Effects of Using Interactive Whiteboards at High School Mathematics Classrooms

Çakir AHMET *

Abstract

This article presents the results of a quantitative research about the effects of using interactive whiteboards in high school mathematics classroom. It will be helpful for the high school mathematics teachers as well as for researchers in the field of teaching mathematics. The aim of the article is to investigate the effects of using interactive whiteboards in high school mathematics classrooms. In the article the following research questions are answered: "What can we do with an interactive whiteboard?" and "Do we really need the properties of the interactive whiteboard?" For the research part of the article mathematics lessons for tenth grade students of a private school in Tbilisi were held in two ways. During the first 6 weeks the topics were taught on a blackboard by traditional methods. Starting from seventh week we used an interactive whiteboard. At the end of the research a student questionnaire was applied. In the questionnaire 10 questions were asked about the benefits and differences of using interactive whiteboards in mathematics lessons. It was found that the application of interactive whiteboards in mathematics lessons has a number of significant benefits.

Keywords: Mathematics Education, Interactive Whiteboard, Technology Integration

Introduction

In the previous centuries, technology was changing slowly, once in about a century or so, but starting from the 20th century, technology has been changing once in every 5 – 6 years. In the 21st century it already takes less than 1 year to develop a new technology. Like technology, education system nowadays also needs to be developed in a speedier way. In the last two centuries there have been a lot of innovations in education systems, which involves the application of computers. In 1956 Gordon Pask and Robin McKinnon-Wood develop SAKI, the first adaptive teaching system to go into commercial production. SAKI taught keyboard skills and optimized the rate by which a trainee keyboard operator learned by making the difficulty level of the tasks contingent on the learner's performance. As the learner's performance improved, the rate of teaching increased and instructional support was delayed (Pask, 1982). The first wave of computer-aided education started in the 1960s and suggested drills for various skills' development. The later waves permitted to involve Internet possibilities, which made computer-aided education especially effective as it became interactive. One of the recent innovations in computer-aided education are interactive whiteboards – devices that use a computer, a projector and a sensitive touch–pad screen that can be operated a magnetic pen or by fingers.

In 1997, the British government announced that they will put interactive whiteboards to all classrooms. So, the schools will not need to use of blackboard and chalk, whiteboard and board markers or overhead projectors as their principle communicative tools. According to Bleecker, (2008), their application correlated with significant improvements on National Tests of achievement. Because of another suggestion, described as "education for all" strategy, the British government decreed that every school in the UK would also receive a broadband access, to enable fast internet service for whiteboards.

In the new century, we can easily observe that we need people who can effectively manage and use the increasing amount of information to solve a lot of complex problems and make important decision making.

According to Reigeluth (1999), the traditional system of education is incompatible with the evolving demands of new age. Also when we look at the general characteristics of the students we will see that they are "born" with internet, so we call them digital natives or the Net Generation. A three years-old child can easily use a computer. They spend lots of their time using computers, cell phones and other media devices. So we can conclude that technology is an integral

* PhD student at the Faculty of Education and Humanities, International Black Sea University, Tbilisi, Georgia.
E-mail: ahmetcak@yahoo.com

part of their lives (Prensky, 2007; Oblinger, 2008). For the students of the Net Generation the best thing is to learn in a classroom with integrated technology. There is no direct and clear definition of technology integration, but we can say that technology integration is viewed as the use of technology for instructional purposes (Bebell at al., 2004).

The above-mentioned researches reveal that there is a need of some new technologies in the classrooms. But, as they are rather expensive, we need to know how useful each particular technology is (Moffatt, 2000). At the moment, interactive whiteboard is one of the most expensive one of them. So, to know how to use it effectively is essential. There is much research concerning the issue (Smith & Throne, 2004; Wall et al., 2005; Kennewell & Beauchamp, 2007; Lewin et al., 2008; Wood & Ashfield, 2008).

According to Smith (2008, p. 173), students experience a constructivist environment when learning through Smart-Board technology. This is especially important for teaching / learning mathematics, as it is an intellectually demanding subject. Particularly, SMART Board activities provide students with opportunities to collaborate, build community, reflect, stay actively engaged, value different perspectives, and take ownership over learning.

Resic and Cukle (2013) were interested in how smart whiteboard functions in an educational environment (technical description), and how the introduction of such a smart whiteboard in the classroom reflects the subjects of mathematics and teaching methodology (methodological description). They enumerate in their article types of educational programs used by them during the experiment – software for teaching of mathematics through interactive whiteboards:

• Graphic tools – Winplot, Dplot, Graph,...

• Software dynamic (interactive) geometry SBS – GeoGebra, Cabra, GSP, Cinderella,

• Computer Algebra System (CAS) – computer software for symbolic calculations: Mathematica, Maple, DERIVE, Sage, Maxima,...

• Programs for the spreadsheet – Microsoft Excel, OpenOffice.org Calc, Lotus 1-2-3, Gnumeric

The experiment results have shown that in the control class (traditional approach) 65% of the students, when they encounter a problem in solving the tasks, address to their teacher, and in the experimental class - only 35%. According to them, the advantages of using interactive whiteboards are:

• Many examples of related to subjects and real life situations

• Demonstrations of experiments that are difficult or impossible to perform in the classroom • Interactive simulations for experiential learning

• Visual examples and animations to easier understanding the material

• The ability to getting verification of the learned feedback

• Tools for help in learning

• Temporal and geographical independence (requires a computer and Internet access)

• Streamlining

• Fast transfer of information

• Stimulation of logical thinking

• The deepening of understanding

• Experimentation, discovery, creation and testing of hypotheses (Resic and Cukle, 2013, p. 127)

What is an Interactive Whiteboard and what are its advantages?

As Shenton and Pagett (2007) define it, an interactive whiteboard is a device that has been used in educational technology in the recent years with the names interactive whiteboard or smartboard or electronic board. This device is something that uses a computer, a projector and a sensitive touch–pad screen that you can use with a magnetic pen or by fingers.

By using an interactive whiteboard we can carry the monitor of a computer to the wall of our classroom and we can do everything that we did in our computer on the interactive whiteboard, to make it visible to all students. Gerard and Widener (1999) claim that interactive whiteboard supports interaction and conversation in the classroom and also helps with the presentation of new materials. Some researchers (Bell, 2002) define the interactive whiteboard as an interaction tool that effects the relationship between the teacher and students.

Interactive whiteboard is an important part of educational technologies. It helps teachers to integrate the technology in education. Bebell, Russell, & O'Dwye (2004) say that integration of technologies in education is simple use of technological equipment for instructional purposes. So, interactive whiteboard has a significant place in technology integration because teachers, use them for instructional purposes in general.

What are the possible processes that occur with the help of an interactive whiteboard?

1. According to Somekh at al. (2007), we can plan and prepare the topics previously and during the lesson we can just present the given information. In our schools a lesson takes 45 minutes. In such a short time first we need to teach a topic, then solve problems, and give time to students to write down the given data and practice the problem solving. Also we need to provide interaction with the students and motivate them to participate actively. The time is not enough to do everything in one lesson. But with the help of an interactive whiteboard we can prepare the presentations

before the lesson and we can print out data to give them to students instead of asking them to write them. In this way we will have more time for teachers to spend for explaining the topic and for students to try to understand and to practice. Interactive whiteboard helps teacher to prepare the materials beforehand and present them in the most fluent way. Also it makes teachers masters of technology.

2. On the interactive whiteboard we can play videos, animations, flash movies, sounds or any other published materials. Visual learning is one of three learning styles (visual, auditory, tactile) in teaching that includes writings, pictures, animations and movies (Beeland, 2002). So, interactive whiteboard will give us a multimedia support of visual learning. In this way our lessons will be more colorful and more beneficial. Scientists say that people understand 10% of the information that they only hear, 40% of the information that they see and 75% that they use (Kinder, 1973).

3. We can save the explained topic in the computer. So, if we need it again in another class or if we want to explain the topic again, we can just recall the related page and it will be ready to use. If it is necessary, the teacher can print out and give the lessons to the students who could not come to the lesson. Becta (2006) counts saving the lessons for future usage an important property of them.

4. Writing on an interactive whiteboard is more exciting than writing on a blackboard / green board. So generally the students want to come to the interactive board to solve problems and join the activities. It makes the students more effective in the class. So interactive whiteboard will both motivate the students and effect them to join the lesson (Asmawi, 2004).

5. Interactive whiteboard is the unique educational tool that provides interaction of all students in educational process (Gillen at al., 2006).

6. According to Healthy Schools Network (2011), interactive whiteboards are hygienic. But traditional blackboards include harmful chalk dust and marker boards include chemical materials that may cause cancer.

There are a lot of more properties of an interactive whiteboard that are listed by Bell (2002), Moss at al. (2007), Becta (2006) and many more researchers, but these properties may change depending on the brands and used programs.

It is obvious that the most important thing in order to use the interactive whiteboard effectively is to educate the teachers (Trench, 2007). If we do not teach all properties of the interactive whiteboard, the teachers will use them like a normal whiteboard or as a computer + projector, without using its rich potential.

Among other important features of interactive whiteboards, based on my experience, are:

7. By using interactive whiteboards we can show the explanation step by step on the board as a movie. After explaining once you can play it again and again, if students need rehearsal. The interactive whiteboard will explain the topic instead of the teacher.

8. Some teachers may have unclear handwriting. But the interactive whiteboard solves this problem. By using the interactive whiteboard's text option you can write on the wall by computer's keyboard.

9. Writing the solutions before lesson and by using curtain option or interactive whiteboard you can close any part of the wall and then you can open when it is necessary.

10. The color option and highlighter options are very useful for a colorful lesson. When teachers use different colors for different types of information, it will be more understandable for students. For example, we may use one color for definitions, another color for examples, another color for solutions.

11. By using basic shapes option we can easily draw geometric shapes of some algebraic or geometric operations. By looking at a badly drawn by hand picture the student may not understand what is given in which part of topic. But basic shapes option will let us draw the figures well.

12. An interactive whiteboard is the brightest place in the class so it is very attractive for students to look at. By using an interactive whiteboard we can draw the students' attention easily.

13. By using internet connections we can join lessons in other places. We can use interactive whiteboard for online lessons also. It will be one of the most important tools in distance education.

14. We can copy and paste pictures, questions, maps or any other document from anywhere in our computer, then we can work on that document. We can copy the question from the book and try to solve it on the board. By this way we can save time, instead of writing and then solving the question we will try only to solve it.

15. By using some fixed tools like protractor, ruler, onboard keyboard of an interactive whiteboard we can do lots of measurements easier.

16. Students can use their hands to drag pictures (fulfil hand-on activities), thus, being physically and emotionally involved on the process of learning.

I. Methodology

Setting

I held my research at Private Demirel College, Tbilisi, Georgia. The research concerned teaching mathematics, so it occurred during mathematics lessons. The duration of the experiment was one semester (14 weeks).

Participants

Fifty 10th grade students participated in the research. All

10th grades at school were involved. Students' knowledge of mathematics and interest towards mathematics were at different levels, some of them were good at math, but some students paid almost no attention to math lessons. 22 of them were girls and 28 - boys.

Procedure

In the research, I taught mathematics lessons to 10th grade students by using a normal blackboard for six weeks. Starting from seventh week of the term I used an interactive whiteboard in my lessons (the same group first served the control one and then – the experimental one). I compared their exam results in the first and second stage of my experiment. I saw that there was a remarkable difference in the exam results. So, I decided to find out what students think about the application of an interactive whiteboard in the mathematics lessons. Then, I prepared a questionnaire for students.

Questionnaire

In the questionnaire I asked 4 questions about the general usage of the technology in the school. Other 6 questions were directly related with the usage of interactive whiteboard in math lessons.

In the questionnaire a 5 – point Likert scale was used for the responses: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The students filled in the questionnaire at the end of the experiment, to be able to give qualified answers (having undergone both traditional teaching and the application of interactive whiteboards).

Reliability and Validity

To provide reliability, only the independent variable (application of traditional board vs. interactive whiteboard) differed during the first and the second stage.

As it was the same group, the number of students and their gender distribution did not change during the experiment, which contributed to the reliability of the results. Their prior interest in the subject area was also the same and if it changed, it was due to the teaching method applied. The same course book was used, and the number of weekly hours did not change. The teacher was the same person (qualification factor excluded). Even the timetable was the same.

To provide the validity of the research I got help from some experts from university. I shared with them the questionnaire items and it was a sort of piloting the questionnaire. In particular, to get content validity I asked questions about general usage of the technology in mathematics lessons and also in other lessons. The questions involved such major aspects of applications of interactive whiteboards in students' views, viewed in the corresponding literature, as the necessity to use them, their integration in the class, increase in understanding, attention, involvement, student achievement and interest. By looking at the general form of the questions

we can say the research is generally reliable and valid.

Results

Table 1 shows the percentages of positive results (strongly agree + agree), neutral results and negative results (strongly disagree + disagree). Also in the table the arithmetic mean (M) of the results has been calculated.
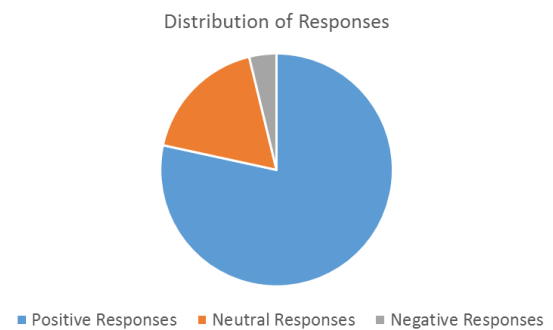
Chart 1. *Distribution of Students' Responses in the whole questionnaire*

Chart 1 shows the distribution of the responses of students. As seen on the graph, more than 75% of the students have a positive attitude towards the usage of the interactive whiteboards in mathematics lessons and all of the other lessons. Such unanimity of opinion also contributes to the reliability of results.

Let us look at the questionnaire results item by item:

As seen from the results, 96% (M = 4.6) of the students support the use of technology in math lesson. 100% (M = 5.0) agreed that all teachers must be technology friendly. Only 4% have a neutral perspective towards the technology. There are always some students which have no positive response to any educational facility. This small 4% is in that minority of our questionnaire, but anyway they are not opposite to technology.

The majority of the students (92%, M = 4.48) agreed that by using interactive whiteboard they understood more in mathematics lesson. 4% of the students say there is no difference and 4% say there is negative effect of use of technology in math lessons. But, this minority is the students who are not good at math in general. So, such a result is not so important.

Using interactive whiteboard increase the attention of the students towards mathematics. 78% (M = 4.2) of the students are agreed about this 20% neutral. The reason for this is the negative perspective of the students for math lessons. Anyway great majority of the students accept that using interactive whiteboard increase their attention in math lessons.

The application of interactive whiteboards in all lessons will increase the interest of the students to the school. 70% (M = 4.14) of the students agreed it. 28% are neutral and

Table 1. *The percentages and the mean of the students' responses are as follows*

		Percentage of Agreement	Percentage of Neutral	Percentage of Disagreement	MEAN (M)
1	I support the use of technology in math lessons.	96	4	0	4.60
2	All teachers should be technology-friendly.	100	0	0	4.70
3	Technology must be an important part of education system.	92	4	4	4.48
4	Technology integration into math lessons help me to learn.	90	2	8	4.38
5	After the usage of interactive whiteboard I understand more in math lessons.	74	24	2	4.12
6	Using an interactive whiteboard in math lessons increased my attention toward math.	78	20	2	4.20
7	Since there is an interactive whiteboard in class I want to participate more in the lessons and solve questions on the board.	62	30	8	3.88
8	Using the interactive whiteboard in math lessons increased my achievement in this class.	60	32	8	3.80
9	Using interactive whiteboard in all lessons will increase my achievement in the school.	62	34	4	3.96
10	By using interactive whiteboards I have increased my interest to the school.	70	28	2	4.14

Average of the Means   **4.23**

only 2% are disagreed. Also 62% (M = 3.96) of the students sure that use of interactive whiteboards in all lessons will increase their achievement in the school. This result show us that if we use the interactive whiteboards in all lessons the students will be more successful in school life and the school will be a more attractive place for them.

Interactive whiteboards are very interesting for students. So lots of the students want to come to board and use it. So they give more attention to lesson. Because, if they don't understand the topic they cannot come to the board. So they study hard to understand the topics and solve examples on the interactive whiteboard. 62% (M = 3.88) of the students agreed about it. 30% say there is no difference. The reason of this answer is having less interest in math lessons in general.

Limitations and Directions of Future Research

The research was limited to one private school and only 50 students in one city / country. To get far-reaching conclusions, more schools, both state and private (correspondingly, more students of various ages) should be involved, in urban and rural areas, and different countries. All of them may give different to some degree results. A more detailed questionnaire has to be developed. Study of applications of interactive whiteboards in teaching various subjects may also yield different advantages and disadvantages. Though the study yielded quite good results, they may be better if more effective ways of interactive whiteboards are found.

II. Conclusion

By looking at the results of the questionnaire we can easily say that using an interactive whiteboard in mathematics lessons and also in other lessons will increase the students' curiosity and motivation. Depending on the motivation students' achievement will also increase (62% of students in my study thought so). By using interactive whiteboard in the classrooms we can increase the attention (78%) and participation (62%) of students to the lessons. All teachers know that making all students active in a lesson is not so easy, but by using the technology and especially the interactive whiteboard we can realize it better than by traditional methods and blackboards.

Secondly, interactive whiteboard make the lessons rich-

er and entertaining by multimedia and technology integration, by this way the learned topics become more permanent in students' storage (70% of the respondents thought that learning became more interesting).

Thirdly, interactive whiteboard effect the interaction between the teacher and the students and by this way more students want to join the lessons. Also, we can decrease the anxiety of students towards the lessons and especially we can eliminate the negative effect of intangible mathematics lessons on students.

The average of the whole questionnaire is 4.23 in a 5-point scale, which is a very good result. It shows that the use of technology, especially interactive whiteboard, is very effective in all levels and subjects of education including mathematics in particular.

We need to add that all these benefits, of course, depend on the teachers' attitude towards the application of interactive whiteboards, their technical and pedagogical skilfulness. So, the most important thing is to teach the teachers to use the interactive whiteboard technology (100 % of the respondents think so). Only on this condition we can expect the benefits of technology.

Further researches may generalize my results for other grades and for other lessons. Also, it will be beneficial if we search the methods for educating the teachers because, they need to be aware of the corresponding programs and their potential, to be able to choose the most effective programs and teaching methods.

Students they use a variety of technological devices at home, but interactive whiteboard belongs to educational technology which has not entered their houses. So, it will be very attractive for students for a long time. But after some time the students may get used to applying it, and then we may need another innovation – maybe in the educational technology or maybe, concerning the methods of application this technology. Until that time comes, interactive whiteboard will be very effective in the system of educational institutions.

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