Effects of Geogebra Instructional Package on Secondary School Students Achievement in Geometry in Makurdi Metropolis of Benue State

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Abstract: **- The research was concerned with the effects of Geogebra Instructional Package on secondary school students achievement in Geometry in Makurdi Metropolis of Benue State, Nigeria. Two research questions were asked and answered while two hypotheses were formulated and tested at 0.05 level of significance. The design of the study was quasi-experimental design of pretest-post test non equivalent control group. The sample of the study was 205 students. The experimental group was taught using Geogebra Instructional package while the control group was taught using the expository method. The data collected at the end of the research was analysed using descriptive statistics of mean and standard deviation to answer research questions while the hypotheses were tested using analysis of covariance. The result of the study revealed that students taught geometry using Geogebra Instructional Package achieved higher mean scores than those taught using Expository method. The result also revealed no significant difference in the mean achievement scores of male and female students taught geometry using Geogebra Instructional Package.**

Keywords: **Geometry, Geogebra Instructional Package, Achievement**

I. INTRODUCTION

The term geometry was derived from two Greek words 'geo' meaning 'earth' and 'metry' meaning 'measure'. Geometry as a concept involves visual representation of data, for example charts, solid and plane shapes. It is a branch of mathematics that deals with the study of shapes, size and the property of space. According to Russel (2014), the study of geometry provides the learner with many foundational skills and helps to build the thinking skills of logic, deductive reasoning, analytic reasoning and problem solving. He added that, It helps a child in development of aesthetics around his environment as well as inductive reasoning skills. Despite the importance of geometry, it remains one aspect of mathematics that students have perpetually failed in external and internal examinations as it reflects in the foregoing results of West African Examination Council (WAEC) and National Examination Council (NECO). According to Royati, Ahmad and Rohani (2010), the process of learning geometry is a complex and daunting cognitive exercise to the students; it is therefore pertinent that Mathematics educators examine the opportunities of new technologies in other to enhance their teaching, capture the interest of students in the classroom and facilitate their subsequent achievement in mathematics.

Researchers have shown that technology is capable of assuaging the fears of students in learning geometry if appropriately used in the classroom (Zengin & Kutluca, 2012). Apparently, because of these concerns, different researches have been carried out on effective use of different geometry softwares in facilitating teaching and learning in various parts of the world. One of the researches carried out using Mathematics software includes Kesan and Caliskan (2013) who carried a study in Turkey on the use of Geometer Sketchpad in learning geometry. It is in concert with the trend of the use of mathematics software in the class-room and it resultant effect on learning outcomes of students that the researcher adopts Geogebra Instructional package(GIP) to teach secondary school student Geometry and ascertain it effect on their achievement in Makurdi Metropolis of Benue State.

Geogebra Instructional Package is an innovative, open-source mathematics software that can be freely downloaded from www.geogebra.com. It works on a wide spectrum of operating system platforms and was created in 2002 by Markus Hohenwarter and a team of programmers for the teaching and learning of mathematics from middle school through college to university level (Hohenwarter, Hohenwarter & Lavicza, 2010). After the creation of Geogebra at the University of Salzburg, Austria; a lot of research has been carried out on it in Asia, Europe and America. Specifically, teachers in Malaysia, Austria, Germany and North Korea started using Geogebra for teaching concepts in mathematics after it was published on the internet in 2002 (Hohenwarter et al. 2008).

The following research questions were raised to guide the study;

1. What are the mean achievement scores of Secondary School Students' taught Geometry using GIP and expository method in Makurdi Metropolis?
2. What are the mean achievement scores of male and female secondary school students' in the GIP method group?

The following null hypotheses were formulated for the study and were tested at 0.05 level of significance:

HO_1. There is no significant difference between secondary school students' mean achievement scores in Geometry in the GIP and expository method groups in Makurdi Metropolis.

HO_2. There is no significant difference between male and female secondary school students' mean achievement scores in Geometry in the GIP method group in Makurdi Metropolis.

II. METHODOLOGY

The design of the study was quasi-experimental design of pretest-post test non equivalent control group. The sample of the study was 205 students. The experimental group was taught using Geogebra Instructional package while the control group was taught using the expository method. The instrument for collection of data was Geometry Achievement Test(GAT) which was validated by experts in test and measurement and Mathematics Education. The reliability of the instrument was 0.91 and it was determined using Kuder-Richardson formula 21. The data collected at the end of the research was analysed using descriptive statistics of mean and standard deviation to answer research questions while the hypotheses were tested using analysis of covariance.

III. RESULTS

Presentation of results is based on research questions asked and hypotheses formulated.

Research question one

What is the Mean Achievement Score of students taught Geometry using GIP and Expository method in Makurdi metropolis?

Table 1. Mean and Standard deviation of students in GIP and Expository method Group.

Groups	N	PRETEST		POST TEST		MEAN GAIN
		$\bar{\chi}$	SD	$\bar{\chi}$	SD	
GIP	87	15.64	4.87	62.70	8.09	47.06
Expository	118	17.07	4.80	46.03	8.19	28.96

The result presented in Table 1 indicates that the students taught Geometry using GIP had a mean score of 15.64 with a standard deviation of 4.87 in the pretest Achievement Scores and a mean score of 62.70 with a standard deviation of 8.09 in the post test Achievement Scores leading to a mean gain of 47.06. the students taught Geometry using Expository method had a mean score of 17.07 with a standard deviation of 4.80 in the pretest Achievement Scores and a mean score of 46.03 with a standard deviation of 8.19 in the post test Achievement Scores, leading to a mean gain of 28.96.

The result shows that the students taught Geometry using GIP scored higher than those taught with Expository method. However, hypothesis one will be tested to determine if this finding is significant.

Hypothesis One

There is no significant difference between Secondary School Students mean Achievement Scores in Geometry in the GIP and Expository method groups in Makurdi metropolis.

Table 2: ANCOVA test of students taught Geometry in GIP and Expository method groups

Source	Type III sum of squares	Df	Mean square	F	Sig.
Corrected model	13916.203[a]	2	6958.102	104.319	0.000
Intercept	47135.069	1	47135.069	706.671	0.000
Pretest	4.659	1	4.659	0.70	0.792
Groups	13692.323	1	13692.323	205.282	0.000
Error	13473.436	202	66.700		
Total	605569.000	205			
Corrected total	27389.639	204			

Table 2 shows the ANCOVA result on mean achievement scores between the GIP and the Expository method groups. The value under groups shows that $P = 0.00 < 0.05$. This means that the null hypothesis is not accepted. This implies that the students taught Geometry using GIP achieved higher than those taught Geometry using Expository methods.

Research question two

What is the mean Achievement Scores of male and female students taught Geometry with GeoGebra instructional package in Makurdi metropolis?

Table 3. Mean and Standard deviation of male and female students in GIP Group

Group	Gender	N	PRETEST		POST TEST		MEAN GAIN
			$\bar{\chi}$	SD	$\bar{\chi}$	SD	
GIP	Male	42	15.55	5.38	69.26	6.71	53.71
	Female	45	17.42	5.31	71.24	8.89	53.82

The result presented in Table 3 indicates that the male students taught Geometry with GeoGebra instructional package had a mean score of 15.55 with a standard deviation of 5.38 in the pretest Achievement Score and a mean score of 69.26 with a standard deviation of 6.71 in the post test Achievement Score, leading to a mean gain of 53.71. The female students taught Geometry with GeoGebra instructional package had a mean score of 17.42 with a standard deviation of 5.31 in the pretest Achievement Scores and a mean score of 71.24 with a standard deviation 8.89 in the post Achievement Scores, leading to a mean gain of 53.82.

The result shows that the female students scored slightly higher than the male students. However, hypothesis two will be tested to determine if this finding is significant.

Hypothesis Two

There is no significant difference between male and female Secondary School Students mean achievement scores in Geometry in the GIP method group.

Table4: ANCOVA TEST OF MALE AND FEMALE STUDENTS IN THE GIP METHOD GROUP.

Source	Type III sum of squares	Df	Mean square	F	P_{value}
Corrected model	93.835	2	46.918	0.741	0.480
Intercept	38936.063	1	38936.063	615.013	0.000
Pretest	8.450	1	8.450	0.133	0.716
Gender	73.815	1	73.815	1.166	0.283
Error	5317.981	84	63.309		
Total	435219.000	87			
Corrected total	5411.816	86			

Table 4 shows the ANCOVA result of the male and female student mean achievement scores in Geometry in the GIP method group. The table shows that the P_{value} under gender=0.283>0.05. Hence, the null hypothesis is accepted. This means that, there is no significant difference between male and female Secondary School Students mean achievement scores in Geometry in the GIP method group. This implies that both male and female students improved on their achievement in geometry when taught using GeoGebra instructional package.

IV. DISCUSSION

The result presented in Table 1 shows that the Secondary School Students taught Geometry with GeoGebra instructional package had a higher mean achievement scores than the students taught Geometry using the Expository method. This difference in the mean achievement score between the two groups was established to be statistically significant in hypothesis one in Table 2.

This finding indicates that the GeoGebra instructional package enhanced the achievement of Secondary School Students in Geometry more than the Expository method. The findings of this study agree with the findings of Zengin and Kuluca (2012) who carried out a study to determine the effect of GeoGebra on students achievement in Trigonometry in Turkey and found that the students taught trigonometry with GeoGebra achieved higher than those taught with the traditional method.

From Table 3, the result indicates that both the male and female students had a similar entry behavior before the commencement of the treatment. The mean achievements of male and female students in Geometry in the post test were 69.26 and 71.24 respectively. This result shows that the male student had a mean gain of 53.71 while the female students had a mean gain of 53.82. Even though the female students have higher scores in the mean achievement, the mean difference was not statistically significant as it is shown in hypothesis two (2) in Table 4.

This finding shows that GeoGebra instructional package is not gender bias in terms of improving students' achievement in Geometry. This finding is in agreement with Gambari, Falode and Adegbenro (2014) who carried out a study on the effectiveness of Computer Animation and Geometry instructional model on Mathematics achievement and retention on Junior Secondary School Students in Minna, Nigeria and found that, there was no significant difference reported in the post test performance scores of male and female students

taught Geometry using computer animation and instructional model respectively.

V. CONCLUSION

The following conclusions were made based on the findings of this study;

1. The findings of this study provide an empirical support that the study of Geometry using GIP improves students Achievement much more than the Expository method. It is pertinent to note in conclusion that, the achievement of students in Geometry could be significantly improved if Mathematics educators examine the opportunities of new technologies such as GeoGebra instructional package and appropriately utilized them in the classroom.
2. The study empirically shows that both male and female students can achieve high in Geometry if the appropriate medium of instruction is applied in the classroom. Most importantly, the findings of this study revealed that technology is capable of helping students to grasp Mathematics content better and could bridge the gender gap in terms of students' achievement.

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