

# Effect of Geometer's Sketch Pad on Senior Secondary School Students' Interest and Achievement in Geometry in Gboko Metropolis

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## ABSTRACT

The study determined the effect of geometer's sketchpad on senior secondary school students' interest and achievement in geometry. The study was carried out in Gboko Metropolis, Benue State Nigeria. A sample of 458 from 4,467 SS1 students was used. A multi-stage sampling technique and quasi-experimental design of non-equivalent group was used for the study. The hypotheses were tested at 0.05 level of significance using a 2- way ANCOVA. Results from the study revealed that students taught geometry using GSP approach achieved higher scores as well as showed greater interest in learning geometry than those taught with conventional approach. The study recommended among others that mathematics teachers should use GSP software's in teaching geometry and other mathematical concepts.

**Key Words:** Interest, Achievement, Interest, Geometry and Mathematics Education

## 1. INTRODUCTION

Teachers of Mathematics are continually challenged to find the most effective method of teaching students. Thus, Mathematics teachers today are finding ways to work with various forms of visual media to help gain and keep students' interest. The Mathematics community worldwide is also seeing potential values in the variety of forms of technology now available. In 2000, the National Council of Teachers of Mathematics (NCTM) found technology to be very important in teaching and learning of Mathematics. Specifically, it states that "technology is essential in teaching and learning of Mathematics as it influences the teaching of Mathematics and enhances students' learning" (Heidi, 2004). As such, the use of technology in the teaching and learning of Mathematics is not

out of place because it plays a major role in changing classroom environment to bring about meaningful and result oriented learning.

The NCTM (1989) suggests in their geometry standards for grades 9–12 (SS1-3) that computer software should be used to promote inductive reasoning among geometry students. "Computer graphics software that allows students to create and manipulate shapes provides an exciting environment in which they can make conjectures and test their attempts at two-dimensional visualization".

Technology should not be seen as a panacea nor should it replace the Mathematics teacher. However, it can enhance the teacher's delivery of lessons as well as facilitate the curriculum and instruction process in the classroom. The

burden of utilizing the technology available today falls on the shoulders of the teacher. It is in light of this that the researcher seeks to find the effect of Geometers' sketchpad on students' interest and achievement.

Geometer's sketchpad (GSP) is a dynamic geometry software program which enables teachers and students to construct and transform geometric objects or components of objects, by dragging different objects across a computer screen. GSP provides immediate feedback, motivates students to think mathematically, and engages students (Deturek, 1993; Jackiw, 1995; Ruthven, 2008). According to Noraini (2009), GSP provides a flexibly structured Mathematics laboratory that supports the investigation and exploration of concepts at a representational level, linking the concrete to the abstract. He further states that many students are not able to comprehend what their Mathematics teachers teach because Mathematics content is taught with the intention of finishing the syllabus and preparing students for examinations. The students' difficulties are especially compounded when the topic is geometry which many students find too abstract and difficult to comprehend or relate to real life situations. According to Stacey (2007), the use of GSP with exploratory technique in the teaching and learning of Mathematics enhances the understanding of geometry. The lack of understanding in learning geometry often discourages students, which invariably might leads to poor achievement in geometry. A number of factors have been put forward to understand why the learning of geometry is difficult. They include: the language of geometry, visualization abilities, and ineffective instruction (Noraini, 2009). Teoh and Fong (2005) state that using dynamic visualization approach helps students to better understand Mathematical concepts taught.

The students' interest in geometry is also another great factor affecting student's achievement in Mathematics. If the students do not have interest in geometry even with the introduction of the above software, the

results of their achievement might not be encouraging. According to More in Tella (2007), various factors have been adduced for poor achievement of students in Mathematics. The interest of students in Mathematics have been related to the volume of work completed, students' task orientation and skill acquisition, students' personality and self - concept. Research on Mathematics achievement should be considered as continuous process until there is evidence of improvement in interest and achievement of learners in the subject particularly the secondary school students (Tella, 2007).

Despite the relevance of mathematics in national development, analysis of school certificate mathematics examination results show that students' have consistently perform low as less than 42% of registered candidates obtain credit pass (Uwadiae, 2010). Consequently, the number of students meeting university requirement yearly in the country is very low, thus, end up forfeiting the pursuit of many careers that should have benefitted them and the country better (Anaduaka & Okafor, 2013). West Africa Examination Council (WAEC) Chief Examiners' report (2014) clearly commented on poor achievement of candidates in geometry aspects of questions. He further stated that, only very few candidates attempted questions on geometry. Perhaps, the candidates' aversion to answering questions on geometry may have been caused by the manner in which geometry was taught. This research seeks to determine how the use of GSP could improve students' interest in geometry and invariably improve their achievement geometry.

It is as a result of the above mentioned unresolved controversy that this research is also aimed at contributing its quota in resolving the differences in achievement and interest of senior secondary school students in geometry among the gender using GSP.

### **1.1 Statement of the problem**

WAEC Chief Examiners' Report (2014) indicates in spite of the seeming improvement of candidates' achievement in mathematics, findings shows that their level of achievement in geometry is still very poor, in comparison with other areas of the subject. Could this be because little regard is given to how well the students understand geometrical concepts? Though a lot of researches have been conducted on students' interest and achievement in geometry using other softwares like Geogebra, Geometrix, Geolog and host of others, most of them focused on practice and drill. Most instructions utilize technology for its own sake. The concern of this study therefore, will be: whether the use of GSP will improve the interest and achievement of students in geometry? Would both genders increase their interest and achievement scores when taught using GSP?

### **1.2 Purpose of the Study**

The main purpose of this study was to determine the efficacy of using geometer's sketchpad on senior secondary one students' interest and achievement in geometry. The specific objectives of the study determined:

- i. if the use of GSP would improve senior secondary one students' interest in geometry.
- ii. if the use of geometer's sketchpad would improve senior secondary one students' achievement in geometry

### **1.3 Research Question**

The following research questions were asked in this study

- i. What are the mean interest ratings of senior secondary one students taught geometry using GSP and those taught using the conventional method?
- ii. What are the mean achievement scores of senior secondary one student taught geometry using GSP and those taught using the conventional method?

### **1.4 Research Hypothesis**

The following null hypotheses were tested at 0.05 level of significance.

- i. There is no significant difference between the mean interest ratings of senior secondary one students taught geometry using geometer's sketchpad and those taught using conventional method.
- ii. There is no significant difference between the mean achievement scores of senior secondary one students taught geometry using geometer's sketchpad.

## **2. RESEARCH METHODOLOGY**

### **2.1 Research Design and Sampling Techniques**

The study is centered on senior secondary school students in Gboko metropolis, Gboko Local Government, Benue State, Nigeria. The research design that was adopted for the study was Pre-test, Post-test quasi- experimental design of non-equivalent group. Intact classes were assigned at random to the experimental and control groups. The design of the study was pretest- posttest group design where the experimental group was taught using geometer's sketchpad while the other group was taught using the conventional method.

Multistage sampling technique was used for the study because different sampling techniques were used at different stages of the study. The sampling techniques used are (a) purposive sampling technique (b) simple random sampling technique.

Purposive sampling technique was used in selecting the four schools. The schools were selected based on the following criteria (i) government approved (ii) availability of a functional computer laboratory (iii) ability of the students to operate computer (iv) mixed school (male and female students). Nine schools met these conditions. Four schools were randomly selected out of the nine schools. Simple random sampling was used to assign schools to experimental and control groups.

### **2.2 Instrumentation, Sample Size and Data Collection**

Two instruments were developed by the researcher for the collection of data namely; Geometry Achievement Test (GAT) and Geometry Interest Inventory (GII). Both instruments were made up of two parts; the bio data of the respondents and questions for the GAT and statements for the GII. The GAT comprised 25 multiple choice items with four options each while GII was made up of 30 items using the 4-point likert scale anchored on Strongly Agree (SA)=4, Agree (A)=3, Disagree (D)=2 and Strongly Disagree (SD)=1 respectively.

The sample for this study was 458 out of 4467 students drawn from four secondary schools out of the 47 government approved secondary schools in Gboko Metropolis.

### 2.3 Method of Data Analysis

Data collated were analyzed using descriptive statistic of mean and standard deviation to answer the research questions while the hypotheses were tested at 0.05 significance level using the analysis of covariance (ANCOVA). The pre-test scores and pre-interest rating were used as covariates to the post test and post interest rating. The choice of ANCOVA was to take care of the covariates and to control differences across the groups.

## 3. PRESENTATION OF RESULTS

Table 2: ANCOVA results of interest ratings of SS1 students taught geometry with geometer's sketchpad and those without GSP.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15.341 <sup>a</sup>	2	7.671	191.404	.000
Intercept	53.289	1	53.289	1.330E3	.000
Pretest interest ratings	.003	1	.003	.064	.801
Groups	15.336	1	15.336	382.689	.000
Error	18.234	455	.040		
Total	4698.356	458			
Corrected Total	33.575	457			

Table 2 show ANCOVA value  $F(1,457) = 382.689$ ,  $P = .000$ ,  $P < 0.05$ . Thus, the null hypothesis is rejected. This implies that GSP arouse more interest in the students to learn geometry than conventional method.

**Research Question 1** What are the mean interest ratings of senior secondary students taught geometry using GSP and those taught using the conventional method? The means and standard deviation of interest ratings is shown in table 1.

Table 1: Means and standard deviation of interest ratings of experimental and control groups

Group	N	Pre GII Mean	SD	post GII Mean	SD
Experimental	248	1.82	0.25	3.36	0.19
Control	210	1.81	0.13	3.00	0.16
Mean difference		0.01		0.36	
Total	458				

Table1 shows that, the mean pre-test geometry interest rating of the experimental group was 1.82 while that of the control group was 1.81. After undergoing geometry lessons using GSP, the mean post-test geometry interest rating of the experimental group was 3.36 while that of the control group was 3.00. The mean geometry interest rating of the experimental group was higher than that of the control group by a geometry interest rating of 0.36.

### Hypothesis 1:

There is no significant difference between the mean interest ratings of senior secondary one student taught geometry using geometer's sketchpad and those taught without GSP. The ANCOVA results of interest ratings of SS1 students taught Geometry with geometer's sketchpad and those without GSP is shown in Table 2.

### Research Question 2

What are the mean achievement scores of senior secondary one student taught geometry using GSP and those taught using the conventional method? The mean and standard deviation of achievement scores of

experimental and control groups is shown in Table 3.

**Table 5: Means and standard deviations of achievement scores of experimental and control groups**

Group	N	Pretest Scores Mean	SD	Posttest Scores Mean	SD
Experimental	248	24.53	9.90	74.28	10.78
Control	210	24.89	9.34	54.31	11.50
Mean difference		0.36		19.97	
Total	458				

Table 3 shows that, the mean pre-test achievement scores of the experimental group was 24.53 while that of the control group was 24.89. After undergoing geometry lessons using GSP, the mean posttest achievement scores of the experimental group was 74.28 while that of the control group was 54.31. The mean scores of the experimental group were higher than that of the control group by a mean score of 19.97.

**Hypothesis 2:**

There is no significant difference between the mean achievement scores of senior secondary students taught geometry using geometers' sketchpad and students taught geometry without GSP. The ANCOVA results of achievement scores of SS1 students taught geometry with geometers' sketchpad and those without GSP is shown in table 4.

**Table 4: ANCOVA results of achievement scores of SS1 students taught geometry with geometer's sketchpad and those without GSP.**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	44724.18	2	22362.09	176.99	.000
Intercept	278582.12	1	278258.12	2202.35	.000
PRETEST SCORES	739.55	1	739.55	5.853	.016
GROUPS	43885.04	1	43885.04	347.34	.000
Error	5748.40	455	126.35		
Total	2039082.00	458			
Corrected Total	102211.57	457			

R Squared = .438 (adjusted R squared = .435)

In Table 4, the ANCOVA value  $F(1,457) = 347.34$ ,  $p = .000$ ,  $p < 0.05$ . The null hypothesis is rejected. It shows that there is a significance difference in the mean achievement scores of senior secondary one students taught geometry in experimental group and control group. This result indicates that the students taught geometry with GSP achieved higher than those taught with conventional method.

**4. DISCUSSION OF RESULTS**

This study assessed the efficacy of using geometers' sketchpad on senior secondary one students' interest and achievement in geometry. The findings were discussed below

**4.3.1 Effect of GSP on Students' Interest in Geometry**

The findings of this study indicates that, there is a significant difference between the mean interest ratings of senior

secondary one students taught geometry using geometers' sketchpad and those taught without GSP. Dekker (2011) documented similar findings when he conducted a research on the effect of Geometer's Sketchpad on student knowledge and attitude at Calvin Christian High School in Grandville, Michigan, United State of America (USA). There were significant differences when looking at difference scores from the pretest and posttest. Similarly, Roberts and Stephen as cited in Heidi (2004) in their studies found that technology use, adds to students' enjoyment and interest, hence the use of technology may be one of the measures taken to improve the senior secondary school students' interest in geometry. The findings of the above stated studies agree with the findings of the present study, hence clearly showing that the use of GSP can improve students' interest in geometry.

### 4.3.3 Effect of GSP on Students' Achievement in Geometry

The result of the study showed that, there is a significant difference between the mean achievement scores of senior secondary students taught geometry using geometers' sketchpad and students taught geometry without GSP. Senior secondary students taught geometry using geometers' sketchpad had higher mean scores than students taught geometry using conventional method. The findings are in agreement with previous investigators. For instance, Noraini (2009) studied the impact of geometer's sketchpad on Malaysian students' achievement and Van Hiele geometric thinking in one of the secondary schools in Perak, Malaysia. The result of the test with  $\chi^2 = 18.72$ ,  $df = 1$ , indicated a significant difference ( $p < 0.1$ ) between treatment and control groups on subjects' change in rank on van Hiele levels from pre-test to post test. In another similar study conducted by Dimakos and Zarani (2010) to investigated the influence of the geometer's sketchpad on the geometry achievement of Greek school students. The t-test for equality of means was significant ( $t = 9.667$ ,  $p < 0.001$ ) indicating significant difference, in mean achievement scores between the experimental and control groups.

The experimental group had higher geometry achievement than the control group, and the difference was statistically significant as in the present study. Kamariah, et al (2009) sees GSP as a dynamic geometry construction and exploration tool, which can make an enormous difference in the students' learning of mathematics. Also, Wenglinisky in Heidi (2004) states that the use of technology can improve students' interest and achievement in geometry.

### 5. CONCLUSION

Based on the result of the study, the following conclusions were drawn: The interest of the senior secondary one students taught geometry with geometer's

sketchpad improved, leading to an improvement in their achievement.

### 6. RECOMMENDATION

The following recommendations were made based on the findings of the study:

1. Mathematics Teachers should always use GSP in teaching geometrical concepts to students to aid their interest in learning.
2. The school authorities should create an enabling environment for Mathematics teachers to access the GSP to enable them teach geometry effectively so as to enhance the interest of both male and female students.

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