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EFFECTIVENESS OF GEOGEBRA APPLICATION ON GEOMETRICAL MATHEMATICS AMONG SECONDARY SCHOOLS STUDENTS IN DELTA STATE

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ABSTRACT

This study investigates the effectiveness of GeoGebra application on geometrical mathematics among secondary school students in Delta state. Dynamic mathematics software (GeoGebra) is a freely available interactive dynamic software for the teaching and learning of mathematics that combines geometry and algebra into a single package. A descriptive survey and quasi–experimental design was used, specifically, the pretest-posttest non-equivalent control group. The population consists of all the SS 2 students and mathematics teachers in all the public and private schools in Delta State. Fifteen mathematics teachers participated in the online workshop and that form the sample size of the teachers and 600 students were sampled, but 516 scripts were returned. Three (3) research questions guide the study. Two instruments were developed for the study; Mathematics Ability Test (MAT) and a Questionnaire on Mathematics Teacher's Attitudes toward GeoGebra Software (QMTAGS) were used for data collection. MAT was administered as a pre-test and post-test to the experimental and control groups which have 15 objective questions, while QMTAGS was administered to teachers after the workshop exercise on the GeoGebra software which contained 14 multiple-choice items. The data obtained were subjected to mean and standard deviation. The result of the findings showed that GeoGebra makes the teaching and learning of mathematics fun and enjoyable and factors responsible for mathematics teachers' non-access to digital teaching of mathematics are lack of computer-literate skills, non-availability of computer lab software, lack of power supply, and lack of professional development. Male students performed better than their female counterparts; private schools also performed better than public school students. It was recommended that GeoGebra should be fully integrated into Nigeria's education curriculum.

KEYWORDS: Geogebra, geometrical mathematics, teachers attitude.

INTRODUCTION

Technology integration in the classroom become an essential aspect of successful teaching. It has activated many researchers to investigate different aspects of such integration. (Kotrlik & Redmann, 2005). This is because it allows students to learn more in less time and

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allows schools to focus on global learning environments if used correctly. As a result of technology dominating our lives and society becoming immersed in a digital world, a new paradigm has evolved in education, changing how teaching is delivered and how learning is processed. Teaching and learning are no longer confined to the physical school structure or the classroom but can take place anytime and anywhere, such as in computer laboratories, via the radio, television, and the internet. Technology, therefore, includes all the tools we use to search, sort, create and report information in our own unique sociocultural context.

Geometry is an aspect of mathematics that deals with measurement like distance, angle, shapes (2-dimesnsional & 3-dimenstional). Geometry can be grouped into three phases; plane geometry- these deals with flat shapes e.g circle, triangle, polygona; solid geometry – this are three-dimensional objects e.g prisms, spheres, cylinders, cubes; spherical geometry – that are objects like spherical triangle & spherical polygon. Knowledge gained in the study of geometry helps to build thinking skill and problem-solving techniques that can be applied in real life situation. However, geometry can be linked to other field of study such as engineering, architecture, robotics, construction, astronomy, and many others. Some of the tolls used in the study of geometry include a compass, protractoer, calculator, ruler and GeoGebra.

According to Ajaegba and Ekwueme (2018) see the word Geogebra as the combination of Geometry "Geo" and „Gebra" derived from Algebra (Geometry + Algebra = GeoGebra). It is a free, open-source program that can be downloaded from (http://www.geogebra.org). This dynamic and interactive mathematics software program was created by Markus Hohenwater in 2001, for the teaching and learning of mathematics. The use of GeoGebra empower teachers and students in manipulating the tools that helps to gain better understanding of geometrical concepts. Tools like, point, line, perpendicular line, polygon, circle, ellipse, angle and reflect about line. Shaughnessy (2011) says if Algebra is the only language of mathematics, then, geometry is the glue that connect them. This implies that, Algebraic expression cannot stand alone without connecting to Geometry. As such, it makes geometry an essential branch of mathematics.

Learning geometry with GeoGebra allow students to manipulate and drag with a cursor from points A, B, and C to change the triangle and obtain the coordinate of precise point, in the algebra view. It will measure the exact angle with given size, distance or length, area, and slope. This brings out the beauty of mathematics and make the learning of geometry much more meaningful and fun. Integrating GeoGebra in mathematics classrooms can be a way of providing opportunities for mathematical investigation and teamwork which enables students gain better understanding of mathematics and improve their mathematical reasoning skills (Bhagat and Chang, 2015)

However, with the application of GeoGebra, students should be able to develop their potential to elevate their conceptual and procedural knowledge which depends on the teacher's attitude. The National Council of Accreditation of Teacher Education (2001) sees teachers' characteristics as attitudes, values, and beliefs established through covert and overt behavior toward students, colleagues, and communities. However, this positive behavior establishes a teacher's professionalism and promotes student learning and development. On this ground, the study tends to investigate the effectiveness of GeoGebra application on geometrical mathematics among secondary school students in Delta State.

STATEMENT OF PROBLEM

In recent times, the spread of COVID-19, a disease caused by a highly infectious virus, has instigated educational systems all over the globe to adjust by immediately shifting the traditional face-to-face teaching and learning process to virtual learning. Technology has become one of the significant determinants of quality education in our society. As such, it leads to effective teaching and learning by providing a medium for teachers and students to be continuously involved in the

Process, regardless of their levels.

The negligent attitude of not adopting an activity-oriented method of teaching and learning in our schools today has led to the abstraction of mathematics which makes students less active and more prone to rote learning. On this ground, a new learning environment for effective teaching and learning is proposed by introducing Dynamic mathematics software known as "GeoGebra".

Purpose of the Study

1. To explore teachers' attitude towards the use of GeoGebra application.
2. To examine factors responsible for mathematics teachers not to have access to digital teaching of mathematics.

3. To what extend does Geogebra application affect the performance of students with respect to ;
a) male and female students
b) private and public school students

Research Questions

1. What are teachers' attitude towards the use of GeoGebra software?
2. What are the factors responsible for mathematics teachers' non-access to digital teaching of mathematics?
3. To what extend does Geogebra application affect the performance of students with respect all ;
a) male and female students
b) private and public-school students

Research Methodology

A descriptive survey and quasi–experimental design was used, specifically, the pretest-posttest non-equivalent control group. The population consists of all the SS 2 students and mathematics teachers in all the public and private schools in Delta State with a population of. Fifteen mathematics teachers participated in the online workshop and that form sample size of teachers, and 600 students were sampled but 516 scripts were returned. Three (3) research questions guide the study. Two instruments were developed for the study; Mathematics Ability Test (MAT) and Questionnaire on Mathematics Teachers Attitude toward GeoGebra Software (QMTAGS) were used for data collection. MAT was administered as a pre-test and post-test to the experimental and control groups which have 15 objective questions while QMTAGS was administered to teachers via online after the workshop exercise on the use of GeoGebra software which contained 14 multiple-choice items. The data collected were analyzed using descriptive mean and standard deviation through Statistical Packages for Social Sciences version 24 (SPSS 24).

DATA PRESENTATION

Research Question 1: What are teachers' attitude towards the use of GeoGebra software

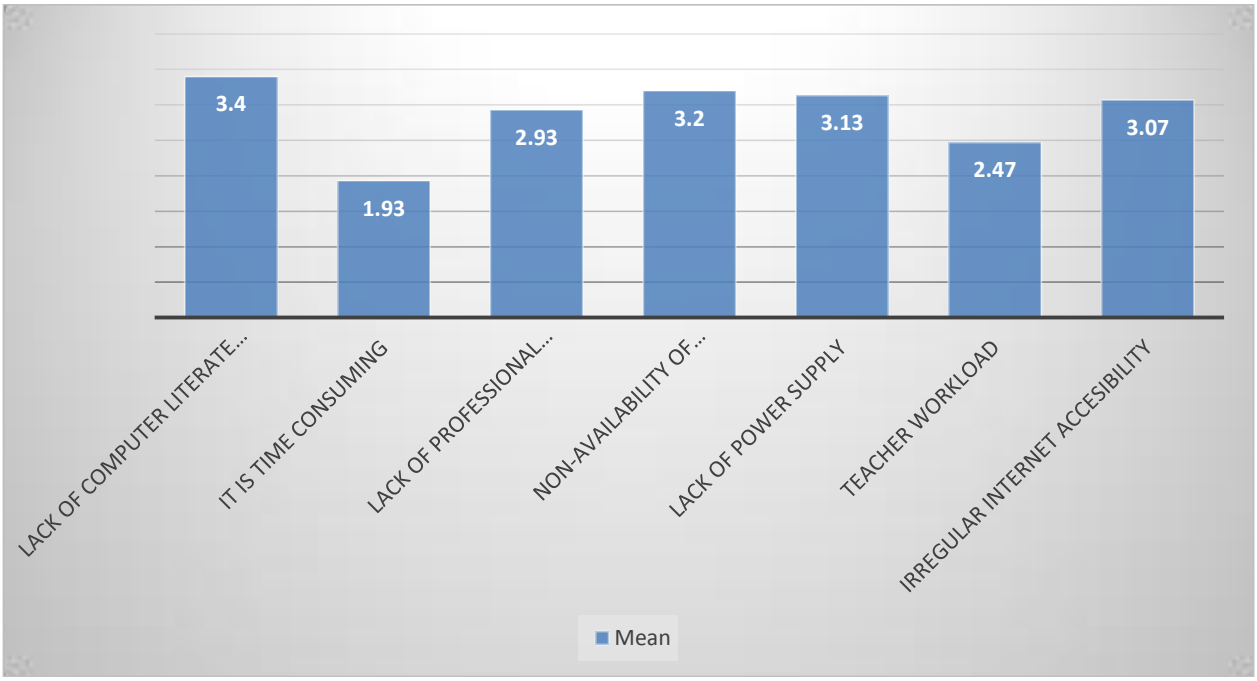
Table 1: Mean and Standard deviation of teachers attitude towards the use of Geogebra software

S/N	Statement	Mean	S.D	Decision
1	I enjoy Geogebra software	3.20	1.014	Agree
2	Geogebra make the teaching and learning of mathematics fun and enjoyable.	3.53	.640	Agree
3	Geogebra makes the teaching and learning of mathematics less abstract.	3.20	.561	Agree
4	Geogebra will make the student to be lazy	2.00	.535	Disagree
5	This strategy of teaching and learning incorporate the three domains (cognitive, affective and psychomotor)	3.13	.834	Agree
6	This strategy enables the learners to learn at their own pace.	3.20	.676	Agree
7	i feel like new kind of mathematics is being taught..	2.73	.961	Agree
	Grand Mean	**2.99**		**Agree**

Table 1 above shows items 1, 2, 3, 5,6, &7 had mean score values of 3.20, 3.53, 3.20, 3.13, 3.20 & 2.73 respectively which are above the cut-off point of 2.50. The standard deviation is 1.014, 0.640, 0.561, 0.834, 0.676, and 0.961 respectively. While item 4 had a mean score of 2.00 which is below the cut-off point of 2.50 and the standard deviation is 0.535. The grand mean of 2.99 shows that mathematics teachers have a positive attitude towards Geogebra software.

Research Question 2: What are the factors responsible for mathematics teachers non-access to digital teaching of mathematics?

Table 2: Bar chart on the factors responsible for mathematics teachers non-access to digital teaching of mathematics



The above bar chart showed that all the factors listed were of high extent except the mean of 1.93 and 2.47; it is time-consuming and teacher workload was not a factor responsible for mathematics teachers' non-access to digital teaching of mathematics.

Research question 3: what extend does Geogebra application affect the performance of students with respect to:

i) male and female students?
ii) Public and private schools?

Table 3: Mean and Standard deviation of male and female students

Gender		Pre-test		Post-test		Mean	Mean
	N	X	S.D	X	S.D	gain	Difference
Male	268	30.71	15.01	33.15	14.23	2.44	
Female	248	30.31	12.51	32.23	12.48	1.92	0.52
	516						

Table 3, reveals that male students had a pre-test mean score of 30.71. and standard deviation of 15.01 while female students had a mean score of 30.31 and a standard deviation of 12.51. For the post-test mean score, male students obtain a mean of 33.15 and a standard deviation of 14.23, while female students obtain a mean score of 32.23 and a standard deviation of 12.48. The mean gain scores for the two groups were 2.44 for male and 1.92 for female students respectively. The difference in the mean gain scores was established at 0.52, which is in favour of the male students. This implies that male students outperformed their female counterparts.

Table 4: Mean and Standard deviation mean scores of private and public school students

School type	N	Pre-test X	S.D	Post-test X	S.D	Mean gain	Mean Difference
Public	276	30.90	12.85	32.85	12.67	1.95	
Private	240	33.03	13.59	35.04	13.87	2.01	0.06
	516						

Table 4, reveals that public school students had a pre-test mean score of 30.90 and a standard deviation of 12.85 while the private school students had a mean score of 33.03 and a standard deviation of 13.59 respectively. For the post-test mean score, public school students obtain a mean of 32.85 and a standard deviation of 12.67, while private school students obtain a mean score of 35.04 and a standard deviation of 13.87. The mean gain scores for the two groups were 1.95 for public school students and 2.01 for private school students respectively. The difference in the mean gain scores was established at 0.06, which is in favour of the private school students. This implies that private school students performed better than public school students.

DISCUSSION OF FINDINGS

The findings in Table 1 showed that that mathematics teachers have a positive attitude towards using Geogebra software in the teaching and learning of mathematics. This agrees with the work of Kadel (2005) who noted that regardless of the quantity and quality of technology available in classroom, they key to how ICTs are used is the teacher. Therefore, teachers must have the competence and right attitude towards technology.

The result in Table 2 showed the factors responsible for mathematics teachers' non-access to digital teaching of mathematics. This study concurs with Ertmer, Ottenbreit-Leftwich, Sadik, Sendururm and Sendururet (2012), that lack of technology implementation in the classroom is related to lack of professional development and training. That is, teachers need to gain new skills to enhance their teaching profession. However, lack of computer literate skills has the highest mean of 3.4. This indicates that majority of mathematics teachers are unable to perform simple digital function such as compose email, log into online platforms, and even save work to an external device (Gibbs, 2018).

In terms of students performance scores in mathematics with respect to gender, table 3, revealed the mean scores and standard deviations of male and female students in both group in the pretest and posttest. It was discovered that male students had a higher mean compared to their female counterparts. This study concur with Ajaegba & Ekwueme (2018) whose study indicated that male students slightly outperformed the female in the GeoGebra method. This implies that male students gained better understanding than their female counterparts.

The findings in table 4, revealed that private school students in all the three senatorial districts in Delta State outperform their public counterparts in the performance tests. The study finding is in line with Hahn (2014) which study indicated that the students in private schools have better academic achievement than those in public schools. In related research carried out by Lubienski and Lubienski (2006) compared academic achievement of private and public schools. they found out that student in private schools scores higher than those in public schools. However, this implies that students in private schools are competence and intelligent respectively.

CONCLUSION

Teaching and learning of mathematics through the integration of technology has a significant benefit in eliminate the abstract nature of mathematics. If proper integration is being put into consideration, then, teaching and learning via technology would help students develop positive attitude toward learning of mathematics. As such proper attention should be on the factors listed in the bar chart in Table 2. When teachers are not provided with the necessary tools and professional development, they tend to be discouraged and inefficient in implementing technology into practice.

RECOMMENDATIONS

From the findings of the study, the following recommendations are made:

1. Mathematics teachers should be provided with digital tools for effective teaching and learning.
2. Teachers should be trained regularly.

3. Curriculum planner should integrate into the syllabus GeoGebra software as a tool for teaching and learning of mathematics.
4. Government should equip rural schools with digital tools in other for teachers to digitalize their lesson.

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