not allowed to use the interactive whiteboard.

In the emerging model, there was a positive relationship between students' high success level and their attitude, and a negative relationship between students' low success level and their attitude. In other words, successful

students have a more positive attitude towards the interactive whiteboard, whereas unsuccessful students have a negative attitude. In the studies related to the relationship between attitude and success, it has been found that positive attitude toward the interactive whiteboard usually increases success (Yorgancı & Terzioğlu, 2013; Tataroğlu, 2009). But there are studies that show that success predicts the attitude. Kırkız (2010) in his thesis stated that students who are academically successful have a positive attitude towards English lesson.

The analysis of data collected from high school students was modeled with ease-of-use, compatibility, observability, testability, and gender independent variables. There is a positive relationship between ease of use, compatibility, observability, and testability and attitude. There is also a positive relationship between gender as a categorical variable and attitude. Unlike the results of analysis of the data obtained from the middle school students, observability and testability predicted the attitude toward the interactive whiteboard. These results show that Rogers' diffusion of innovations theory also applies to the use of interactive whiteboards.

According to Rogers, visibility and testability of the innovation increases the adaptation of individuals to this innovation and the spread of innovation. In addition, the testability of the innovation reduces the individual's hesitations, and observability allows the individual to exchange information with the environment about innovation (Rogers, 1995). The fact that interactive whiteboards in the schools have observability feature can be explained by teachers can actively use the boards and testability of them can be explained by the permission given to the students to use the table. Letting students draw on interactive whiteboards, solve problems, or use them to access information through the Internet can be examples of testability. According to the results of this study, the fact that the interactive board is observable and testable positively affects students' attitudes toward the interactive whiteboard.

The last independent variable involved in the stepwise regression analysis model applied to high school students' data was gender. There was a positive relationship between gender and attitude according to the analysis results. Gender was coded numerically before the regression analysis because it is a categorical variable (dummy variable in some sources). To convert the gender variable into numeric, male was coded as 1 and female was coded as 0. The t value in the Coefficients table was 2.503 (p <0.05), so the relationship between gender and attitude was significant. In this case, males can be said to have a more positive attitude than females. This result was supported by the studies in the literature. Altun, Alev and Yiğit (2009) found that male prospective teachers think that ICT tools are effective and interesting, whereas female prospective teachers think that the ICT tools that they believe helpful are not effective and interesting.

Regarding the results of stepwise regression analysis, success and mathematics anxiety for high school students' data were not included in the model as predictors of attitude. It has been observed that anxiety about computer use is not an effect on the intention to use virtual reality technology in a study that has the conclusion that anxiety is not an important effect on acceptance of technology (Bertrand & Bouchard, 2008). This study examines whether the characteristics of interactive whiteboards as a technological innovation, students' mathematical anxiety and achievements, teachers' technology integration approach in the eyes of students, and gender as independent variables predict the attitude towards interactive whiteboard use in mathematics lessons in middle school and high school. The results of the analyses showed that ease of use and compatibility variables among the perceived characteristics of the interactive whiteboards, students' mathematical anxiety, traditional technology integration approach, and mathematical achievement predicted the attitude in middle schools. In high schools, on the other hand, the results showed that ease of use, compatibility, testability and observability variables among the characteristics of the interactive whiteboard and gender variable predicted the attitude. These results will give teachers tips on how they can help students develop positive attitudes towards the information and communication technologies used in the classrooms when considering the changeability of attitude. The fact that ease of use and compatibility predict the attitude in both data groups can be interpreted as those activities with interactive whiteboards should be at an appropriate level to meet the needs of students for an effective integration of interactive whiteboards.

Considering that the students with high mathematics anxiety have a negative attitude, mathematics teachers should find solutions for how students can like mathematics. In this case, teachers can examine the academic studies investigating the causes of mathematics anxiety and evaluate the results of these studies to produce new solutions for their students. The attitudes and characteristics of innovations scale developed in this study will provide insight into the academic work to be done in the future for the acceptance and use of information and communication technologies in the classrooms. Information and communication technology products commonly used in the classrooms in our country are interactive whiteboards and tablets. When the geometry and algebra software programs begin to be actively used in classrooms, the study of the reasons for the attitude towards interactive whiteboard can be adapted to such technologies.

Acknowledgement

This article is a part of the author`s dissertation. Also this study is supported by Balikesir University Scientific Research Projects Unit with 2017/ 123 numbered project.

References

Akbulut, Y. (2010). *SPSS Applications in Social Studies*. Istanbul: Ideal Kultur Publishing.

Akgün, M. & Koru Yücekaya,(2015) Akıllı tahta kullanımına yönelik öğrenci tutumu ve öğretmen görüşlerinin incelenmesi (Ankara ili örneği) [Analyzing the students' attitudes and teachers' opinions towards use of interactive board (Ankara Sampling)]. NWSA-Qualitative Studies, E0023, 10, (3), 1-11. 1.

Alkan, V. (2011). Etkili matematik öğretiminin gerçekleştirilmesindeki engellerden biri: kaygı ve nedenleri [One of the obstacles for effective mathematics education: anxiety and its reasons] *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi,* 29 (1), 89-107.

Altun, T., Yiğit, N., & Alev, N. (2007). İlköğretim fen bilgisi öğretmen adaylarinin bilgisayar destekli fen öğretimine karşi tutumlari [Attitudes of science teachers candidates towards computer based science education]. *1. Ulusal İlköğretim Kongresi* Sözlü Bildiri, 15 – 17 Kasım, Hacettepe Üniversitesi, Ankara.

Anbarlı Kırkız, Y. (2010). Öğrencilerin İngilizce dersine ait tutumları ile akademik başarıları arasındaki ilişki [The relation between attitudes of students towards English lesson and academic achievement] Yayımlanmamış yüksek lisans tezi. Trakya Üniversitesi, Edirne.

Başıbüyük, K , Erdem, E , Şahin, Ö , Gökkurt, B , Soylu, Y . (2014). Opinions of Teachers and Students About Use of Smart Board in Mathematics Courses. *Adıyaman Üniversitesi Eğitim Bilimleri Dergisi*, 4 (2), 72-97. DOI: 10.17984/adyuebd.78901.

Beckers, J. J., Schmidt, H. G. (2001). The structure of computer anxiety. Computers in Human Behavior, 17, 35–49.

Bertrand, M. & Bouchard, S. (2008). Applying the technology acceptance model to VR with people who are favourable to its use. *Journal of Cyber Therapy & Rehabilitation,* vol. 1, I. 2, Summer. in press.

Büyüköztürk, Ş. (2010). *Sosyal Bilimler İçin Veri Analizi El Kitabı* [Data Analysis Handbook for Social Science]Pegem Akademi Yayınları, Ankara.

Büyüköztürk, Ş., Çakmak, E.K., Akgün, Ö.E., Karadeniz, Ş. ve Demirel, F. (2012). *Bilimsel araştırma yöntemleri* [Research Methods]. Ankara: Pegem Akademi Yayınları.

Cohen, J. (1988). Statistical power analysis fort he behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

Davis, F. D. (1986). A technology acceptance model for empirically testing new end-user information systems: Theory and results. Doctoral dissertation. Cambridge, MA: MIT Sloan School of Management.

Davis, F. D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly* 13 (3): 319–340.

Davis, F.D., (1993), "User Acceptance Of Information Technology: System Characteristic, User Perceptions And Behavioral Impacts", International Journal of Man-Machine Studies, S. 38, ss. 475-487.

Demir, K. (2006). Rogers'ın yeniliğin yayılması teorisi ve internetten ders kaydı [Rogers' diffusion of innovation theory and online course registration]. Kuram ve Uygulamada Eğitim Yönetimi, 12(47), 367.

Demircioğlu G., Demircioğlu H. (2015). Öğrencilerin kimya derslerinde akıllı tahta kullanımına yönelik tutumlarının farklı değişkenler açısından incelenmesi,[Analyzing the attitudes of students towards use of interactive whiteboard in chemistry classes in terms of different variables]. *Eğitim ve Öğretim Araştırmaları Dergisi*, 4, 387-395.

Dönmez, A. (1984). Belirli toplumsal durumların algılanmasında denetim odağının etkisi. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi*, 17(1-2), 146-148.

Erktin, E. Dönmez, G. S. Özel Matematik kaygısı ölçeginin psikometrik özellikleri [Psychometric features of math anxiety scale]. *Egitim ve Bilim*, 31 (140) (2006).

Fennema, E., & Sherman, J. A. (1976). Fennema-sherman mathematics attitudes scales:Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education, 7* (5), 324-326.

Fishbein, M., & Ajzen, I. (1975*). Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Gündüz, S., ve Çelik, H. C. (2015). Öğrencilerin matematik dersinde akıllı tahta kullanımına yönelik tutumların çeşitli değişkenler açısından incelenmesi [Analyzing the attitudes of students towards using smartboard in math classes]. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, 25, 157-174

Hair, J.F. Jr., Anderson, R.E., Tatham, R.L., Black, W.C. (1995). *Multivariate Data Analysis With Readings*. 4th ed. Prentice-Hall International Inc..

Harrington, D. (2009). *Confirmatory factor analysis*. New York: Oxford University Press.

Hoerup, S.L. (2001). Diffusion of an innovation: computer technology integration and the role of collaboration, Doctoral dissertation, *Virginia Polytechnic Institute and State University*, 2001. ProQuest DigitalDissertations. (UMI No. AAT 3031436)

Jöreskog, K. and Sörbom, D. (1993), *LISREL 8: Structural Equation Modeling with the SIMPLIS Command Language*. Chicago, IL: Scientific Software International Inc.

Kağıtçıbaşı, Ç. (2008). Günümüzde insan ve insanlar, sosyal psikolojiye giriş [Person and people in current days, social psychology]. (pp.71-106). İstanbul, 11. Basım.

Karasar, N. (2005). *Bilimsel Araştırma Yöntemi* [Research Methods]. Ankara: Nobel.

Keser, H. ve Çetinkaya, L. (2013). Öğretmen ve Öğrencilerin Etkileşimli Tahta Kullanımına Yönelik Yaşadıkları Sorunlar ve Çözüm Önerileri [The problems that teachers and students have when using smartboard and solutions]. *Electronic Turkish Studies,* 8(6), 377-403.

Koca, M. ve Usluel, Y.K. (2007). Öğretmenlerin bilgi ve iletişim teknolojilerini kabul ve kullanım niyetleri. [Teachers intentions and acceptance for ICT usage].Eğitim Bilimleri ve Uygulama, 6 (11), 3-18.

Korucu, A. T., Usta, E. ve Toraman, L. (2016). Ortaokul öğrencilerinin etkileşimli tahta kullanımına yönelik tutumlarının farklı değişkenler açısından incelenmesi [Analyzing middle school students attitudes towards using interactive board in terms of different variables]. *Bartın Üniversitesi Eğitim Fakültesi Dergisi*, 5(3), 690-717

Kurbanoğlu, İ.N. & Takunyacı, M. (2012). Lise öğrencilerinin matematik dersine yönelik kaygı, tutum ve öz-yeterlik inançlarının cinsiyet, okul türü ve sınıf düzeyi açısından incelenmesi [Analyzing high school students attitudes, anxiety and self efficacy beliefs 'n terms of gender, school type and classroom level].*Uluslararası İnsan Bilimleri Dergisi*, 9(1), 110-130.

Maddux, C. D., Johnson, D. L., & Willis, J. W. (2001). Educational computing: Learning with tomorrow's technologies, 3rd Ed. Boston, MA: Allyn and Bacon.

Ntemana, T. J. & Olatokun, W. (2012). Analyzing the Influence of Diffusion of Innovation Attributes on Lecturers' Attitude Towards Information and Communication Technologies. *Human Technology*, Volume 8 (2), 179-197.

Okur, M. R., Salar, H. C., Süral, I., & Uça-Güneş, E. P. (2009). Mobil 3g teknolojilerinin uzaktan eğitimde kullanımı [The use of mobile 3G technologies in distance education]. *In proceedings of 9 th international educational technology conference*, 679-684.

Önal, N. (2017). Use of interactive whiteboard in the mathematics classroom: Students' perceptions within the framework of the Technology Acceptance Model. *International Journal of Instruction*, 10(4), 67-86.

Pallant, J. (2015). *SPSS Survival Manual*. Open University Press, Berkshire.

Park, S. (2004). *Factors that Affect Information Technology Adoption by Teachers*. Faculty of The Graduate Collage, University of Nebraska, Nebraska.

Rogers, E. M. (1983). Diffusion of innovations. New York, NY: The Free Press.

Rogers, E. M. (1995). *Diffusion of innovation* (Rev. ed.). New York, NY: Free Press.

Seçer, İ. (2015). *SPSS ve Lisrel ile pratik veri analizi: Analiz ve raporlaştırma.* [Data analysis with LISREL and SPSS: Analysis and Reporting]. Anı Yayıncılık, Ankara.

Sümer, N. (2000). Yapısal Eşitlik Modelleri: Temel Kavramlar ve Örnek Uygulamalar [Structural Equation Models: Fundamentals and illustrative practices]. *Türk Psikoloji Yazıları,* 3(6), 49-74.

Tabachnick, B.G. and Fidell, L.S. (2007), *Using Multivariate Statistics* (5th ed.). New York: Allyn and Bacon.

Tatar, E., Zengin, Y., & Kağızmanlı, T. B. (2015). What is the relationship between technology and mathematics teaching anxiety? *Educational Technology & Society*, 18 (1), 67–76.

Tataroğlu, B. & Erduran, A. (2010). Matematik dersinde akıllı tahtaya yönelik tutum ölçeğinin geliştirilmesi [Scale development towards use of interactive board in mathematics classes]. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 1(3), 233-250..

Teo. T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education*, 57(2011), 2432–2440.

Tezci, E. (2016). Öğretmenlerin Bit Entegrasyon Yaklaşımlarının Ölçülmesi[Measurement of teachers ICT approaches]. *Kastamonu Eğitim Dergisi*, 24(2).

The Problem of Anxiety. By Sigmund Freud. English Translation by H. A. Bunker. (New York: W. W. Norton, Inc., 1936.)." *American Journal of Psychiatry*, 93(5), p. 1254

Tobias, S., & Weissbrod, C., (*1980*) Anxiety and Mathematics: An Update. *Harvard Educational Review*: April 1980, Vol. 50, No. 1, pp. 63-70.

Turan, B & Haşit, G. (2014). Teknoloji kabul modeli ve sınıf öğretmenleri üzerinde bir uygulama [Technology acceptance model and a case study on pre-school teachers]. Uluslararası Alanya İşletme Fakültesi Dergisi, 6(1),109-119.

Ural, A. (2015). Ortaokul matematik öğretmenlerinin bilgi iletişim teknolojisi ve psikomotor beceri kullanımlarının incelenmesi.[The research of middle school mathematics teachers use of ICT and psychomototr skills]. *Turkish Journal of Computer and Mathematics Education*, 6(1), 93-116.

Yorgancı, S. & Terzioğlu, Ö. (2013). Matematik öğretiminde akıllı tahta kullanımının başarıya ve matematiğe karşı tutuma etkisi [The effect of using interactive board to the mathematics achievement and attitude towards mathematics]. *Kastamonu Eğitim Dergisi,* 21(3), 919-930..

Author Information

Kevser Erdener
Teacher, Turkish Ministry of National Education
Balikesir
Turkey
Contact e-mail: *kevserbozbiyik@hotmail.com*

Mehmet Ali KANDEMİR[2]
Assistant Prof., Balikesir University
Necatibey Education Faculty
Balıkesir
Turkey