

EFFECT OF INTERACTIVE WHITEBOARD ON STUDENTS ACADEMIC ACHIEVEMENT IN MATHEMATICS IN ONITSHA NORTH L.G.A OF ANAMBRA STATE.

by

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Abstract

The essence of teaching mathematics is to equip student with skill that will help them provide solution to myriad of problems in the society. Despite the importance attached to the teaching of mathematics in secondary school, the academic achievement of students in the subject has not been impressive. This study was designed to determine the effect of interactive whiteboard based instructional model on students' academic achievement in mathematics in In Onitsha North L.G.A of Anambra State. The study employed a quasi-experimental design. The sample for this study comprised one hundred SS2 Students. Two intact class consist of fifty students were randomly assigned to the experimental and fifty to control group. The experimental group was taught mathematics using the interactive whiteboard instructional model while the control group was taught mathematics using the lecture method. Three research questions guided the study. Three null hypotheses were formulated and tested at .05 level of significance with analyses of covariance (ANCOVA). The instrument Mathematics Achievement Test (MAT) was constructed, validated and reliability of internal consistency was established (.87) using K-R 20 before data collection. The research questions were answered using mean and standard deviation while the hypotheses were tested at ($P < .05$) using analysis of covariance (ANCOVA). The result revealed that the interactive whiteboard based instructional model is superior to the lecture method in improving achievement among the students in mathematics. Based on these, some recommendations were made which include; that seminars and workshops should be organized by government and relevant professional bodies like ASSEREN, STAN to educate and sensitize the teachers on the proper use of the interactive whiteboard based instructional model. An urgent curriculum review to reflect the Nigerian culture and environment in secondary school curriculum was also recommended.

Key words: interactive whiteboard, mathematics, test, gender, academic achievement

Introduction

Mathematics is one of the key subjects at both the primary and secondary school education system in Nigeria. According to the Federal Republic of Nigeria (2014), mathematics is a compulsory subject taught at the primary and secondary levels of education in Nigeria. Its

function and relevance to education and the society makes it to be regarded as the bedrock of science and technological development. In view of this, Okafor (2013) argued that no nation can develop scientifically and technologically without proper foundation in mathematics.

In spite of the importance and usefulness attached to mathematics, Kurumeh (2006) reported that students achieved poorly in public examinations in mathematics. For instance, in Nigeria, from 2016-2019 the percentage pass with credit and above in mathematics were 23.0%, 31.0%, 24.94% and 38.98% respectively (Kurumeh & Imoko 2017; Moseri 2018; Iyi 2019). Also, the chief examiner's report (2017-2019) from West African Examination Council (WAEC) shows that students' achievement in senior school certificate examination SSCE May/June in Mathematics has not been encouraging. Nwankwo (2011), reported that the poor achievement of students in mathematics is as a result of ineffective instructional skills and methodologies by mathematics teachers and students' fear for the subject. Azurku (2006) and Tukur (2007) noted that mathematics classes in the state secondary schools are overcrowded, most times one finds a single teacher in a class with about one hundred (100) students which lead to use of ineffective teaching method. John (2003) argues that students' attitudes towards learning mathematics in Nigeria secondary schools are not encouraging, both at the junior and senior secondary school which is the preparation of students for higher education

An interactive whiteboard (IWB) also commonly known as Interactive board or Smart board is a large interactive display in the form of a whiteboard. It can either be a stand-alone touchscreen computer used independently to perform tasks and operations, or a connectable apparatus used as a touchpad to control computers from a projector. They are used in a variety of settings, including classrooms at all levels of education, in corporate board rooms and work groups, in training rooms for professional sports coaching, in broadcasting studios, and others. Interactive whiteboards operate on the connection between a computer, a projector and a touch screen electronic whiteboard. At the heart of the interactive whiteboard lies a touch screen smart board (Klammer, 2011) which students can use the touch screen whiteboard to experiment, solve, write and erase applications such as visual experiments, visuals, animations and graphics. Electronic microscopes, multimedia materials, videos, data tables, CD ROM, or the Internet may be used depending on the software programmes used by these whiteboards (Miller, Glower & Averis, 2005).

The usage of interactive whiteboards in education and its effect on achievement have been the subject of many research studies. According to Oktay and Hüseyin (2011) measured effectiveness on students at various age levels such as kindergarten, primary and secondary school and university in the field of mathematics, science and language learning and how educational environment, enriches support benefits of the interactive board. According to Peker (2015) the benefits of using new technologies in mathematics education as well as increasing the success, are seen as important in respect to positive attitudes towards math, increasing attention, unease towards mathematics courses and fear reduction and, more importantly, analytical and effective thinking habits (Alakoç, 2013). On the other hand, Moffat (2010) taught geometry topics with educational games on the interactive whiteboard and investigated the effect in the understanding of the issues and found that using of interactive whiteboard makes it easy to grasp and understanding of geometry. Ceren and Ergul (2017) has determined that use of interactive whiteboard increases students' interest, participation and motivation in their study in order to determine the views of teachers who used interactive whiteboards in science and mathematics education. Akçayı (2011) claims that the use of an interactive whiteboard in the teaching and learning process has an important influence on mathematics achievement of students, attitudes toward mathematics, motivation and also more problems

have been solved in classes where the interactive whiteboard technology is used. 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. Turel and Johnson (2013) examined the impact of using the interactive whiteboard on attitudes towards mathematics and achievement, and they reached the conclusion that using the interactive whiteboard in mathematics lesson increases achievement in mathematics lesson and attitude towards mathematics.

On the other hand, Turel (2011) has explored how the use of the interactive whiteboards in mathematics education affects mathematics achievements of secondary school students, attitudes towards mathematics course and their level of self-sufficiency. The findings have shown that the use of the interactive whiteboard does not have an impact on academic achievement and self-efficacy but it has a positive impact on levels of attitudes toward mathematics lesson. In the result of his study related to Effect of Smart Board on Mathematics Success in Basic Education, Uzun (2014) has determined 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, according to Adeney (2011), is a socially ascribed attribute, which differentiate feminine from masculine. A number of studies have verified the influence of gender on mathematics achievement and retention of students. Imiko (2014) and Timothy (2011), in their separate research works found out that female student score higher than their male counterparts. This result is contrary to the findings of Olagunju (2001), Aiyedum (2010) that stated that performance or achievement does not depend on sex. Agwagah (2014) and Timothy and Awodi (2014), in their separate research works found out that female student score higher than their male counterparts. The above literature revealed that gender bias, still exist in Nigerian education system.

Statement of the Problem

The indispensability of mathematics in the development of our society has been universally acknowledged, although the output of its teaching and learning is still not encouraging. Literature is replete with evidence that teachers' use of ineffective method in mathematics teaching has contributed to students' poor achievement in mathematics. Conventional method, which was revealed to militate against students' participation, interest and motivation in the learning process and results in their poor achievement, is still commonly used by mathematics teachers in Nigeria and Anambra State in particular.

There is need therefore, to search for a better method that will demystify mathematics. This is to ensure that students achieve what they are expected to learn in a given lesson. This prompted the quest for an innovation method like interactive whiteboard based instructional model (IWB). Some researchers have embraced the interactive whiteboard instructional model and it had worked so well in improving achievement of all categories of students in science subjects.

Some researchers found out discrepancies in the achievement of males and females when taught using IWB. Some researchers were of the opinion that males achieved higher than the females which some were that females achieved higher than the males while some researchers noted that achievement does not depend on sex. Secondly, there has not been any work in mathematics known to the researchers done with IWB in Onitsha North Local Government

Area (L.G.A) and on secondary school II students (SSS2). Hence, the present study is therefore designed to determine the effect of interactive whiteboard instructional model (IWB) on students' academic achievement in mathematics in Onitsha North L.G.A of Anambra State.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught mathematics with interactive whiteboard based instructional model (IWB) and those taught with conventional teaching method?
2. What are the mean achievement scores of male and female students taught mathematics?
3. What is the interaction effect of gender and treatment on the students' achievement in mathematics?

Hypothesis

1. There is no significant difference between the mean achievement scores of students taught mathematics with interactive whiteboard based instructional model and those taught with conventional teaching model.
2. There is no significant difference between the mean achievement scores of male and female students in mathematics.
3. There is no significant interaction effect of treatment and gender on students' achievement in mathematics.

Research Method

Research Design

This study adopted quasi-experiment of pretest-posttest randomized control group design. This design according to Nworgu (2015) is the one subjects are randomly experimental and control groups. This design is more appropriate for this study because the administrative set up in the schools allow for intact classes to be used for experimental and control group. Figure 1 presents the research design.

Fig 1: Quasi –Experimental Design

E	O ₁	X ₁	O ₂
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C	O ₁	-	O ₂

Where E represents the experimental group taught using interactive white board, C represents the control group that was taught with the traditional lecture method. O₁ represents the test administered on the subjects before treatment. X₁ represent treatment and O₂ represents the test administered on the subjects after treatment.

Area of the Study

This study was conducted in Onitsha North Local Government Area of Anambra State.

Sample and Sampling Techniques

The sample for this study was made up of 100 S.S.2 secondary students, 60 female and 40 male students. Two intact classes consist of fifty students each, were randomly assigned to the experimental and control group.

Instrument for Data Collection

One instrument was used to gather data for the study. The researchers constructed 50 multiple choice questions in mathematics (2marks for each correct answer). The items haveonly one

correct option. The students were expected to select only one option for each question and write the letter corresponding to that option on the answer sheet that would be provided to them. A test blue print which specifies the level of objectives and course content was constructed and used to select the test items that formed the instrument. The treatment package was designed for the experimental group.

Validation of the Instrument

Face and content validation were established for the instrument. Three copies of the initial draft of 50 items with the table of specification were given to three experts in measurement, evaluation and research for validation. These resource persons were requested to vet the items in terms of clarity of words, appropriateness to the class level and plausibility of the distracters. For content validity, the use of a well-constructed table of specification in constructing the items and the contributions of the experts helped to ensure the content validity of the instrument.

Reliability of the Instrument

The instrument was trial tested on twenty (20) students of the same academic status as the sample used for the study in Anambra East Local Government Area outside the study area so as to ascertain its true consistency. The responses of the students were subjected to a reliability test so as to determine the degree of internal consistency of the items using the K-R 20 coefficient of internal consistency. The K-R 20 was used because Kline (2018) argued that it required single administration of instrument and is dichotomously scored. The reliability coefficient of the instrument is 0.87, hence the instrument was considered reliable for the study.

Experimental Procedure

The pre-test was first administered on the subjects before treatment to ensure homogeneity of the subjects. In the pre-test, the instrument was administered on the participants by the teacher (research assistants) in the school, the mathematics teachers marked the script using marking scheme prepared by the researchers. Each script was vetted and totaled section by section by the researchers. Each participant's score in a section of the instrument was entered against his or her name. After the treatment which lasted for six weeks that covered six topics in mathematics, the same instrument was re-administered for the post-test.

The conditions of the testing indicated in the instrument were strictly observed in both the experimental and control groups. In the group that served as control, uniform lesson notes with the same instructional objectives were used for instruction as prepared by the researchers. This was to ensure uniform implementation of the content and check teacher's effect. The two research assistants in the groups were used to teach the students. Also uniform discussion guides prepared by the researchers were used by the two research assistants in the experimental group. Traditional teaching method was used for teaching the control group as a base for establishing the effect of treatment

Control of Extraneous Variable

The extraneous variables which may introduce bias to study are controlled by adopting the following procedures:

Experimental Bias

One of the major sources of effect on the study is the experimental bias which is introduced when the experimenter becomes the teacher. To control this, the researchers made use of two research assistants for the study. Also, to reduce the effect, the same units of instruction were

used for the two groups involved in the implementation of the interactive whiteboard strategies for the experimental group as an experimental variable.

Initial Group Differences:

To control this initial group differences the subject in the group, an analysis of covariance (ANCOVA) was applied in analyzing the data from the study, using the pre-test scores as covariates to the post-test scores.

Teacher Variable:

To control the teacher variable for this study, the researchers organized two days training for the two research assistants so that differences in the effectiveness of individual teachers were made to follow the lesson plans strictly.

Novelty Effect:

Novelty effect is created when a new teaching or instructional material is introduced in the teaching-learning endeavour. This effect may be positive or negative in nature. The presence of an experimenter for instance, would create this novelty effect on the students, in order to minimize that, the mathematics teachers (research assistants) of the students were used for the study.

Pre-test sensitization:

For the fact that the same instrument was used for the study as pre-test and posttest, test-wise students were likely become familiar with the test instrument thereby introducing error in the study. For that, all the instruments were collected by the researchers after pre-testing and kept until the day of posttest and students were not informed that there will be any such. Moreover, the duration before the posttest (two weeks) is enough to diminish any effect of pre-test.

Method of Data Analysis

The data were analyzed using mean, standard deviation and analysis of covariance (ANCOVA). All hypotheses were tested at .05 level of significance. A probability less than .05 indicates that the hypothesis is significant otherwise not significant. A score of 55 and above in the achievement test indicates that the treatment is effective.

Results

Data analysis is in accordance with the research questions and the hypotheses that guided the study.

Research Question One: What are the mean achievement scores of students taught mathematics with interactive whiteboard based instructional model and those taught with conventional teaching method?

Table 1: Mean and standard deviation of achievement scores of students taught mathematics with interactive whiteboard based instructional model and those taught using convectional teaching method

Group	Pre-test			Post-test		
	Number	Mean	SD	Mean	SD	Mean Gain
Experimental	50	23.6	6.3	55.9	8.5	32.3
Control	50	22.4	7.4	49.5	5.9	27.1

Table 1 shows that the students that were taught mathematics with interactive whiteboard based instructional model had mean achievement score of 55.9 with a standard deviation of 8.5 at the post-test while those that were taught using conventional teaching method had mean achievement score of 49.5 with a standard deviation of 5.9. Mean gain scores of 32.3 and 27.1 for the two groups respectively imply that the students that were exposed to mathematics with interactive whiteboard instructional model achieved higher than their counterparts.

Research Question Two: What are the mean achievement scores of male and female students taught mathematics?

Table 2: Mean and standard deviation of achievement scores of male and female students in mathematics

Group	Pre-test			Post-test		
	Number	Mean	SD	Mean	SD	Mean Gain
Male	40	23.8	7.0	52.3	7.2	28.5
Female	60	22.5	6.8	53.1	8.5	30.6

Table 2 reveals the achievement mean scores of male and female students in mathematics. It shows that male students had post-test mean achievement score of 52.3 with a standard deviation of 7.2 while their female counterparts had post-test mean achievement score of 53.1 with a standard deviation of 8.5. Mean gain scores of 28.5 and 30.6 for the male and female students respectively may have indicated that female students achieved higher than the male counterparts.

Research Question three: What is the interaction effect of gender and treatment on the students' achievement in mathematics?

Table 3: Mean and standard deviation of achievement scores of students' for the interaction effect of gender and treatment

Group	Gender	Number	Pre-test		Post-test	
			Mean	Std.D	Mean	Std.D
Experimental	Male	21	25.5	7.8	55.3	8.1
	Female	29	22.3	6.9	56.4	8.9
Control	Male	19	21.8	5.6	48.6	3.5
	Female	31	22.7	6.7	50	7.0

Table 3 shows the interaction effect of gender and treatment on students' achievement in mathematics. It shows that male students of the experimental group had a post-test mean score of 55.3 with a standard deviation of 8.1 while the male students of the control group had a post-test mean score of 48.6 with a standard deviation of 3.5. Similarly, female students of the experimental group had a post-test mean score of 56.4 with a standard deviation of 8.9 while female students of the control group had a post-test mean score of 50 with a standard deviation of 7.0. This shows that both male and female students of the experimental group had higher post-test mean scores than the male and female students of the control group.

Hypothesis One: There is no significant difference between the mean achievement scores of students taught mathematics with interactive whiteboard based instructional model and those taught with conventional teaching method.

Table 4: Analysis of Covariance of the effect of interactive whiteboard based instructional model on students' achievement in mathematics

Tests of Between-Subjects Effects

Dependent Variable: posttest

Source	Type III SS	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1071.786 ^a	2	535.893	9.920	.000	.170
Intercept	21230.290	1	21230.290	393.009	.000	.802
Pretest	15.536	1	15.536	.288	.593	.003
Method	1023.206	1	1023.206	18.941	.000	.163
Error	5239.924	97	54.020			
Total	284357.000	100				
Corrected Total	6311.710	99				

a. R Squared = .170 (Adjusted R Squared = .153)

Table 4 shows that the probability associated with the calculated value of F (18.941) for the effect of treatment on students' achievement in mathematics is .000. Since the probability value of .000 is less than the .05 level of significance ($p < .05$), the null hypothesis was rejected. Hence, there is a significant difference between the mean achievement scores of students taught mathematics with interactive white board based instructional model and those taught with conventional teaching method in favour of the experimental group.

Hypothesis Two: There is no significant difference between the mean achievement scores of male and female students in mathematics.

Table 5: Analysis of Covariance of the influence of gender on students' achievement in mathematics

Tests of Between-Subjects Effects

Dependent Variable: posttest

Source	Type III SS	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	77.549 ^a	2	38.775	.603	.549	.012
Intercept	19927.332	1	19927.332	310.057	.000	.762
Pretest	55.123	1	55.123	.858	.357	.009
Gender	28.970	1	28.970	.451	.504	.005
Error	6234.161	97	64.270			
Total	284357.000	100				
Corrected Total	6311.710	99				

a. R Squared = .012 (Adjusted R Squared = -.008)

Table 5 shows that the probability associated with the calculated value of F (.451) for the influence of gender on students' achievement in mathematics is .504. Since the probability value of .504 is greater than .05 level of significance ($p > .05$), the null hypothesis was not rejected. Thus gender has no significant influence on the achievement of students in mathematics.

Hypothesis Three: There is no significant interaction effect of treatment and gender on students' achievement in mathematics.

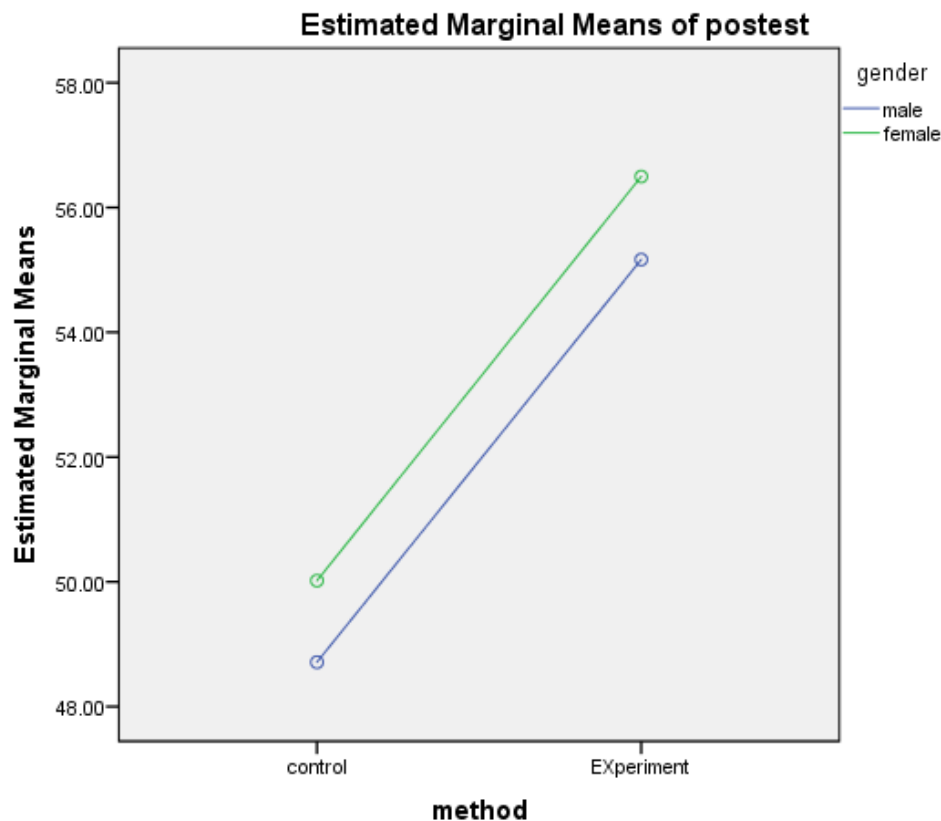
Table 6: Interaction effect of treatment and gender on students' achievement in mathematics.
Tests of Between-Subjects Effects

Dependent Variable: posttest

Source	Type III SS	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1113.156 ^a	4	278.289	5.086	.001	.176
Intercept	20195.393	1	20195.393	369.054	.000	.795
Pretest	19.706	1	19.706	.360	.550	.004
Method	986.994	1	986.994	18.037	.000	.160
Gender	41.363	1	41.363	.756	.387	.008
method * gender	.003	1	.003	.000	.994	.000
Error	5198.554	95	54.722			
Total	28437.000	100				
Corrected Total	6311.710	99				

R Squared = .176 (Adjusted R Squared = .142)

Table 6 reveals that the calculated value of F (.000) for the interaction effect of treatment and gender on students' achievement in mathematics has a probability value of .994. Hence, there is no significant interaction effect of treatment and gender on students' achievement in mathematics since the probability value is greater than the .05 level of significance ($p > .05$).



Covariates appearing in the model are evaluated at the following values: pretest = 23.0000

Discussion and Conclusion

Results of data analysis have shown that students taught with interactive whiteboard perform significantly better in mathematics achievement test than their counterparts who were taught using the convectional teaching method. This result is in agreement with the result of earlier studies carried out. Erduran andTataroğlu (2009) have found out that use of interactive whiteboard increases students' interest, participation and motivation in their study in order to determine the views of teachers who used interactive whiteboards in science and mathematics education. Akçayı (2011) study also affirmed that the use of an interactive whiteboard in the teaching and learning process has an important influence on mathematics achievement of students, attitudes toward mathematics, motivation and also more problems have been solved in classes where the interactive whiteboard technology is used. 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. The lecture method often subjects the learner to the position of the passive recipient of the facts as handed down to him by the teacher.

The result of the study also revealed that female students had a higher mean score on achievement than their male counterparts taught mathematics using interactive white board based instructional model. Hence female performed better than their male counterparts in mathematics. This agreed with the findings of Imiko (2014) and Timothy (2014), in their separate research works found out that female students scored higher than their male counterparts. This result is contrary to the findings of Olagunju (2011), Aiyedum (2010) that stated that performance or achievement does not depend on sex. Agwagah (2014) and Ibe (2014), in their separate research works found out that female students scored higher than their male counterparts. The finding of this study revealed that gender bias, still exist in Nigerian secondary schools.

It has been established in this study that there is no significant interaction effect of treatment and gender on students mean score in the post achievement test. The finding of this study is in agreement with Obiekwe (2008) who found no interaction effect between gender and instructional model. However, the finding of the study disagrees with Turel (2011) who found out that the achievement of male and female students may not vary due to variation in the instructional model. White interactive board based instructional model is activity oriented and the learners are allowed to learn at their own rate, offering the learner the unique opportunity to read, work, accept and internalize the basic mathematics concepts at their own pace. The approach equally allows learners the knowledge of immediate feedback which serves as a great motivation propelling learners to want to learn more.

Recommendations

Based on the findings of the study, the researchers made the following recommendations:

1. Interactive whiteboard based instruction should be adopted in school system. The current school curriculum should be reviewed in terms of basic instructional approaches to incorporate basic interactive whiteboard materials, concepts and paradigms in a systematic and well-articulated fashion so that mathematics instruction will be improved in our school system.
2. Teachers should be trained on the use of the model through workshops and seminars by professional bodies like ASSEREN, STAN etc.
3. The lecture method approach should be de-emphasized in school system. This study has revealed its inadequacy in improving achievement

4. The school should provide white interactive board to enhance effective teaching and learning

References

- Adeney, A. K. (2011). The effects of using an interactive whiteboard on the academic achievement of university students. *Asia-Pacific Forum on Science Learning and Teaching*, 11, (4), 9-19
- Agwagha, A. K. (2014). The effects of using an interactive whiteboard on the academic achievement of mathematics students. *Education Research*, 12 (2), 1-19.
- Akayi, O.K. (2011). The effects of using an interactive whiteboard on the academic achievement of university students. *Asia-Pacific Forum on Science Learning and Teaching*, 9, (4), 7-19
- Alakoç, Z. (2003). Matematiköğretimindeteknolojik modern öğretimyaklaşımları. *Turkish Online Journal of Educational Technology*, 2(1), 43-49.
- Ayedum, A. P. (2010). The effects of using an interactive whiteboard on the academic achievement of university students. *Education Research*, 10 (2), 1-19.
- Azurku, T. G. (2006). Linear measurement in elementary school. *Arithmetic Teacher*, 21, 520-526.
- Ceren, T. & Ergül, D. (2017). The Effect of teaching supported by interactive whiteboard on students' mathematical achievements in lower secondary education. *Journal of Education and Learning*; 6(1), 81-94.
- Ekici, M. P. (2008). The effects of using an interactive whiteboard on the academic achievement of university students. *Asia-Pacific Forum on Science Learning and Teaching*, 10, (4), 5-19
- Federal Republic of Nigeria (2014). *Revised. National policy on education*.
- Be, E. (2014). Effect of guided inquiry, demonstration and conventional methods of teaching science on acquisition of science process skills among senior secondary school students. *An unpublished M.Ed Thesis*, department of science education, university of Nigeria, Nsukka
- Imiko, B.I. (2014). Effect of concept mapping on student's achievement and interest in trigonometry. *Unpublished Ph.D Thesis*. Faculty of education University of Nigeria Nsukka.
- John, F. H. (2003). Effect of periodic self-evaluation on student achievement. *Journal of Educational Psychology*, 49, 197-199.
- Klammer, M. P. (2011). The effects of using an interactive whiteboard on the academic achievement of university students. *Asia-Pacific Forum on Science Learning and Teaching*, 12, (4), 7-19.
- Kurumeh, N.P. & Imoko, M. (2017) Reading and computation ability as determinants of problem solving. *Arithmetic Teacher*, 11, 18 -22.
- Kurumeh, N.P. (2006). Effects of Ethnomathematics Approach on Students Achievement and Interest in Geometry and Mensuration. *Journal of Educational Psychology*, 4, 191-199.
- Moffat, H. (2010). The effects of using an interactive whiteboard on the academic achievement of secondary school students. *Education Research*, 12 (2), 1-19.
- Moseri, B.T. (2018). The Relationships among the development of counting, number Conservation and basic arithmetic abilities. *Dissertation Abstracts International*, 39, 6640A - 6641A.
- Nwankwo, D. J. (2011). Induced versus spontaneous attainment of concrete operations and their relationship to school achievement. *Journal of Educational Psychology*, 67, 576-580.

- Obiekwe, C.L (2008). Effects of constructivist instructional approach on students' achievement and interest in basic- ecological concepts in biology. *Unpublished M.ED thesis*, Department of Science Education, University of Nigeria, Nsukka.
- Okafor, R. J. (2013). Reading and mathematics. *Mathematics Teacher*, 54, 149-157.
- Oktay A. K. & Hüseyin M. P. (2011). The effects of using an interactive whiteboard on the academic achievement of university students. *Asia-Pacific Forum on Science Learning and Teaching*, 4(6), 1-19.
- Olagunju, A. K. (2011). The effects of using an interactive whiteboard on the academic achievement of secondary school student. *Education Research*, 13 (2), 11-19.
- Peker P. (2015). The effects of using an interactive whiteboard on the academic achievement of university students. *Education Research*, 12 (2), 1-10.
- Timothy, A. K. (2014). The effects of using an interactive whiteboard on the academic achievement of secondary school students. *Education Research*, 10 (2), 1-19.
- Tukur, V. B. (2007). Achievement in and attitude toward high school mathematics with respect to sex and socio-economic status. *Dissertation Abstract International*, 41 (5), 1812A.
- Türel, Y. K. (2011). An interactive whiteboard student survey: Development, validity and reliability. *Computers and Education*, 57(4), 2441-2450.
- Türel, Y. K., & Johnson, T. E. (2012). Teachers' belief and use of interactive whiteboards for teaching and learning. *Educational Technology & Society*, 15(1), 381-394.
- Uzun, S. B. S. Ç. (2014). Mathematics teachers' views on interactive whiteboard use in their courses: A sample of Artvin province. *Elementary Education Online*, 13(4), 1278-1295