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Effects of Geometry Interactive Software on Secondary School Students' Achievement in Geometry in Wukari Local Government Area, Taraba State, Nigeria

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Abstract: This study used Geometry Interactive software (GIS) to ascertain students' geometry achievement at senior secondary school one (SS1). Quasi-experimental design of non-randomized pre-test post-test control group design was utilized. The research was carried out in Wukari Local Government Area of Taraba State with a population of 1,003 senior secondary one students. From this, 68 students were sampled from two schools out of nine governments owned senior secondary schools. The research instrument was Geometry Achievement Test (GAT). The reliability of the instruments was 0.85. Four research questions were asked and answered with means and standard deviations while the four hypotheses formulated were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. The study found among others that students taught using Geometry Interactive Software (GIS) improved in their achievement in geometry more than those taught geometry using conventional strategy. Recommendations such as incorporating Interactive Software (IS) among instructional strategies for teaching mathematical concepts as well as encouraging Proprietors of schools to purchase interactive software for their students in the schools were made among others.

Keywords: Geometry Interactive software, Achievement, Geometry, Secondary School Students.

I. INTRODUCTION

The study of Mathematics in Nigeria has continued to generate a great deal of interest to the general public. The fact that the average Nigerian child under-achieve in Mathematics is a source of serious concern to educationists, parents and the general public. Mathematics is the science that deals with the logic of shape, quantity and arrangement. Mathematics is all around us and in everything we do. It is the building block for everything in our daily lives, including computer devices, architecture (ancient and modern), art, money, engineering, and even sports. Mathematics occupies a central place in the Nigerian educational system (Iji, Honmane & Omenka, 2016). The importance of mathematics to nation building has led the Federal Government of Nigeria to make Mathematics a core subject to be offered by students at the basic and secondary education in Nigeria. Federal Republic of Nigeria,(FRN 2013).

Mathematics provides the structure and methodology for the study of virtually all the important modern disciplines, and also provides an important key to understanding of the world in which we live (Abakpa, Anyor & Olaifa, 2017). Mathematics was further expressed as the prime instrument for understanding and exploring the scientific, technological, economic, social and information world (Zakariyya, 2014). Despite the importance attached to mathematics as key subject in realizing any nation's scientific and technological aspiration, it has experienced a flood of persistent high failure (Onah, 2015). This may be due to lack of innovative pedagogical strategy that will enable teachers meet the challenges of teaching of the subject especially in this era of information age.

From the National Curriculum for senior secondary schools, Ramatu (2014), observed that, mathematics is divided into five sections which include: Number and Numeration; Algebraic processes; geometry, statistics and probability. The focus of this study is on geometry. This is because the West African Examination Council (WAEC, 2016) Chief Examiner reported that candidates were observed to be generally weak in geometry. Geometry is a branch of mathematics of Egyptian origin. Geometry is a science of space, involving, describing and measuring figures theory of ideas and methods by which one can construct and study idealized model of the physical world as well as other real world phenomenon (Iji, Ogbole & Uka, 2014).

Geometry is one aspect of mathematics that is mostly dreaded by the students (Osman, Erhan, Ramazan & Adem, 2015). According to WAEC Chief Examiner's report (2016), Geometry is among the areas students avoid attempting questions on while those who dare it perform poorly. Anyamene, Nwokolo, Anyachebelu and Anemelu **(**2012), observed that students have problems on how to study mathematics. These problems emanate as a result of problems facing the effective teaching and learning of mathematics at all levels of Nigerian educational institutions. Azuka (2013), identified poor teaching methods and lack of knowledge of technological innovations by the mathematics teachers, as the major factors contributing to the low achievement of students in Mathematics.

Achievement refers to the students' present academic skills in Mathematics (Ogunleye & Babajide, 2011). A close examination of the achievement of students in Taraba State in the West African Senior Secondary Certificate Examination (WASSCE) results of ten consecutive years revealed that most students would not get admission into university owing to their failure to obtain credit in mathematics (WAEC, 2007-2016). According to Blackwell, (2014) technology has been seen as a potential solution to increase educational attainment. The use of technology will help students to have a change of attitude in learning mathematics. The teaching methods over the years have revealed that there have been changes from one position to another, many efforts have been made to improve the teaching methods through the use of instructional material such as Interactive software (Onah, 2015).

Software per se refers to a set of instructions or programs instructing a computer to do specific task. Interactive software in the order word refers to software which accepts input from human as it runs (Merriam Webster, 2013). Software or interactive software, that can be used in teaching can be presented in form of Multimedia aided instruction. By Multimedia instruction we mean computer-mediated information that is presented concurrently in more than one medium (Adegoke, 2011). In the words of Onah (2015), the advantages of this computer software in teaching and learning is enormous. This includes the storage of large amount of information, giving immediate feedback to individual learner, presenting the learner with printed and animated diagrams; to mention but a few. Students enjoy attending classes that utilize Multimedia presentation because they find these classes to be more interesting and exciting (Kenyon, 2002). Since the Geometry Interactive Software has been recognized as software that does not recognize gender, but only keeps to instruction, it was necessary to find out if Geometry Interactive Software when used in teaching geometry would lead to bridging of gap between boys and girls in their achievement in geometry.

II. PURPOSE OF THE STUDY

The purpose of this study was to determine the effectiveness of Geometry Interactive Software (GIS) in mathematics classroom. Specifically the study was to:

1. Determine the effect of Geometry Interactive Software (GIS) on Secondary School Students' achievement in geometry.
2. Determine the extent to which the use of Geometry Interactive Software (GIS) can influence achievement among female Students in geometry.
3. Determine the extent to which the use of Geometry Interactive Software (GIS) can influence achievement among male Students in geometry.
4. Determine whether there is a difference in the use of Geometry Interactive Software (GIS) in achievement in Geometry among male and female gender of secondary school students.

III. RESEARCH QUESTIONS

The following research questions were asked to provide guide for the study.

1. What is the difference in the mean achievement scores of SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught using conventional strategy?
2. What is the difference in the mean achievement scores among female SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using conventional strategy?
3. What is the difference in the mean achievement scores among male SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using conventional strategy?
4. What is the difference in the mean achievement of male and female SS1 students taught geometry with Geometry Interactive Software (GIS)?

IV. RESEARCH HYPOTHESES

The following hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores of SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using conventional strategy.
2. There is no significant difference in the mean achievement scores of female SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using conventional strategy.
3. There is no significant difference in the mean achievement scores of male SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using conventional strategy.
4. There is no significant difference in the mean achievement scores of male and female SS1 students that were taught geometry with Geometry Interactive Software (GIS).

V. METHODOLOGY

The research design for this study was quasi-experimental of non-equivalent group. Precisely, the study used a non-randomized pre-test post-test control group design. The subjects of the study were not randomized into experimental and control groups but were left as intact classes. This was to avoid the disruption of the school programmes. However, the study was conducted in Wukari Local Government Area in the southern senatorial district of Taraba State, Nigeria. The population of this study was 1,003, SS 1 students made of 517 male and 486 female of students in nine government Secondary Schools in Wukari Local Government Area of Taraba State. Simple random sampling was used to select two schools for the study. Simple random

sampling (flip of a coin) was used to assign experimental and control groups, one for each of them respectively. The choice of senior secondary one was purposive. This was basically because it is at this level that vigorous academic work begins in preparation for both internal and public mathematics examinations. The sample size for this study was 68 students, because intact class that was used for experimental group has 36 students and intact class that was used for control group has 32 students. The Instrument of the study was Geometry Achievement Test (GAT). It consists of 40 items comprising of 16 lower order questions and 24 higher order questions. These items were developed in accordance with the instructional objectives as it is contained in Senior Secondary School one textbook written by Mathematics Association of Nigeria (2012). The units that were taught during the experiment were covered by GAT.

It was validated by two mathematics teachers, two mathematics educators and one measurement and evaluation experts. It has a reliability index of 0.85, established using Kuder-Richardson (KR-20) formula. The study lasted for four weeks. Data collected and collated were analyzed using mean, standard deviations and Analysis of Covariance (ANCOVA) at 0.05 level of significance.

VI. RESULTS

The results from analysis of data for this study are presented according to the research questions asked and hypotheses formulated.

Research Question 1

What is the difference in the mean achievement scores of SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught using conventional strategy?

Answer to this research question is presented in Table 1.

Table 1: Mean and Standard Deviation of Achievement Scores of SS1 Students Taught Geometry with (GIS) and Those Taught using conventional strategy

Group	N	Pre-test Mean	SD	Post-test Mean	Mean SD Gain
With GIS	36	8.92	2.273	29.44	2.645 20.52
Conventional	32	12.84	1.370	22.41	6.460 9.57
Mean difference		**3. 92**		**7.03**	**3.11**
Total	68				

Table 1 shows that for pre-test, the GIS had a mean score of 8. 92 while the control group had a mean score of 12.84. Their mean difference is 3.92. For post-test scores, the GIS had a mean score of 29.44 while the control group had a mean score of 22.41. Their mean difference is 7.03.

Research Question 2

What is the difference in the mean achievement scores among female SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught Geometry using conventional strategy? Answer to this research question is presented in Table 2

Table 2: Mean and Standard Deviation of Achievement Scores of SS1 Female Students Taught Geometry with (GIS) and those Taught Geometry using conventional strategy

Group	N	Pre-test Mean	SD	Post-test Mean	Mean SD Gain
With GIS	15	8.33	2.47	28.40	2.03 20.07
Conventional	14	13.21	1.25	21.07	5.92 7.86
Mean difference		**4. 88**		**7.33**	**2.45**
Total	29				

Table 2 shows that for pre-test, the GIS female students had a mean score of 8.33 while the control group had a mean score of 13.21. Their mean difference is 4.88. For post-test scores, the GIS female students had a mean score of 28.40 while the control group had a mean score of 21.07. Their mean difference is 7.33.

Research Question 3

What is the difference in the mean achievement scores among male SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught Geometry using conventional strategy? Answer to this research question is presented in Table 3.

Table 3: Mean and Standard Deviation of Achievement Scores of SS1 Male Students Taught Geometry with (GIS) and those Taught Geometry using conventional strategy

Group	N	Pre-test Mean	SD	Post-test Mean	Mean SD Gain
With GIS	21	9.33	2.08	30.19	2.82 20.86
Conventional	18	12.56	1.42	23.44	6.84 10.88
Mean difference		**3. 23**		**6.75**	**3.52**
Total	39				

Table 3 shows that for pre-test, the GIS male students had a mean score of 9.33 while the control group had a mean score of 12.56. Their mean difference is 3.23. For post-test scores, the GIS male students had a mean score of 30.19 while the control group had a mean score of 23.44. Their mean difference is 6.75.

Research Question 4

What is the difference in the mean achievement scores of male and female SS1 students taught geometry with Geometry Interactive Software? Answer to this research question is presented in Table 4,

Table 4: Mean and Standard Deviation of Achievement Scores of SS1 Male and Female Students Taught Geometry with (GIS)

Group	N	Pre-test Mean	SD	Post-test Mean	Mean SD Gain
Male	21	9.33	2.08	30.19	2.82 20.86
Female	18	8.33	2.47	28.40	2.03 20.07
Mean difference		**1. 00**		**1.79**	**0.79**
Total	39				

Table 4 shows that for pre-test, the male had a mean score of 9.33 while the female had a mean score of 8.33. Their mean difference is 1.00. For post-test scores, the male had a mean score of 30.19 while the female had a mean score of 28.40. Their mean difference is 1.79.

Research Hypothesis 1

There is no significant difference between the mean achievement scores of SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using conventional strategy. The test result of this hypothesis is presented in Table 5.

Table 5: ANCOVA Result of Achievement Scores of SS1 Students Taught Geometry with (GIS) and those Taught Geometry using conventional strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1416.313[a]	2	708.156	47.873	.000	.596
Intercept	159.389	1	159.389	10.775	.002	.142
Pre Test Achieve	577.112	1	577.112	39.014	.000	.375

Groups	**1397.549**	**1**	**1397.549**	**94.479**	**.000**	**.592**
Error	961.496	65	14.792			
Total	48815.000	68				
Corrected Total	2377.809	67				

a. R Squared = .596 (Adjusted R Squared = .583)

Table 5 shows that P- value of 0.00 was less than the significance level of 0.05. Since the p-value of 0.00 is less than the significance level of 0.05, the null hypothesis of no significant difference was rejected.

Research Hypothesis 2

There is no significant difference in the mean achievement scores of female SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using convectional strategy. The result of this hypothesis is presented in Table 6.

Table 6: ANCOVA Result of Achievement Scores of SS1 Female Students Taught Geometry with (GIS) and those Taught Geometry using conventional strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	618.545[a]	2	309.272	28.423	.000	.686
Intercept	69.225	1	69.225	6.362	.018	.197
PreTestFemale	229.625	1	229.625	21.104	.000	.448
Groups	**580.232**	**1**	**580.232**	**53.326**	**.000**	**.672**
Error	282.903	26	10.881			
Total	18827.000	29				
Corrected Total	901.448	28				

a. R Squared = .686 (Adjusted R Squared = .662)

Table 6 shows that P- value of 0.00 was less than the significance level of 0.05. Since the p-value of 0.00 is less than the significance level of 0.05, the null hypothesis of no significant difference was rejected.

Research Hypothesis 3

There is no significant difference in the mean achievement of male SS1 students taught geometry with Geometry Interactive Software (GIS) and those taught geometry using conventional strategy. The result of this hypothesis is presented in Table 7.

Table 7: ANCOVA Result of Achievement Scores of SS1 Male Students Taught Geometry with (GIS) and those Taught Geometry using conventional strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	812.962[a]	2	406.481	25.152	.000	.583
Intercept	57.511	1	57.511	3.559	.067	.090
PreTestMale	371.876	1	371.876	23.010	.000	.390
Groups	**812.952**	**1**	**812.952**	**50.302**	**.000**	**.583**
Error	581.807	36	16.161			
Total	29988.000	39				
Corrected Total	1394.769	38				

a. R Squared = .583 (Adjusted R Squared = .560)

Table 7 shows that P- value of 0.00 was less than the significance level of 0.05. Since the p-value of 0.00 is less than the significance level of 0.05, the null hypothesis of no significant difference was rejected.

Research Hypothesis 4

There is no significant difference in the mean achievement of male and female SS1 students that are taught geometry with Geometry Interactive Software (GIS).The result of this hypothesis is presented in Table 8.

Table 8: ANCOVA Result of Achievement Scores of Male and Female SS1 Students Taught Geometry with (GIS)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	124.301[a]	2	62.151	17.008	.000	.508
Intercept	1067.386	1	1067.386	292.101	.000	.898
PreExperi	96.251	1	96.251	26.340	.000	.444
Gender	**9.048**	**1**	**9.048**	**2.476**	**.125**	**.070**
Error	120.587	33	3.654			
Total	31456.000	36				
Corrected Total	244.889	35				

a. R Squared = .508 (Adjusted R Squared = .478)

Table 8 shows that P- value of 0.13 was greater than the significance level of 0.05. Since the p-value of 0.13 is greater than the significance level of 0.05, the null hypothesis of no significant difference was not rejected.

VII. SUMMARY OF FINDINGS

The following major findings were based on the data presented in this study:

1. The students taught geometry with GIS improved in their achievement during the period of this study more than those taught without GIS.

2. The use of interactive software in teaching Geometry influence Female SS1 students' achievement in geometry.

3. The use of geometry interactive software in teaching Geometry influence male SS1 students' achievement in geometry.

4. There was no significant difference in the mean achievement scores of male and female SS1 students taught geometry with Geometry Interactive Software.

VIII. DISCUSSION OF FINDINGS

The students taught geometry with Geometry Interactive Software (GIS) improved in their achievement during the period of this study more than those taught without Geometry Interactive Software (GIS). This finding is in line with that of Iyekekpolor (2012), and Ram and Satwant (2017) who also found that students that were taught using Computer Aided Instruction and computer based instruction, achieve higher than those taught with convectional strategy. The reason for the better achievement of students taught with interactive software than those taught without interactive software may most likely be that the students taught with Interactive software had the opportunity of interacting with both real and stimulate material, whereas students taught without interactive software did not. Interacting with the software gave students better opportunity to form their own cognitive models. Using interactive software to learn geometry provides students with access to multiple representations of phenomena and the opportunity to learn geometry in the practical sense. The findings also showed that the adoption of Geometry Interactive Software (GIS) in the Mathematics classroom enhanced male and female SS1 students' achievement in the geometry taught during the period of this study.

Again the findings found that both sexes improved their achievement in geometry with Geometry Interactive Software, though the male improved more than their female counterparts.

However, this difference was not statistically significant. The result confirms the finding of Williams, Charles-Ogan and Adesope (2017) who found that there is no significant difference in the mean achievement scores of male and female students using Geogebra Interactive Software. This implies that if male and female students are given equal opportunities in the learning process using innovative teaching strategies such as geometry interactive software, the educational inequality in our educational system in terms of gender differences especially in mathematics may be addressed.

IX. CONCLUSION

It could be concluded in this study that geometry interactive software enhanced students' achievement in Geometry irrespective of gender. This implies that if mathematics teachers use innovative teaching software such as the geometry interactive software which is found to have enhanced students' achievement, the issue of low achievement in mathematics at the senior secondary school level could improve. Similarly, the gender gap created by continued use of unfavourable conventional teaching method in geometry could also be bridged with geometry interactive software.

X. RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Interactive Software should be incorporated among teaching strategies for teaching mathematical concepts.
2. Proprietors of schools should endeavor to purchase Geometry Interactive Software for their students in the schools.

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