STATISTICAL ANALYSIS OF GEOGEBRA 3D SOFTWARE AS A MODE OF TEACHING GEOMETRICAL CONSTRUCTION IN POST COVID 19.

Okechukwu Ijeoma Eberechukwu PhD. and Akunna Ogochukawu

Department of Statistics, Federal Polytechnic Oko, Anambra State,

Corresponding e-mail: okechukwuijeoma41@gmail.com

The study investigated the statistical analysis of GeoGebra 3D software as a mode of teaching geometrical construction in post COVID 19. The study, adopted quasi experimental research design. A sample of 70 senior secondary year 11 students made up of 25 male students and 45 female students were selected out of 5,480 SS11 students through multistage sampling. Two research questions and two hypotheses guided the study. The instruments for data collection, The Geometry Achievement Test (GAT) and Geometry Interest Inventory (GII) were validated by two lecturers from departments of Mathematics and Measurement and evaluation, Nnamdi Azikiwe University Awka. The reliability index was established using, Kuder Richardson Formula 20 (K-R 20) for the GAT which yielded reliability coefficient of 0.80 and the GII yielded 0.79 reliability index using Cronbach Alpha. The result has provided empirical evidence that the use of GeoGebra enhances students' interest and achievement in geometrical construction irrespective of gender. Based on the finding it was recommended that GeoGebra should be integrated in the curriculum for the teaching and learning of Geometry .

Keynote: GeoGebra, Mathematics, Interest, Achievement, Gender

INTRODUCTION

Geometry is a branch of mathematics that studies points, lines, planes, shapes and their properties. Geometry is an important branch of mathematics that helps in the development of critical thinking and problem solving skills. Geometrical shapes are all around us in our environments. Geometry is seen in both sciences and Arts. Making effective use of geometrical objects depends on defining them and understanding the relationship between the objects and their duties. Studying of geometry helps in the development of logic deductive reasoning, and analytical reasoning. A mathematician who works in the field of geometry is called a geometer.

Geometry is a word derived from Greek words "geo" which means "earth" and metria which means measure. The ancient Greek mathematician is considered as the father of geometry. Geometry is in students' curriculum from primary, secondary and university. Most 2-dimensional and 3-dimensional figures are introduced right from primary school. The importance of teaching of geometry in school cannot be overemphasized from familiarizing with shape, structure to understanding of spatial relationship in problem solving and thinking. Geometry plays significant role in the curriculum. It equips us with vocabulary to talk about the space we occupy, since we are living in a three dimensional world. Geometry also helped in Global positioning system. It has added to our art and aesthetics life.

Despite the importance of geometry as an important part of school mathematics in our immediate environment there has been recorded facts of students poor attempting of problems in geometry which has contributed to their low achievement in mathematics. According to WAEC Chief Examiners Report (2016-2018) students lack the skills to answer questions on circle geometry, and its application, geometrical construction, geometry-circle theorem and plane geometry. Teachers were encouraged to go for training and retraining in order to brace up for proper teaching and learning of mathematics. This clearly indicates that geometry remains a difficult area among senior secondary school students.

The responsibility of selecting the appropriate teaching and learning strategies that will suit the prevailing circumstances and level of learning abilities of the students lies on the teacher. Since the conventional method of teaching has failed to sustain students interest and promote their performances in mathematics. There is need to embrace the use of activity based, simulating, student centered and computer based approach like GeoGebra.

GeoGebra is a computer based, software developed by Markus Hohen waiter 2001. It is designed to combine geometry, algebra and calculus in one interactive learning environment. GeoGebra is a user friendly, open access and easy to use software. It can be used in the computer or in any smart phone. The most recent version of the software can be down loaded from the GeoGebra website (www.GeoGebra.org). One can also download it from android play store.

The facilitating feature of GeoGebra is the ability of the students to have graphical representation of their geometrical construction, and algebraic formula. According to Akogwu, Abugu Okeke, and Umakalu (2019), GeoGebra could be integrated into teaching and learning of mathematics, while Ajaegba and Ekwueme (2019) reported that application of GeoGebra software enhanced students' performance in plane geometry. Ekhosuch and Osagiede (2015) explored the adoption of GeoGebra as a computer aided technology for teaching coordinate geometry without determining its effect on students' achievement, while Mehmet, (2017) reported that GeoGebra helped students in the conceptualization of applications of derivatives in mathematics.

`A review of some literature about GeoGebra revealed that although some researchers are aware of the existence of GeoGebra no research known to the researchers existence on effect of GeoGebra on students interest and achievement in geometrical construction in Anambra State. Since GeoGebra could be used by both male and female students, there is need to investigate, if GeoGebra could help to streamline gender differences in mathematics.

Gender according to Okechukwu (2019) is the social qualities and attributes associated with being a male or female. Olasesan and Akaje (2019) reaffirms that these qualities, prospects and relationships are socially constructed and learned through socialization. Gender difference in mathematics achievement has been investigated in many studies with conflicting reports. Gumel Galadinma 2014 indicate that boys are better than girls in mathematics achievement, others (Ajai and Imoko 2015; Nurudeen,B 2019) reported that gender has no significant effect on students achievement in mathematics. These inconsistent results in students' achievement in mathematics calls for further investigation.

Based on the conflicting reports, this study sought to investigate the effect of GeoGebra software on interest and achievement of male and female students in geometrical construction in Anambra State

Statement of the problem

The WAEC Chief Examiners Report (2016-2018) posits that students lack basic skills in answering questions in geometry. And since they have been out of school for a long time due to the ravaging effect of COVID 19, there is need for innovative strategy that could help to reduce gender imbalance which has been identified by researchers' to be one of the contributory factors to students poor interest and achievement in mathematics. Hence the question , could GeoGebra 3D software enhance students interest and achievement in geometrical construction in Anambra State?

Purpose of the Study.

The purpose of the study is statistical analysis of the effect of GeoGebra 3D software on students' interest and achievement in geometry in Anambra State.

Specifically, the study examined the:

1. difference in the mean interest scores of male and female students taught geometrical construction using GeoGebra software .
2. difference in the mean achievement scores of male and female students taught geometrical construction using GeoGebra software .

Research Questions.

1 What is the difference between the mean interest scores of students taught geometrical construction using GeoGebra software ?
2 What is the differences on the mean achievement scores of male and female students taught geometrical construction using GeoGebra software?

Research Hypotheses

The following hypotheses were also formulated to further guide study. It was tested at 0.05 level of significance

1. There is no significant difference in the mean interest scores of male and female students taught geometrical using GeoGebra software.
2. There is no significant difference in the mean achievement scores of male and female students taught geometrical using GeoGebra software

Methodology.

The study adopted quasi experimental research design. Specifically pretest, post-test, non-equivalent control group design. The population of the study was 4590 Senior Secondary year II students in Awka Education Zone. There are 61 public schools, with 15 co-educational schools in the zone. Multistage sampling was used in selecting 70 senior secondary year II students made up of 25 male students and 45 female students. Through simple random sampling the two classes from the co-educational schools were assigned to the experimental and control groups respectively. The experimental group had a population 25 students with 15 female and10 male students. And they were taught using GeoGebra 3D software. The control group had a total of 45 students made up 30 female students and 15 male students. The researchers used Geometry Achievement Test (GAT) and Geometry Interest Inventory (GII) for the collection of data. The GAT is an essay type test developed by the researchers. The GII is a 15 item interest Likert scale inventory. The respondents were requested to express their interest from five points Likert scale with Strongly agree (SA), Agreed (A), Undecided (UD), Disagreed (D) and Strongly disagree (SD). The instruments were validated by two experts from department of Mathematics and Measurement and evaluation. Kuder Richardson formula 20 was used to estimate the reliability of GAT because of the binary nature of the test and varying difficulty index, while Cronbach Alpha was used to estimate the reliability of GII. The two instruments yielded reliability coefficients of 0.84 and 0.70 respectively.

Before the treatment both groups of students were given GAT as pre test, which served as covariate. After the pre-test, the research assistants commenced the treatments. The experimental group was taught using GeoGebra software, while the control group was taught using lecture method. After three weeks of the treatment the students were given the post test and their scores collated. The data were analyzed used descriptive and inferential statistics. Research questions were answered using mean and standard deviation, while hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Geometrical Construction Activities Using GeoGebra Software.

A. How to bisect an angle using GeoGebra software.
1. Create two line segments with shared points to form and angle.
2. Draw a circle of arbitrary radius with the angle at its centre.
3. Mark the intersection of the circle with the segments.
4. Draw two circles one with the centre at one of the intersection points with the arc on the other point and vice versa.
5. Mark the intersection of the two new circles.
6. Draw a segment from the angle point to the intersection of the two circles to form your angle bisector.

B. Construction of an equilateral triangle
1. Draw a line segment.
2. Draw two circles using the two endpoints as centre of the circle and the line segment as the radius of the circles.
3. Draw two segments from the point of intersection to the end points of the first segment.

3

STATISTICAL ANALYSIS

Research Question 1:

What is the difference in the mean interest scores of male and female students taught geometrical construction using GeoGebra?

Data related to research question are presented in Table1

Table 1: Mean interest scores of male and female taught geometry using GeoGebra

Gender	N	Pretest Interest $\bar{x}$	Post interest $\bar{x}$	Interest Gain	Pre Interest SD	Post Interest SD
Male	10	6.40	67.80	63.72	4.77	7.69
Female	15	6.33	71.60	63.27	3.15	9.16

From Table 1, the male students had pre-interest mean of 6.40 with SD 4.77 and post-interest mean of 67.80 with SD of 7.69, while the female students had a pre-interest mean of 6.33 with 3.15 SD and a post-interest mean of 71.6 with a 9.16 standard deviation. The mean gain of the male students is 63.72, while interest mean gain for the female students is 63.27. The mean gain indicated that the male students had higher interest gain than their female counterparts

Research Question 2:

What is the differences in the mean achievement scores of male and female students taught geometrical construction using GeoGebra software?

Table 2: Mean Achievement scores of male and female taught geometry using GeoGebra

APPROACH	GENDER	N	PRETEST MEAN	POSTTEST MEAN	MEAN GAIN	PRETEST SD	POSTTEST S.D
GeoGebra	MALE	10	3.20	69.60	63.40	1.81	7.03
	FEMALE	15	3.60	73.87	70.27	2.47	11.84

4

	Total	25	3.44	72.16		2.20	10.24

From Table 2, the result shows that male students had 3.20 and 69.60 as pretest mean score and posttest mean scores respectively with a mean gain of 63.40. The female students had a pretest mean score of 3.60 and posttest mean score of 73.87 with a mean gain of 70.27. Based on the results the female students performed better than their male counterpart

Hypothesis 1

There is no significant difference in the mean interest scores of male and female students taught geometrical construction using GeoGebra software.

Table 3: Summary of Analysis of Covariance (ANCOVA) of the Mean Interest
Scores of Male And Female Students Taught Geometrical Construction Using GeoGebra

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	91.248[a]	2	45.624	.589	.563
Intercept	29800.411	1	29800.411	384.614	.000
Pre interest	4.608	1	4.608	.059	.810
Gender	86.986	1	86.986	1.123	.301
Error	1704.592	22	77.481		
Total	124576.000	25			
Corrected Total	1795.840	24			

From Table 3, gender has F-ratio of 1.123 with associated p-value of .301 hence P> 0.05, which implies that the null hypothesis is not rejected. Thus there is no significant difference in the mean interest scores of male and female students taught geometrical construction using GeoGebra software.

Hypothesis 2

There is no significant difference in the mean achievement scores of male and female students taught geometrical construction using GeoGebra software.

Table 4 : Summary of Analysis of Covariance (ANCOVA) of the Mean Achievement
Scores of Male And Female Students Taught Geometrical Construction Using

5

GeoGebra.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	375.069[a]	2	187.534	1.926	.170
Intercept	41639.188	1	41639.188	427.609	.000
PRETEST	265.842	1	265.842	2.730	.113
GENDER	141.375	1	141.375	1.452	.241
Error	2142.291	22	97.377		
Total	132694.000	25			
Corrected Total	2517.360	24			

From table 4, gender has F-ratio $(1, 24) = 1.452$ which is significant at $p = .241$, but $p > 0.05$. Hence the null hypothesis is not rejected. Thus there is no significant difference in the mean achievement scores of male and female students taught geometrical construction using GeoGebra software.

Discussion of Results

Influence of gender on the interest and achievement of students taught geometrical construction using GeoGebra.

The Analysis of Covariance (ANCOVA) for gender as a main effect on students interest revealed that gender has no significant difference on students interest in geometrical construction. The study revealed that GeoGebra software enhances students' interest in geometrical construction. This study is not in conformity with the findings of Gebhandt, Thomson, Ainley and Hillman (2019) that male students reported significantly higher level of interest and enjoyment of ICT than their female peers.

Evidence from the result indicate that the female students performed better in the geometrical construction than their male counterparts, although the Analysis of Covariance (ANCOVA) for gender as main effect revealed that gender has no significant difference on students achievement in geometrical construction. This result conforms with the findings of Okechukwu (2019) and Osakwe, Obodo, and Inweregbuh,(2019) that gender has no significant difference on students achievement in mathematics,

Conclusion

This study concludes that with the ravaging effect of covid 19 the use of GeoGebra in teaching geometry enhances students interest, conceptual learning and achievement in geometrical construction.

Recommendations

1. GeoGebra should be integrated in the school curriculum,
2. The study recommends that GeoGebra should be introduced in the pre-training and in-service training of teachers, so as to acquaint them with technological skills that will enhance innovative learning in the present dispensation.
3. Computers palmtops, and phones should be provided to teachers and students by the relevant stakeholders

References

Akogwu,JN., Abugu,G.N.,Okeke,A.N.,& Umakalu,C.P. (2019). Integrating GeoGebra software
in teaching mathematics . A remedy to students declining interest in mathematics. *Abacus. The Journal of Mathematical Association of Nigeria 44*(1)1-5

Ajaegba,N.M &Ekwueme C.O.application of GeoGebra software and students performance in
plane geometry in secondary schools in Delta State, *Abacus. The Journal of Mathematical Association of Nigeria 44*(1)10-18

Gebhandt,E. Thomson, S. Ainley J & Hillman ,K. (2019).*Gender differences in computer and
information literacy*.An in-depth analysis of data from ICILS. Berlin : Springer

7

Gumel,A.M & Galadima,H. (2014). Effect of gender-related differences in a academic

achievement and retention of senior secondary school students taught geometry using problem solving approach . *The Eurasia Proceedings of Educational & Social Sciences, (EPESS), 1,* 484-488

Mehmet, F. O. (2017).The Effect of GeoGebra on Students' Conceptual and Procedural

Knowledge: The Case of Applications of Derivative Higher Education Studies.7(2),67 78.

Nasirudeen,A.M., Bunrat, A.A.& Debo, S.A(2019). Effects of peer mentoring strategy on

student performance in mathematics at senior secondary schools in Lagos State , Nigeria *Abacus. The Journal of Mathematical Association of Nigeria 44*(1),130-143

Tali,D.J, & Dogo,P. (2019). Effect of collaborative learning approach on upper basic two

students interest in geometry in Parkshin education zone. Mathemathical Association of Nigeria, 56th Annual Conference Proceeding of September 2019.

Okechukwu, I. E. (2019). The effects of self-regulated learning strategy on senior secondary

school mathematic in Anambra State. Unpublished Dissertation, Nnamdi Azikiwe University, Awka.

Olasesan,O.O. & Akaje ,T.W (2018) Influence of school location and gender on secondary school students' achievement in mathematics. *Proceeding of 55th annual national conference of Mathematical Association of Nigeria,* 348-353

Osakwe,I.J. Obodo,G.C & Inweregbuh,O. C. (2019). Improving secondary school students'

achievement in geometrical construction using interaction approach. *Abacus. The Journal of Mathematical Association of Nigeria 44*(1)151-157

West African Examination Council, (2016).*The Chief Examiners Report.* Lagos: WAEC.

West African Examination Council, (2017).*The Chief Examiners Report.* Lagos: WAEC.

West African Examination Council, (2018).*The Chief Examiners Report.* Lagos: WAEC.