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EFFECT OF INTERACTIVE WHITEBOARD ON STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS

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Abstract

The study investigated the effect of interactive whiteboard on students' academic achievement in mathematics. The researchers used quasi-experimental method of pre-test posttest group design to collect and analyse data and interpret the results. To achieve the study objectives, two research questions and three hypotheses tested at 0.05 Alpha levels guided the study. The participants consisted of 93 SS11 students in two intact classrooms drawn using purposive sampling techniques. Students' achievements in mathematics were measured using Mathematics Achievement Test (MAT) which contained 40 items which were face and content validated by three experts. Reliability of the instrument was estimated at 0.81 using Kuder Richardson 20. Data were analysed using SPSS and mean and standard deviation were used to answer the research questions while Ancova was used to test the hypotheses at .05 level of significance. The findings of the study revealed that students that were taught mathematics using interactive whiteboard achieved better than those taught with lecture method. There is a statistically significant difference between the mean achievements scores of students taught mathematics using interactive whiteboard than those taught with lecture method. It was recommended that mathematics teachers should embrace the innovative instruction such as interactive whiteboard as it has been found to enhance both male and female students' achievement in mathematics.

Keywords: Mathematics, interactive whiteboard, mathematics achievement

Introduction

A rapid increase in the development of technology has created a paradigm shift in the pedagogy of mathematics education over the world. The production and use of information and communication technologies are spreading rapidly, in education development. Teaching concept is geared towards technology-aided teaching (Alakoç, 2003). There are two approaches to the use of technology in schools. These are learning from technology and learning with technology. In the approach to learning from technology, the content is offered through technology and it is assumed that it will result in learning. In the approach to learning with technology, technology is used as a tool that helps in critical thinking and high-level learning (Jonassen, Peck, & Wilson, 1999). The interactive whiteboard (IWB) which is also known as smart board, electronic board, provides persistence in learning in providing visual materials supported with sound and animation (DeSantis, 2012). The interactive board consists of a combination of a computer, an interactive board, an interactive pen, a projector and with the use of some software (Sarı & Guven, 2013). The interactive whiteboard is an electronic whiteboard on which the teacher can display content projected from a computer, tablet, or other source, and which can be used as a touch screen using a pen or finger (Chen & Tsai, 2013). The IWB is usually used for multimedia presentations that can include images, audio, video, and Internet links (Dinsa & Emran, 2011).

However, the impact of IWB on students' academic achievement in mathematics classrooms is not clear (De Vita et al., 2014). Literature on the relationship between IWB

and students' achievement is inconsistent (Bruce, McPherson, Sabeti, & Flynn, 2011; Glover et al., 2005), and contradictory (Sobel-Lojeski & Digregorio, 2009). Some research findings supporting claims that IWB has a positive impact on students' achievement (Gunduz & Kutluca, 2019; Serin, 2015; Tunaboylu & Demir 2017; Nejem & Muhanna, 2014; Yorgancıoğlu & Terzioğlu 2013; Somekh et al., 2007), as well as studies which have found that they do not influence student learning outcomes (Higgins, Beauchamp, & Miller, 2007; Tataroğlu, 2009). Moss et al. (2007) showed that IWB had no impact upon students' achievement. Tataroğlu (2009) revealed that the use of the interactive whiteboard does not have an impact on academic achievement in mathematics. No wonder Yıldızhan (2013) proposed that the interactive whiteboard should not be used throughout the lesson. In a meta-analysis by De Vita (2014) on the use of the IWB, only four studies were identified that dealt with students' cognitive outcomes, of which only two showed small statistically significant difference in students' achievement. The literature on IWB use and students' achievement is diverse in studies that show a positive impact; some indicate a negative impact and some show no impact whatsoever.

On the contrary, there are some literatures that counter these assertions. Isman et al. (2015) stated that the use of interactive whiteboard makes it easier for students to grasp and understand the instructional materials during instructional delivery. Tunaboylu and Demir (2017) proposed that in the classroom teaching and learning of mathematics, teachers should give place to the interactive whiteboard activities. According to Devita (2014), IWB is particularly useful in teaching mathematics, and Glover (2005) affirms the use of the IWB will transform the teaching of mathematics with the potential to support further students' achievement. Akçayı (2011) claims that the use of an interactive whiteboard in the teaching and learning process has an important influence on mathematics students' achievement, attitudes toward mathematics, motivation and also more problems have been solved in classes where the interactive whiteboard technology is used. No wonder Ekici (2008) concluded that mathematics education conducted with the interactive whiteboard has a positive impact on mathematics achievement of students, epistemological beliefs and their level of remembrance as compared with mathematics education conducted by conventional methods. Somekh et al. (2007), in a large scale qualitative study concluded that students in primary grades, taught with the IWB for longer lengths of times, have the greatest gains in students' achievement. Turel and Johnson (2013) examined the impact of using the interactive whiteboard on attitudes towards mathematics and achievement concluded that using the interactive whiteboard in mathematics lesson increases achievement in mathematics lesson and attitude towards mathematics. Uzun (2014) who carried out a study on the effect of smart board on mathematics success in basic education revealed that students often have difficulty when they take notes and follow lessons during the use of the interactive whiteboard, beside the interactive whiteboard increases the interest of students and this situation leads to gripping courses and subjects irrespective of gender.

Gender is seen as the biological characteristics of being either a male or female. The issue of gender inequality in Science, Technology and Mathematics Education has produced inconclusive results, the average gender gap is very small (Statistically insignificant), In Nigeria, the gender difference in mathematics achievement is evident from some replicate studies. Studies like Ocho and Nkpa (2017) found that female students achieved better than their male counterparts in mathematics. While some researchers found significant difference between the performance of males and females with males performing better (Imasuen, 2016; Cobb-Clark & Moschion, 2017 & Johnson

& Kasmer, 2018). On the contrary, some studies discovered that gender is not a significant factor that affects the achievement of students in mathematics (Bunkure, 2016; Khadijatu, 2017; Owan, 2019; Anakpua, Nzeakor & Emefo, 2021). These views appear to be inconclusive making it imperative for further investigation on the issue concerning the influence of gender on students' achievement in mathematics, more especially in the use of interactive whiteboards in teaching mathematics. Obviously, there are a limited number of studies in our country regarding the use of interactive whiteboards in teaching mathematics especially in secondary and tertiary school education. The reason for this limited number of studies is thought to be either non availability of interactive whiteboards in our schools or non-usability of interactive whiteboards available. Despite all these studies, Makraskis & Kostoulas-Makrakis (2012) state that using education for sustainable learning is a big challenge and use of ICT in mathematics is even a bigger one. As use of interactive whiteboards in secondary schools is quite new, the present study is considered to be important in terms of knowing the effects of interactive whiteboards in mathematics instructional delivery.

Purpose of the Study

The following objectives were sought for the study to determine the:

1. effect of interactive whiteboard on the achievement scores of students in mathematics
2. effect of interactive whiteboard on the achievement scores of male and female students in mathematics
3. interaction effect of the method and gender on students' achievement in mathematics

Research questions

Two research questions guided the study:

1. What are the mean achievement scores of students taught mathematics with interactive whiteboard and those taught with conventional method?
2. What are the mean achievement scores of male and female students taught mathematics with interactive whiteboard and those taught with conventional method?

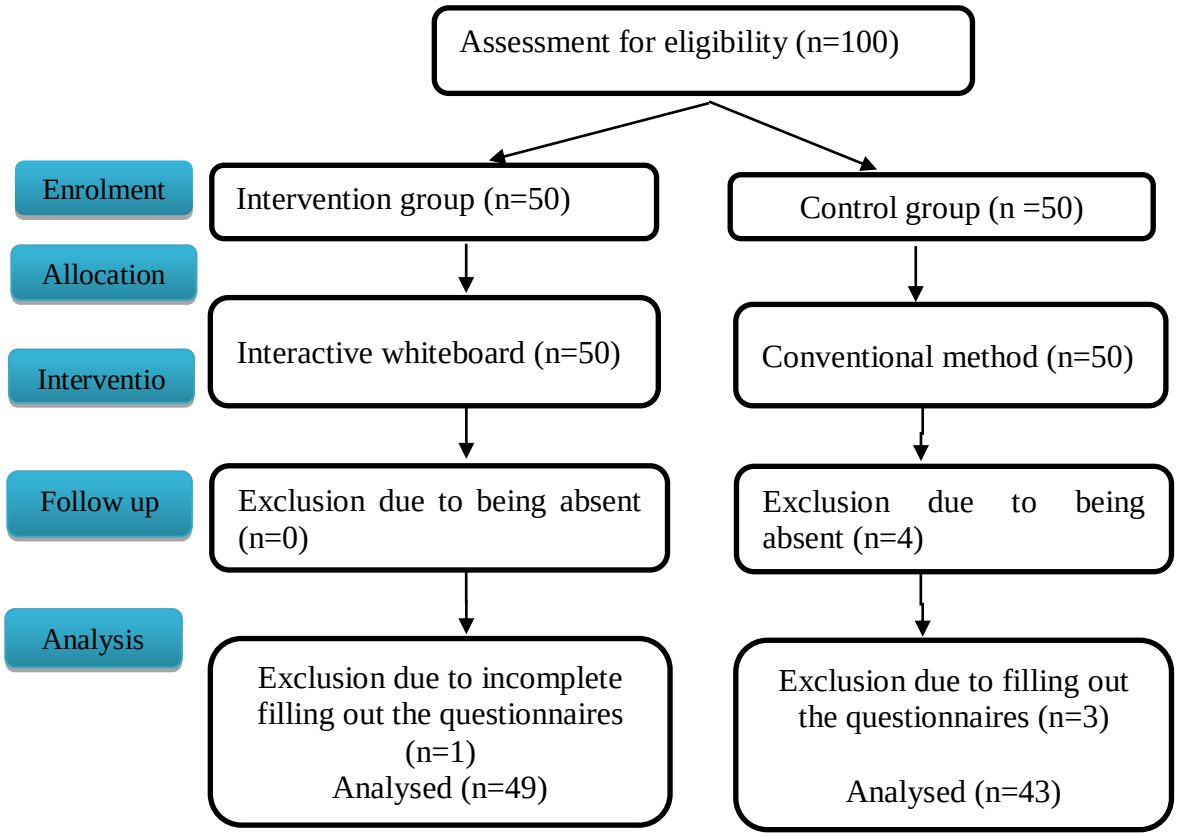
Hypotheses

The following hypotheses were formulated to guide the study:

1. There is no significant difference in the mean achievement scores of students taught mathematics using interactive whiteboard and those taught with conventional method.
2. There is no significant difference in the mean achievement scores of male and female students taught mathematics using interactive whiteboard.
3. There is no significant interaction effect of the method and gender on students' achievement in mathematics.

Methods

The researchers employed quasi-experimental research of pre-test post-test group design. The pretest was used to establish homogeneity of the groups while the posttest was used after the treatment to measure students' achievement in mathematics. This study was carried out in Onitsha Education Zone in Anambra State, Nigeria. The population of this study was 1887 SS11 students (882 males and 1005 females) in Onitsha north local government areas in Onitsha Education Zone. The sample of this study was 93 (45 males and 48 females) SS11 students in two intact classes drawn from the population.



Mathematics Achievement Test (MAT) developed by the researchers was used to collect data for the study. The MAT has two sections A and B. Section "A" sought for the demographic information of the respondents, while section "B" contained 40 multiple choice questions with four response options, A, B, C, and D for each item. Each of the questions in the MAT carried one mark. The test items were on the content taught in the lesson and guided by the senior secondary mathematics curriculum. The Mathematics Achievement Test (MAT) and the lesson plan were subjected to both face and content validation. These were done by three experts in the Department of Science Education, Faculty of Education (two mathematics education experts and one measurement and evaluation expert) all from University of Nigeria, Nsukka. The MAT were trial tested using 40 students in SS11 from a co-education school in Awka Education Zone of Anambra state which is outside the area of the study but share similar characteristics with the area of the study. The trial testing was carried out in order to determine the internal consistency of the items. These were done using Kuder Richardson formula 20. This is because the MAT items were dichotomously scored. The reliability index was found to be 0.81 which is high enough and hence made the instrument reliable for the study. The whole experiment lasted for six weeks, in the first week, the researcher used three days to train the research assistants that are teaching the classes sampled in each of the two sampled schools on how to teach the content using the researchers developed lesson plan. The research assistants teach in their respective classes to avoid experimental bias. While training the research assistants, the researcher through the research assistants administered the MAT to their students in both group. At the second week, the treatment commenced and lasted for three weeks. Week one contained area and perimeter of sector, week two was on surface area of cone and cylinder, and week three was on volume of solid shape and its application in real world problem. After the treatment, the post-test which is the

reorganised form of MAT was administered to the students. The data obtained in this study was analysed using SPSS version 23 and mean and standard deviation was used to answer the research questions and analysis of covariance (ANCOVA) was used to test all the hypotheses at 5% significant level. The use of ANCOVA served as a means of controlling the extraneous variables from the dependent variables, thereby increased the precision of the experiment as well as reduced error of variance. Moreover, the statistical technique of ANCOVA enabled the researchers to adjust the initial group differences (that is, non-equivalence) since intact classes were used.

Result

Research Question One

What are the mean achievement scores of students taught mathematics with interactive whiteboard and those taught with conventional method?

Table 1: Mean and Standard deviation of achievement scores of students taught mathematics with interactive whiteboard and those taught with conventional method

Groups	N	Pretest		Posttest		Mean
		M	SD	M	SD	Difference
Experimental Group	49	10.16	2.44	35.37	3.49	25.21
Control Group	43	10.74	2.24	31.30	7.39	20.56

Result in Table 1 shows that the students taught mathematics using interactive whiteboard had mean achievement score of (M = 10.16, SD = 2.44) at the pretest and mean achievement score of (M = 35.37, SD = 3.49) at the posttest, while students who were exposed to conventional method had mean achievement score of (M = 10.74, SD = 2.24) at pretest and mean achievement score of (M = 31.30, SD = 7.39) at posttest. Mean difference of 25.21 and 20.56 for the experimental and control groups respectively imply that interactive whiteboard had positive effect on the mean achievement scores of students in mathematics.

Hypothesis one

There is no significant difference in the mean achievement scores of students taught mathematics using interactive whiteboard and those taught with conventional method.

Table 2: Analysis of Covariance (ANCOVA) of students' Achievement in mathematics

Dependent Variable: posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	556.052[a]	4	139.013	4.576	.002	.174
Intercept	3171.283	1	3171.283	104.395	.000	.545
Pretest	172.466	1	172.466	5.677	.019	.061
Gender	3.120	1	3.120	.103	.749	.001
Treatment	377.104	1	377.104	12.414	.001	.125
gender * treatment	.109	1	.109	.004	.952	.000
Error	2642.850	87	30.378			

Total	106245.000	92
Corrected Total	3198.902	91

Note: S = Significant, NS = Not Significant, η^2_p = partial eta squared

Result in Table 2 shows that the effect of interactive whiteboard on students' achievement in mathematics was significant ($F(1, 87) = 12.42$, $p < .05$, $\eta^2_p = .125$), hence, the null hypothesis is rejected. This is because the exact probability value of 0.01 is less than 0.05 set as level of significance. Additionally, the effect size of ($\eta^2_p = .125$), shows that 12.5 percent changes in students' achievement scores in mathematics is accounted for by the use of interactive whiteboard. Consequently, inference drawn is that the use of interactive whiteboard in teaching mathematics has a significantly positive effect on students' achievement.

Research Question Two

What are the mean achievement scores of male and female students taught mathematics with interactive whiteboard and those taught with conventional method?

Table 3: Mean and Standard deviation of achievement scores of students taught mathematics with interactive whiteboard and those taught with conventional method

Gender	N	Pretest		Posttest		Mean
		M	SD	M	SD	Difference
Male	36	10.53	2.56	32.67	5.67	22.14
Female	56	10.37	2.24	33.98	6.089	23.61

Result in Table 1 shows that male students taught mathematics had mean achievement score of (M = 10.53, SD = 2,56) at the pretest and mean achievement score of (M = 32.67, SD = 5.67) at the posttest, while female students had mean achievement score of (M = 10.37, SD = 2.24) at pretest and mean achievement score of (M = 33.98, SD = 6.09) at posttest. Mean difference of 22.14 and 23.61 for the male and female students respectively imply that interactive whiteboard had a slight difference in the mean achievement scores of male and female students in mathematics.

Hypothesis Two

There is no significant difference in the mean achievement scores of male and female students taught mathematics using interactive whiteboard.

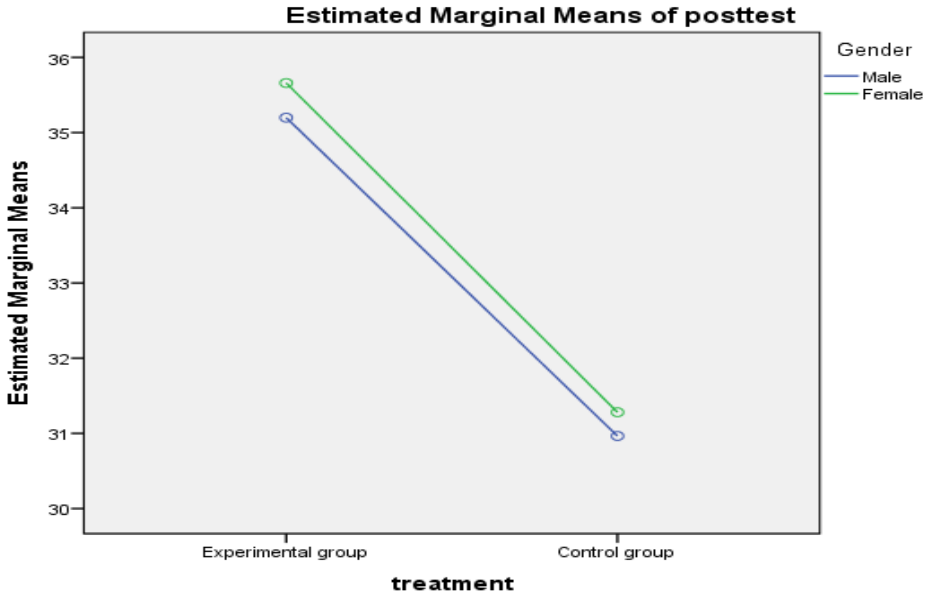
Result in Table 2 shows that the effect of interactive whiteboard on male and female students' achievement in mathematics was not significant ($F(1, 87) = 0.10$, $p > .05$, $\eta^2_p = .001$), hence, the null hypothesis is not rejected. This is because the exact probability value of .749 is greater than 0.05 set as level of significance. Additionally, the effect size of ($\eta^2_p = .001$), shows that the percent changes in male and female students' achievement scores in mathematics accounted for by the use of interactive whiteboard is not significant. Consequently, inference drawn is that interactive whiteboard has no effect on male and female students' achievement in mathematics.

Hypothesis Three

There is no significant interaction effect of the method and gender on students' achievement in mathematics.

Result in Table 2 shows that the interaction effect of the method and gender on students' achievement in mathematics was not significant ($F(1, 87) = .004$, $p > .05$, $\eta^2_p = .000$), hence, the null hypothesis is not rejected. This is because the exact probability value of .952 is greater than 0.05 set as level of significance. Additionally, the effect size of ($\eta^2_p =$

.000), shows that the percent changes in male and female students' achievement scores in mathematics accounted for by the use of interactive whiteboard is also not significant. Consequently, this is an indication that the effect of interactive whiteboard appeared not to have significantly affected the influence of gender on students' achievement in mathematics.



Covariates appearing in the model are evaluated at the following values: pretest = 10.43

Discussion

The purpose of the study was to investigate the effect of interactive whiteboard on students' achievement in mathematics. The findings of this study showed that the students taught mathematics with interactive whiteboard had a higher mean score as against students taught with conventional method. The findings of the study also revealed that the interactive whiteboard had a significant effect on students' achievement in mathematics. This means that teaching mathematics with interactive whiteboard is more efficacious learning approach than the conventional method in improving students' achievement in mathematics. The result of the study was significant due to the fact that the use of interactive whiteboard arouses and sustains students' interest thereby involving them actively during the teaching and learning process. This was confirmed through students' active involvement and participation in the learning process. When students participate actively in a process and relate it to things around them, it widens their understanding thereby making them to retain that which has been learned. This result is consistent with the findings of Nejem & Muhanna (2014), Devita (2014), Tunaboylu and Demir (2017) and Gunduz & Kutluca (2019) who in their different studies revealed that the use of interactive whiteboard is significant in teaching and learning mathematics. The result is also in agreement with Serin (2015) who carried out a study on the effect of interactive whiteboard on students' achievement in physics and found that the use of interactive whiteboard enhances student teachers' achievements and concentrates their students' attention on the physics course. The findings disagree with the study of Tataroğlu (2009), Moss et al. (2007) and Yıldızhan (2013) whom in there different studies revealed that the

use of the interactive whiteboard does not have an impact on academic achievement in mathematics.

Result of the finding also showed that both male and female students that were taught mathematics using interactive whiteboard achieved higher and there is no significant difference between the mean achievement scores of male and female students taught mathematics using interactive whiteboard. This result agrees with the result of Gunduz & Kutluca (2019), who stated that there was no significant difference between achievement of males and females in the experimental group who were taught mathematics using interactive whiteboard. This is in line with (Bunkure, 2016; Khadijatu, 2017; Owan, 2019; Anakpua, Nzeakor & Emefo, 2021) who in there different studies revealed that gender is not a significant factor that affects the achievement of students in mathematics. This finding is in contrary to the result of Johnson and Kasmer (2018) and Cobb-Clark and Moschion, (2017) who found significant difference between the performance of male and female students with male students performing better. This finding is also contrary to the result of Ocho and Nkpa (2017) found that female students achieved better than their male counterparts in mathematics.

Result in Table 2 revealed that that the interaction effect of the method and gender on students' achievement in mathematics was not significant ($F(1, 87) = .004$, $p > .05$, $\eta^2_p = .000$). This is an indication that for enhancement of students' achievement of knowledge in mathematics, gender is not a factor to reckon with in the choice of instructional approach. In other words, the use of interactive whiteboard is gender friendly in terms of achievement in mathematics. The no interaction effect found in this study could be attributed to the fact that since gender is not a significant factor influencing students' achievement in mathematics, there is a very high tendency for the interaction not to affect students' achievement. This therefore, bridges gender disparity in students' academic achievement in mathematics. The finding does not pose any challenge to the school system in the area of streaming of classes on the basis of gender. This finding is in agreement with Sarı and Güven (2013) and Nejem and Muhanna (2014) who in their different studies found that there is no significant interaction effect of treatment and gender on students' achievement in mathematics.

Conclusion

The study shows that the use of interactive whiteboard instructional approach has a significant effect on students' achievement in mathematics. Gender had no significant influence on students' achievement when taught using interactive whiteboard instructional approach. The interaction effect of method and gender on students' achievement in mathematics is not statistically significant. This implies that the use of interactive whiteboard is found viable in teaching mathematics and can be used for teaching both male and female students. The study shows that interactive whiteboard creates an environment of involvement and active learning. It also helps students to become more engaged in learning and retain more information, thus giving them satisfaction.

Recommendations

Based on the findings of this study and the conclusion reached, the following recommendations are made:

1. Mathematics teachers should adopt the use of interactive whiteboard during instruction so that learners could be guided to learn meaningfully.

2. Seminars, workshops and conferences should be organized by the ministry of education for mathematics teachers to educate them on how to use interactive whiteboard for effective instructional delivery in classroom.

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