Effects of Geogebra Instructional Package on Secondary School Students Retention 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 retention 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 instrument for data collection was Geometry Retention Test(GRT) and Geometry achievement Test(GAT).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 retained higher mean scores than those taught using Expository method. The result also revealed no significant difference in the mean retention scores of male and female students taught geometry using Geogebra Instructional Package.

Keywords; **Geometry, Geogebra Instructional Package, Retention**

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 students' Geometry and ascertain it effect on their Retention 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 retention scores of Secondary School Students' taught Geometry using GIP and expository method in Makurdi Metropolis?
2. What are the mean retention 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   retention 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 retention 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) and Geometry Retention Test(GRT) which was validated by experts in test and measurement and Mathematics Education. 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 (ANCOVA).

III. RESULTS

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

Research question one

What are the mean retention scores of students taught Geometry using GIP and Expository method in Makurdi metropolis?

Table1. Mean Scores and Standard deviation of students in GIP and Expository Group.

Groups	N	POST TEST		RETENTIVE TEST	
		$\bar{\chi}$	SD	$\bar{\chi}$	SD
GIP	87	62.70	8.09	59.92	8.94
Expository	118	46.03	8.19	24.22	11.34

The result in Table 1 indicates that the students taught Geometry using GIP had a mean score of 62.70 with a standard deviation of 8.09 in the post Test Achievement Scores and a mean score of 59.92 with a standard deviation of 8.94 in the retention Test Scores. The Expository method had a mean score of 46.03 with a standard deviation of 8.19 in the post test Achievement scores and a mean score of 24.22 with a standard deviation of 11.34 in the Retention Test scores.

The result shows that the students taught Geometry using GIP had a higher mean retentive score than the students taught Geometry using 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 retention Scores in Geometry in the GIP and Expository method groups in Makurdi metropolis.

Table 2: ANCOVA Test of students taught Geometry using GIP and Expository methods.

Source	Type III sum of squares	Df	Mean square	F	Pvalue
Corrected model	32124	2	16062.231	153.811	0.000
Intercept	2404.462	1	2404.462	23.025	0.000
Post test	830.559	1	830.559	7.953	0.005
Groups	10723.643	1	10723.643	102.689	0.000
Error	21094.564	202	104.429		
Total	301900.000	205			
Corrected total	53219.024	204			

Result in Table 2 shows that the P$_{value}$ of Groups is 0.000<0.05. Hence, the null hypothesis is not accepted. This means that there is a significant difference between Secondary School Students mean retention scores in geometry in the GIP and Expository method groups. This implies that the students taught Geometry using GIP had higher mean retention scores than those taught using Expository method.

Research question two

What are the mean retention scores of male and female students taught Geometry with GeoGebra instructional package in Makurdi metropolis?

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

Group	Gender	N	POST TEST		RETENTIVE TEST	
			$\bar{\chi}$	SD	$\bar{\chi}$	SD
GIP	Male	42	69.26	6.71	59.29	6.49
	Female	45	71.24	8.89	60.56	8.17

The result in Table 3 indicates that the male students taught Geometry using GIP had a mean score of 69.26 with a standard deviation of 6.71 in the pot test achievement score and a mean score of 59.29 with a standard deviation of 6.49 in the retentive test scores. The female students taught Geometry using GIP had a mean score of 71.24 with a standard deviation of 8.89 in the post test Achievement Scores and a mean score of 60.56 with a standard deviation of 8.17 in the retentive test scores.

The result shows that the female students had a higher retention mean score than the male students. However, hypothesis 2 will be tested to determine if the result is significant.

Hypothesis Two

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

Table 4: ANCOVA TEST OF MALE AND FEMALE STUDENTS SCORES IN GIP

Source	Type III sum of squares	Df	Mean square	F	Pvalue
Corrected model	3938.448a	2	1969.224	218.149	0.000
Intercept	0.52	1	0.52	0.006	0.940
Post test	3903.418	1	3903.418	432.418	0.000
Gender	3.905	1	3.905	0.433	0.513
Error	758.264	84	9.027		
Total	317297	87			
Corrected total	4696.713	86			

Result in Table 4 shows that P_{value} of Gender is 0.513>0.05. Hence, the null hypothesis is accepted. This means that there is no significant difference between male and female Secondary School Students mean retention scores in geometry in the GIP method group in Makurdi metropolis. The result implies that both male and female students improved on their retention in Geometry when taught using Geogebra instructional package.

IV. DISCUSSION

From Table 1, the students taught Geometry using the GIP had a mean retention score of 59.92 while those students taught using Expository method had a mean retention score of 24.22, the difference in the mean retention scores between the two groups was found to be statistically significant in hypothesis one in Table 2. This finding is in agreement with Uchechi (2013) who submitted that the present practice of mechanically applying the same method to dull, average as well as bright children could be responsible for poor retention of students in Geometry. Again, the findings are also in consonance with Bester and Brand (2013) who argued that computer technology assists students to make meaning of the learning material and the interactive effects of sound, animation, narration and additional definitions provided by computers appeals to today's learners, motivating them to concentrate better and to retain higher average scores. The findings of the study also agrees with Gambari, Falode and Adegbenro (2014) who found that the students taught Geometry with computer animation performed significantly better in retention test than their counterparts taught Geometry with the conventional material.

In Table 3, the result indicates that the male students had a mean post test score of 69.26 and a mean retention score of 59.29, while the female students had a mean post test score of 71.24 with a mean retention score of 60.56. Even though the female students appeared to have scored higher in the mean retention score, the difference between the male and female students mean retention score is not statistically significant in hypothesis two in Table 4. This finding implies that both male and female students improved in their retention in Geometry in the GIP group. This finding does not agree with the findings of Hydia and Mertzb (2009) who reported that female students perform significantly better than their male counterparts in Mathematics. The findings of the study agrees with Osemmwinyen (2009) who submitted that students retention could be aroused and retained through the use of an appropriate instructional media regardless of their gender.

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 retention much more than the Expository method. It is pertinent to note in conclusion that, the retention 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 retain high scores 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' retentive ability.

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