

# Students' Attitudes Towards Using Interactive Whiteboard in Mathematics Classrooms

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The purpose of the study is to investigate the students' attitudes towards using interactive whiteboard in mathematics classrooms in the middle and high school. The IWB survey was used to measure students' attitudes. The research sampling consisted of 112 students in middle schools and 231 students in high schools in Balıkesir in Turkey. The structural validity of scale was tested through confirmatory factor analysis. The reliability of the scales was tested through Cronbach's Alpha Coefficient. The item discrimination of the scales was calculated through the corrected item total correlation and a comparison between the top and bottom 27% groups. The results of analysis show that students have positive attitude towards the use of IWB. Also t-test method was used to test whether students' attitudes differ in terms of gender, school type and mathematics achievement

**Keywords:** Interactive whiteboard, students' attitudes, interactive whiteboard survey, mathematics education, gender, mathematics achievement

## INTRODUCTION

The information and communication technologies (ICT) have an effective role in the classroom in terms of teaching and learning process. Interactive whiteboard is the most popular and widespread instructional technology in schools in recent years. The interactive whiteboards have significant change in parallel with technological developments. IWB used to have a connection between white teaching board and a digital projector and a computer. In other words the interactive whiteboard used to be as a teaching surface that shows projected image which is transferred from computer to the board. Thus, the instructor can control the related items directly on the screen with a pen or finger. The new generation interactive whiteboards, which are designed on the LCD touch screen panel and compatible with tablet computers, placed in the classrooms. Students and teachers can drag, click, paste and copy items; take notes with using pen or handwriting, highlight texts; show pictures and educational videos to the whole class; use IWB compatible course books and plug in flash disk to share the course documents. New generation IWBs have multi-touch-sensitive screens. In terms of both their appearance and the technology behind them, new generation IWBs that can compare to a huge tablet pc used by the teacher and whole class (Saltan, 2019).

Just as in other countries, significant amounts of investments are made for ICT integration to education in Turkey. The Ministry of National Education (MNE), in "Information Society Strategy Document" of the "FATİH (Increasing Opportunities and Technological Improvement Movement) Project", indicated that 432 thousand interactive boards were distributed in FATİH Project until now (MNE, 2015). In addition, Educational Information Network (EBA), which is a content portal, is aiming efficient use of interactive boards and tablet computers for students and teachers in Turkey.

There are two viewpoints of technology using in education: one of them is using technology to transform information to students. For example, teachers use PowerPoint presentations in classrooms to transform information, show some images or play videos about subject. Second type of technology using is called technology integration (Maddux & Johnson, 2006). The second type of technology using based on student centered education. Maddux and Johnson (2006) explain the technology integration as that make new and better ways of teaching available, ways not possible without the use of information technology. Teachers and students should use interactive whiteboard in classroom as the integration of information technology to enhance students' learning performance in their fields. In student-centered classrooms, students' attitudes towards information technologies play important role in learning. The reactions of students to information technologies 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. In other words investigating students' attitudes gives teachers clues about students' needs for learning.

With regarding to the importance of students' attitudes towards use of IWB, the purpose of this study is to investigate the students' attitudes based on IWB usage in mathematics classrooms.

## LITERATURE REVIEW

### *STUDENTS' ATTITUDE TOWARD USING OF IWB*

The studies about use of IWB have searched different aspects of IWB in classrooms such as students or teachers' attitudes towards IWB; the effects of using IWB on students' achievements or motivations; scale development studies and problems they face during the use of Interactive Whiteboard (IWB). Most of the researches indicate that students and teachers have positive attitudes towards using IWB in classrooms (Akgun & Koru-Yucekaya, 2015; Aytaç, 2013; Balta & Duran, 2015; İpek & Sozcu, 2016; Mathews-Aydinli & Elaziz, 2010; Saltan, 2019; Tataroğlu & Erduran, 2010; Yorgancı & Terzioğlu, 2013). In spite of result of studies above mentioned Çelik & Gündüz (2015) claim that students do not display positive attitudes towards interactive whiteboards used in mathematics lessons.

### *STUDENTS' MATHEMATICS ACHIEVEMENT AND THE USE OF IWB*

There are several studies reveal another positive effect of using IWB upon students' achievement especially in mathematics, science and social sciences (Akgun & Koru-Yucekaya, 2015; Anatürk & Ateskan, 2019; Hendawi & Nosair, 2020; Tunaboğlu & Demir, 2017). Except students' achievements, some researches indicate that interactive whiteboards enhance motivation of students so their learning influence by positively (Baran, 2010; Lai, 2019). Also by virtue of the increasing motivation using IWB, enhance the student involvement and active participation in lessons (Essig, 2011; Saltan, 2019). Although these findings Torff & Tirota (2010) reported that, suggest that the IWB increases student motivation, but only by the slimmest of margins.

### *USE OF IWB IN MIDDLE AND HIGH SCHOOL MATHEMATICS CLASSROOMS*

One of the principal objectives of interactive white boards is to facilitate teaching-learning process and provide the permanent learning. Becta (2004) claims that IWBs ensure enhancing demonstration and modeling, provide quality interactions, improve teacher assessment, balance resources and instructional planning, and help to increase the pace and depth of student learning. Also according to Becta (2004), effective use of IWB supports and extends a wider range of learning styles – but, as with any ICT tool, its success depends on effective use. In other words, use of IWB can have impressively positive effect on teaching and learning if IWBs are used effectively, its materials are well prepared and teachers become aware of developments in technology behind IWB (Bruce, McPherson, Sabeti, & Flynn, 2011). In parallel with these concludes the results of Türel and Johnson's 2012 study points out that IWBs can be used to facilitate learning and instruction if teachers have collaboration with colleagues, they get training about effective instructional strategies using IWB, and they use more frequently to improve IWB competency.

The features of IWB have effects on students' attitudes towards using IWB in classrooms (Erdener & Kandemir, 2017; Onal, 2017). According to Erdener and Kandemir (2017) students' perceptions of ease of use, compatibility, testability, and observability as the characteristics of interactive whiteboard have positive effect on students' attitudes towards the interactive whiteboard. Onal (2017) indicates that perceived usefulness and perceived ease of use have an effect on students' acceptance of using IWB in classrooms.

The rise in use of technology is related to students' acceptance and attitudes about the technology. So some of researchers investigate that significant differences existed for attitudes toward using interactive whiteboard based on gender and school type (Balta & Duran, 2015; Erdener & Kandemir, 2017; Onal & Demir, 2017). In addition, in some studies researchers have found differences for teachers' attitudes towards use of IWB in terms of gender and teaching experience (Akçay, Arslan & Guven, 2015).

## **SIGNIFICANCE OF THE STUDY**

The IWBs have become popular and widespread instructional technology all over the world. IWBs have important role in teaching and learning process so they affect both teachers and students' performance in classroom. The governments make large amount of investments for integrating ICT just as IWBs to education. The diffusion of information and communication technologies in schools depends on acceptance and attitudes of both teachers and students. The attitudes and opinions of the students for the use of interactive boards in mathematics class that will help students to take an active role in the knowledge construction process in mathematics class need to be known. This is because the responses students to this innovation brought to their class are influenced by their attitude. Kagıtcıbası (2008) stated that attitudes are not observable but factors that attitudes lead to are observable such as behaviors, feelings and thoughts and these factors lead measurable responses. By considering student attitudes, it will be possible to plan activities that are more productive by investigating the effect of the interactive boards on the teaching and learning process. In other words, effective use of IWBs depends on determining the students' attitudes and perceptions. Although there are studies to determine teachers' and pre-service teachers' attitudes towards the interactive boards, very few studies investigate middle school and high school students' attitudes.

## **PURPOSE OF THE STUDY**

With regarding to the importance of students' perceptions and attitudes about IWB use, this study aims to investigate the students' attitudes based on IWB usage in mathematics classrooms. Based on the purpose of this study, the research questions are as follows:

1. What are the attitudes of students toward IWB usage in mathematics classrooms?
2. Do the middle school and high school students' attitudes towards using IWB in mathematics classroom differ significantly by mathematics achievement?
3. Do the middle school and high school students' attitudes towards using IWB in mathematics classroom differ significantly by gender?

## **METHOD**

### *DESIGN OF STUDY*

In the present study, a quantitative descriptive research method was employed to investigate the perceptions of students regarding the current usage of IWB use in middle and high schools. Descriptive research methods are one of the most primary and effective methods to describe and analyze the opinion of participants' beliefs about a certain issue or phenomenon (Gall, Gall, & Borg, 2003). Survey method have been identified as one of the descriptive research methods in the literature. Survey research involves asking questions of a sample of individuals who are representative of the group or groups being studied (Koh&Owen, 2000).

### *PARTICIPANTS*

This study was conducted in a public high school and a middle school in Balıkesir, Turkey. An interactive whiteboard survey was distributed to 260 high school students and 125 middle

school students in Balıkesir, Turkey. 112 middle school students (female male) and 231 high school students (female male) properly responded the questionnaire. All students that participated to the study have been taught with IWB since two years.

### *PROCEDURES*

Public schools have been using the IWB as instructional technology commonly in urban areas in Turkey. For this study, it was considered to study with public school students who have had adequate knowledge of and experience with IWBs and also were familiar with the issues of IWBs in practice. Students selected randomly in these schools so some of them have low and some of them have high academic performance. In both middle schools and high schools, the students have mixed socio-economic status. Before collecting data from students, researcher had chance to interview with Mathematics teachers in these schools. The teachers indicated that they use IWB effectively. For example, they use interactive subject books through IWB so they do not have to write or draw geometric shapes on the board. That makes them use the time efficiently. Also before collecting data, students were observed in their classrooms by researcher. The survey was applied to students during their out of class hours by permission of school principal.

### *MEASUREMENTS AND INSTRUMENTS*

In order to collect the data the “interactive whiteboard survey” developed by Türel (2011) was used. According to Türel (2011), the survey was formed considering constructivist theory, technology acceptance model. The survey included 26 questions including positive and negative statements which were based on 5-point Likert scale for perceptions ranging from a low score of 1 (strongly disagree) to high score of five (strongly agree). Additionally, the participants indicated their mathematics performance level on a three-point scale as 1-Low 2-Medium 3-High. Students asked to express their previous semester mathematics grade as self-reported levels of mathematics achievement. Students asked to consider their average of mathematics exams grade than if their average is between 0 and 45 they mark “Low” point; if it is between 45 and 80, they mark “medium” point and if they have an average between 80 and 100 they mark “High” point. In addition, they were asked to indicate their gender and grade.

### *DATA ANALYSIS*

By using SPSS the Cronbach alpha internal consistency coefficient, which is frequently used to determine whether the items are consistent with each other, is calculated. In order to determine the discrimination levels and the prediction of the total score level of the items in the scale, the adjusted total item correlation was calculated. In addition, the 27% upper and lower group comparisons were made, and the significance of the differences between the item mean values of the groups was examined. Also independent sample t-test conducted to investigate the difference between male and female students' attitudes for both middle school and high school and to state the differences between the students' views in terms of school types. In addition to that, a one way ANOVA was conducted to compare the effect of math achievement on students' views about IWB for both school types.

So as to determine the structural validity of scales in other words to examine how to collect data fit into model including three factors the confirmatory factor analysis was applied through LISREL 8.54 program. Confirmatory factor analysis (CFA) is a statistical technique used to test whether the factor structure of a set of observed variables are consistent with their underlying latent constructs. (Suhr, 2006) In order to determine suitability of model to data CHI-SQUARE, RMSEA, GFI and CFI values which were calculated. The Chi-square value indicates the amount of difference between expected and observed covariance matrices. RMSEA (Root mean square error of approximation) is one of the good fit index that measures the discrepancy between the observed covariance matrix and the estimated covariance matrix per degree of freedom (Staiger & Lind, 1980; Staiger, 1990). GFI (Goodness- of -fit statistic) measures the proportion of variance that is accounted for by the estimated population covariance (Tabachnick and Fidell, 2007). CFI (Comparative fit index) indicates how a model fits the data compared to a baseline model where all variables are uncorrelated (Bentler, 1990).

## RESULTS AND FINDINGS

### *THE FINDINGS RELATED TO RELIABILITY ANALYSIS*

In this study, Cronbach alpha internal consistency coefficient, which is frequently used to determine whether the items are consistent with each other, is calculated. The Cronbach alpha reliability coefficient of the scale for middle school students and high school students was found to be 0.90. These findings show that the reliability coefficients obtained were sufficient. Liu (2003) stated that the limit value for the reliability of the scale can be taken as 0.70.

In order to determine the discrimination levels of the items in IWB survey and to determine the prediction level of total score, the adjusted total item correlation was calculated and the 27% upper and lower group comparisons were made. Adjusted total item correlation: While interpreting total item correlation, items that have values equal to .30 or above are considered sufficient to distinguish the feature to be measured. 27% upper and lower group comparisons: The t values for the differences between the lower and upper group should be significant. The significance of the t-values for the differences between the total item correlations at .30 and above (Akbulut, 2010; Field, 2009; Nunnally & Bernstein, 1994) and the 27% difference between the upper and lower groups is considered as evidence for the distinction of the item (Erkuş, 2012; Tezbaşaran, 1997). According to these criteria, it can be said that all of the items on the scale are discriminant.

The mean scores and standard deviations for the 26 survey items were calculated related to attitudes toward using the IWB. All means were greater than 3.0 on the 5-point scale. This indicates an overall positive response and attitude toward using the IWB to each question in this scale. The results of analysis show that students have positive attitude towards the use of IWB.

### *FINDINGS RELATED TO CONFIRMATORY FACTOR ANALYSIS*

In consequence of confirmatory factor analysis, the good fit indices for high school data shown in Table 1.

Table 1. *Goodness of Fit Statistics of High School*

| CFA         | CFI  | TLI  | NFI  | GFI  | RMSEA | SRMR  | Chi-square |
|-------------|------|------|------|------|-------|-------|------------|
| High school | 0.97 | 0.93 | 0.95 | 0.82 | 0.072 | 0.088 | 652.28     |

At the end of the confirmatory factor analyses, the chi-square goodness of fit statistic, which is shown by the corresponding p-value in table 1, is 652.28 and the degree of freedom is 296. So the chi-square per degree of freedom value (.20) is below 3 that means the chi-square goodness of fit statistic is significant beyond the 0.000 level. According to Sumer (2000) if the chi-square per degree of freedom value is below 3 the data fits into model significantly. Other goodness of fit statistics CFI (0.97), TLI (0.926), and NFI (0.95) values meet the criteria (0.90 or larger) for acceptable model fit. The GFI value range from zero to one with a larger value indicating better model fit. The GFI value was found to be 0.82 so that value being indicative of good fit. The RMSEA (0.072) is less than 0.08 so this shows acceptable model fit.

The factor loadings are ranged between 0.62 and 0.93 for high school in the confirmatory factor analysis (CFA) model and CFA results show that three factors were named as follows: Learning contribution and motivation (18 items); efficiency (4 items) and negative effects (4 items).

At the end of the confirmatory factor analysis the goodness of fit statistics for data, which was collected from middle school, is shown in Table 2. The confirmatory factor analysis results show that the chi-square value (is significant beyond the 0.0000 and the degree of freedom is 296 so the chi-square per degree of freedom value is below 3 which would indicate close fit between model and data. Other fit indices were examined to evaluate the overall fit of the model: CFI (0.96), TLI (0.897), NFI (0.90), GFI (0.77), and RMSEA (0.067). These results again strongly support the acceptable model fit.

Table 2. *Goodness of Statistics of Middle School Data*

| CFA           | CFI  | TLI  | NFI  | GFI  | RMSEA | SRMR | Chi-square |
|---------------|------|------|------|------|-------|------|------------|
| Middle school | 0.96 | 0.89 | 0.90 | 0.77 | 0.067 | 0.10 | 443.13     |

The factor loadings were ranged between 0.60 and 0.96 for middles school in the CFA model. In addition, the model shows three factors such as the CFA model for high school data.

#### FINDINGS RELATED TO T-TEST

Table 3. Results of t-Test Analysis by School Variables

|                                      | Middle School  | High School    | t        | Sig. (two tailed) | Cohen's d | Df  |
|--------------------------------------|----------------|----------------|----------|-------------------|-----------|-----|
| Overall                              | 3.62<br>(0.58) | 3.78<br>(0.65) | -2.180*  | .030              | 0.26      | 341 |
| Learning Contribution and Motivation | 4.04<br>(0.77) | 3.99<br>(0.77) | 0.519    | .604              | 0.06      | 341 |
| Efficiency                           | 4.02<br>(0.92) | 4.10<br>(0.83) | -0.846   | .398              | 0.09      | 341 |
| Negative Effects                     | 2.80<br>(1.01) | 3.25<br>(1.03) | -3.729** | .000              | 0.43      | 341 |

Table 3 shows the results of an independent sample T-test conducted to state the differences between the students' views in terms of school types. The t-test revealed that there is a statistically significant difference between middle school and high school in terms of overall attitude and negative effects. However, specifically, there is not a clear difference between middle school and high school in terms of learning contribution and motivation and efficiency.

Table 4. Results of t-Test Analysis by Gender for Middle School

|                                      | Girl        | Boy         | t     | Sig (two tailed) | d     | Df  |
|--------------------------------------|-------------|-------------|-------|------------------|-------|-----|
| Overall                              | 3.61 (0.60) | 3.62 (0.58) | 0.043 | 0.966            | 0.008 | 110 |
| Learning Contribution and motivation | 4.01(0.80)  | 4.07(0.73)  | 0.428 | 0.669            | 0.08  | 110 |
| Efficiency                           | 4.03 (0.95) | 4.01(0.90)  | 0.068 | 0.946            | 0.01  | 110 |
| Negative Effects                     | 2.82 (1.0)  | 2.78 (0.99) | 0.189 | 0.851            | 0.03  | 110 |

Table 4 shows the results of an independent sample T-test conducted to state the differences between the middle school students' views in terms of genders. The test results indicate that there is no statistically significant difference between male and female students in terms of overall attitude and specifically for any factors.

Table 5. Results of t-Test Analysis by Gender for High-School

|                                      | Girl        | Boy         | t       | Sig(two tailed) | d    | Df  |
|--------------------------------------|-------------|-------------|---------|-----------------|------|-----|
| Overall                              | 3.74 (0.67) | 3.82 (0.64) | 0.043   | 0.373           | 0.12 | 231 |
| Learning Contribution and Motivation | 3.86 (0.82) | 4.13 (0.68) | **0.428 | 0.009           | 0.35 | 231 |
| Efficiency                           | 4.03 (0.86) | 4.18 (0.78) | 0.068   | 0.179           | .18  | 231 |
| Negative Effects                     | 3.33 (0.98) | 3.15 (1.07) | 0.189   | 0.186           | 0.17 | 231 |

Table 5 shows the results of an independent sample T-test conducted to state the differences between the high school students' views in terms of genders. The test results indicate that there is not any statistically significant difference between male and female students in terms of overall attitude and in terms of efficiency and negative effects factors. Nevertheless, there is a meaningful difference between male and female students in terms of learning contribution and motivation factor.

*FINDINGS RELATED TO ONE WAY ANOVA*Table 6. *Results of One-way ANOVA Mathematics Achievement Levels for Middle School*

|                                      | Low         | Medium      | High        | F     | sig   | Effect size |
|--------------------------------------|-------------|-------------|-------------|-------|-------|-------------|
| Overall                              | 3.60 (0.91) | 3.67 (0.52) | 3.53 (0.49) | 0.559 | 0.573 | 0.010       |
| Learning Contribution and Motivation | 3.85 (1.02) | 4.03 (0.64) | 4.14 (0.84) | 0.777 | 0.462 | 0.014       |
| Efficiency                           | 3.87 (1.20) | 4.02 (0.82) | 4.07 (0.92) | 0.257 | 0.774 | 0.004       |
| Negative Effects                     | 3.09 (1.19) | 2.95 (0.96) | 2.38 (0.89) | *4.39 | 0.015 | 0.07        |

A one-way ANOVA was conducted to compare the effect of math achievement on students' views about IWB. We can see that, there is not a statistically significant difference between students who have different math achievement in terms of overall attitude and learning contribution and motivation and efficiency factors. However, the results indicate that there is statistically clear difference between students at different achievement levels in terms of negative effects factor.

Table 7. *Results of One-way ANOVA Mathematics Achievement Levels for High-School*

|                                      | Low            | Medium         | High           | F       | sig   | Effect size |
|--------------------------------------|----------------|----------------|----------------|---------|-------|-------------|
| Overall                              | 3.68<br>(0.68) | 3.80<br>(0.64) | 3.92<br>(0.61) | 1.224   | 0.296 | 0.010       |
| Learning Contribution and Motivation | 4.03<br>(0.80) | 3.94<br>(0.75) | 4.24<br>(0.76) | 1.565   | 0.211 | 0.013       |
| Efficiency                           | 4.16<br>(0.83) | 4.08<br>(0.82) | 4.04<br>(0.85) | 0.237   | 0.789 | 0.002       |
| Negative Effects                     | 2.86<br>(1.05) | 3.38<br>(0.97) | 3.46<br>(1.16) | **6.367 | 0.002 | 0.052       |

The one-way ANOVA results revealed that, a statistically significant difference has not been between students who have different math achievement in terms of overall attitude and learning contribution and motivation and efficiency factors. However, the results indicate that there is a statistically clear difference between students at different achievement levels in terms of negative effects factor.

**DISCUSSION AND CONCLUSION**

This study aims to investigate the middle school and high school students' attitudes toward use of IWB in mathematics classrooms. The interactive whiteboard survey that consists of 26 items developed by Turel (2011) was used to measure students' attitudes. The reliability of the scales was tested through Cronbach Alpha Coefficient as internal consistency. The Cronbach's alpha reliability coefficient of the scale is  $\alpha = 0.90$  for both data collected from middle school and high school students. In order to determine the structural validity of scales confirmatory factor analysis was conducted. Confirmatory factor analysis results show that goodness of fit statistics values meet the criteria for acceptable model fit. The item discrimination of the scales was calculated through the corrected item total correlation and a comparison between the top and bottom 27% groups. Independent sample t-test analysis conducted to determine whether there is a clear difference in terms of gender and school type or not. In addition to that, a one-way ANOVA was conducted to compare the effect of math achievement on students' views about IWB for both school types.

The results of calculation of mean scores and standard deviation show that students have positive attitude towards the use of IWB. Several studies conducted to identify students' attitudes toward IWB have the similar result (Aytaç, 2013; Balta & Duran, 2015; Önal & Demir,

2017; Saltan, 2019; Sözcü & İpek, 2016; Tataroğlu & Erduran, 2010). As a result of t-test conducted to state the differences between the students' views in terms of school types, it is revealed that there is a statistically significant difference between middle school and high school students' attitudes. Some studies revealed that students' attitudes differ in terms of school types ( Balta & Duran, 2015).

There is a meaningful difference between male and female students in terms of learning contribution and motivation factor for high school students but the test results indicate that there is not a statistically significant difference between male and female students in terms of overall attitude for middle school and high school students. Similarly, the studies conducted by Öz (2014) showed that there is no difference on attitudes toward IWB in terms of gender. On the contrary, some studies found significant difference on attitudes in terms of gender (Aytaç, 2013; Balta & Duran, 2017; Önal & Demir, 2017). The findings of up-to-date studies differ from each other that refers more research are needed to have accurate results to determine the effect of gender difference on attitude toward IWB.

To compare the effect of math achievement on students' views about IWB one way ANOVA was conducted. The analysis results indicate that, there is not any statistically significant difference between students have different math achievement in terms of overall attitude. Although the results indicate that, there is a statistically clear difference between students at different achievement levels in terms of negative effects factor. It means that in both middle school and high school students whose mathematics achievement is lower than others have negative attitudes toward IWB. Some of the research that investigate the effect of achievement on attitude toward IWB revealed resemble results. Önal & Demir (2017) pointed out that students at various achievement levels have different attitudes toward IWB. Indeed, attitude and achievement are two important factors that have correlative effect. (Aiken, 1970; Aşkar & Erden, 1987). For example, differently from current research the results of different studies also show that students' positive attitudes towards mathematics have a positive impact on mathematics success (Hendawi & Nosair, 2019; Tunaboşlu & Demir, 2017).

## LIMITATIONS AND SUGGESTIONS

This study focused on students' attitudes towards IWB only in mathematics classrooms. In future studies the attitudes toward IWB may vary when this technology employed in other academic subjects. In current study, only quantitative research methods conducted. Data obtained via a five-point Likert scale and qualitative methods were not used. Results of mixed method as combined of qualitative and quantitative approaches support each other and that increase the reliability of studies.

According to result of this study, students in both middle school and high school have positive attitude toward use of IWB in mathematics classrooms. This conclude should encourage educators especially teachers to prepare their classroom environment to use IWB and train themselves and increase their self development about using technology to use full potential of IWB.

The governments make large amount of investments for technology integration to classrooms. This study only investigated students' attitudes thus research needed to explore teachers' perceptions about use of IWB. After that, it is possible to investigate how teachers can use of the capabilities of these interactive boards. The results of that kind of future studies may guide the governments for effective the investments. In addition, future studies may be conducted upon teachers' collaboration so that teachers can share practical issues with using the interactive whiteboards.

The factors of the IWB scale that was used in this study are learning contribution and motivation, efficiency, and negative effects. Regarding the result of this study, we can say that students think that IWBs have contribution on their learning and IWBs are motivating and effective for learning mathematics. The study shows the importance of using IWB in classroom so it should encourage programmers, teachers and instructional technology designers to create and design different materials that increase students' learning and understanding.



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## APPENDIX

### Survey Factors and Items

#### ***Factor 1: Perceived learning contribution and motivation***

ITEM 1: I can learn more when my teacher uses an IWB

ITEM 2: IWB increases my attention towards the course

ITEM 3: IWB helps me learn faster

ITEM 4: IWB makes learning more exciting

ITEM 5: I feel comfortable when IWB is being used

ITEM 6: IWB makes me learn concepts easier

ITEM 7: IWB increases my motivation towards the course

ITEM 8: I believe that if my teachers use IWB more often, I will enjoy lessons more

ITEM 9: I can focus on the course content more when IWB is used

ITEM 10: IWB helps us learn together

ITEM 11: IWB use makes it easier for me to remember what I learned in

ITEM 12: I can understand the lessons taught using IWB better

ITEM 13: IWB makes the courses more interactive

ITEM 14: I get opportunities to discuss the topics taught with IWB with my classmates

ITEM 15: I learn more when I review topics, which were taught through an IWB, at home

ITEM 16: I look forward to my teacher's using IWB in class

ITEM 17: IWB use increases my interest in class

ITEM 18: IWB makes the class more entertaining

#### ***Factor 2: Perceived efficiency***

ITEM 1: IWB can be used for all classes

ITEM 2: I believe IWB is a useful technology for us to learn

ITEM 3: I think that the courses are more efficient with IWB

ITEM 4: The content of my classes are not suitable for IWB use

ITEM 5: I believe it is necessary for my teachers to use technology (computer, internet, etc.)  
in class

#### ***Factor 3: Perceived negative effects***

ITEM 1: During IWB use, there is a lot of noise in class

ITEM 2: We have technical issues (i.e. connection, stylus problems) with IWB

ITEM 3: IWB was exciting at the beginning but not anymore