African Journal of
Education and Practice
(AJEP)

Geogebra Software: Synergy That Improves Performance in Geometry Learning in Ogbomoso Education Zone of Oyo State

Adigun Olatunde Thomas PhD. and Aasa Moses Adebowale PhD.

IPRJB
INTERNATIONAL PEER REVIEWED
JOURNAL AND BOOK PUBLISHING

African Journal of Education and Practice
ISSN 2519-0296 (Online)
Vol.9, Issue 4, No.1, pp 1 - 14, 2023

www.iprjb.org

Geogebra Software: Synergy That Improves Performance in Geometry Learning in Ogbomoso Education Zone of Oyo State

[1]Adigun Olatunde Thomas PhD. & [2]Aasa Moses Adebowale PhD.
[1]Department of General Studies Education (Science Unit), School of General Education, Oyo State College of Education, Lanlate.
[2]Department of Mathematics, School of Secondary Education (Science Programmes), Oyo State College of Education, Lanlate.

Article History

Received 1st November 2023

Received in Revised Form 10th November 2023

Accepted 17th November 2023

How to cite in APA format:

Adigun, T., & Aasa, M. (2023). Geogebra Software: Synergy That Improves Performance in Geometry Learning in Ogbomoso Education Zone of Oyo State. *African Journal of Education and Practice*, *9*(4), 1–14. https://doi.org/10.47604/ajep.2194

Abstract

Purpose: This study investigated the effect of GeoGebra software on Mathematics performance of senior secondary school students in Ogbomoso Education Zone 1, Oyo State, Nigeria.

Methodology: The research purposes, research questions, and research hypotheses categories each contained three research items.Two (2) public co-education senior secondary schools were chosen using random sampling technique. The experimental group consisted of fifty-three (53) students, consisting of 26 and 27 male and female students, respectively, while the control group consisted of fifty-four (54) students, consisting of 27 male and 27 female students. GeoGebra Learning Approach (GLA) was used to teach the experimental group, whereas the control group received instruction using the conventional learning strategy (CLS). The research instrument utilized for the study was the Mathematics Performance Test in Geometry (MPTG) which was validated by specialists in Mathematics education and Pearson's Product Moment Correlation formula was used to get the index of reliability of 0.78. The data was analyzed using the t-test, mean, and standard deviation.

Findings: The study's findings showed that, prior to using Geogebra Software, there was no discernible difference in the students' means performance scores between the two groups. The study also showed a substantial difference between the mean performance scores of students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry. The study's final finding showed that there was no statistically significant difference in the mean performance scores of male and female students using the Geogebra Learning Approach (GLA) in geometry.

Unique Contribution to Theory, Practice and Policy: Piaget cognitive theory was in conformity with the use of Geogragra Software in teaching mathematics. The study recommends that mathematics teachers should be encouraged to use Geogebra Software and other Information and Communication Technology (ICT) facilities such as power point and projector in teaching their students in order to ease problems of teaching Mathematics.

Keywords: *Geometry, GeoGebra Software, Mathematics Performance, Mensuration, Senior Secondary School Students*

INTRODUCTION

Right from the beginning of time, cultures and societies recognized the importance of Mathematics. According to Ogena, Lana, and Sasota (2010), one of the topics acknowledged as having a significant impact on a country's growth is mathematics education. It is a language that aids in the description of concepts and connections derived from our surroundings. It is a piece of science and technology that lets individuals to properly explore such ideas using idealized models before putting them to the test in the real world. In the primary, junior and senior secondary schools and Colleges of education in Nigeria, Mathematics instruction is still a compulsory subject.It is also a core subject in which students are expected to have at least a credit pass in order to gain admission to any tertiary institution in Nigeria. Mathematics is a subject that is used in every field of life.

Anastacio (2007) explained Mathematics as the supporting knowledge of modern sciences and a legitimacy label for all scientific knowledge. The researcher further opined that any knowledge which does not use mathematical rationality, techniques and languages must be overlooked. The implication of this statement is that the key to opening doors of scientific opportunities is a deep understanding of mathematical concepts and procedures hence a meaningful understanding of Mathematics must occur.In support of above assertion, Uka, Iji and Ekwueme (2012) explained Mathematics as a service subject that exists as a skill to be applied in other areas of study.To think critically and effectively in their environment, every person has to be proficient in Mathematics.It is a subject that touches almost every area of human endeavor and is a significant aspect of everyone's life. A nation's success scientifically and technologically depends on its level of Mathematicseducation.

Mathematics proficiency is necessary for careers in engineering, actuarial science, medicine, physics, nursing, and computer science.The analytical and problem-solving abilities that students develop in Mathematics are useful in almost all areas.According to Tella (2013), who argued in favor of this, the distinction between developed and underdeveloped countries are based on each country's level of mathematical sophistication and ingenuity.Tella (2013) emphasized further that mathematics is an undeniable force for economic growth and national development. One of the main reasons for the review of the National Policy on Education (NPE, 1998), according to Adeyemi, Oribobor, and Adeyemi (2012), was to increase the size of the National Mathematical Center (NMC), whose purpose is to improve the teaching and learning of Mathematics through research.

In addition, the National Policy on Education (NPE, 2013) mandates that the government take the necessary steps to guarantee that instruction is practical, experiential, activity-based, and supported by information technology (IT) in order to fully realize the objectives of education in Nigeria and benefit from its contribution to the national economy. The activity-based learning approach appears to be a gift in recent times when it comes to the teaching of science, especially in Mathematics. Activity-based learning is predicated on the notion that learning is most effective when it is stimulated by the immediate surroundings and motivated by the creation of optimal learning conditions. Thus, an activity-based approach can effectively be used to teach and learn Mathematics. In support of this claim, Roberts (2012) argued that using technology to teach and learn Mathematics has many benefits, including increasing students' learning opportunities. White (2012) added that using technology to teach and learn mathematics increases student engagement.

According to Apperson, Laws, and Scepansky (2006), the use of technology in teaching and learning results in students having a more positive attitude toward their education, and teachers who use it in their classrooms benefit as well. Blogger (2012) argued that in order for students to concentrate their thinking and participation in the class for the process of information analysis, they must be given the knowledge and materials they require.Being actively involved in directing and guiding the students' analysis of the information is an essential component of teachers' responsibilities. According to Hutkemri and Zakaria (2012), technology has changed the way that education is provided. According to these researchers, technology facilitates effective teaching and learning by giving professors and students, regardless of their academic backgrounds, a platform to engage in ongoing idea sharing and exchange.

According to Hohenwarter (2001), one of the most widely used Mathematics software in the classroom is the GeoGebra software. The researcher went on to say that GeoGebra provides capabilities for geometry, algebra, and calculus in a connected, condensed, and user-friendly software environment. It introduces fresh and original ideas when technology is included into Mathematics teaching and learning, particularly when it is supported by the use of suitable software. Teachers and students have different roles to play in computer-based learning. The teachers may no longer take center stage in a normal classroom setting as students become more involved in their own learning.As a result, the computer offers access to a variety of methodologies, numerical computing, graphical representations, the collection and analysis of experimental data, as well as a variety of ways for document production.

Geogebra is a straightforward but effective teaching and learning resource (computer application) for Mathematics, particularly geometry, algebra, probability and statistics, trigonometry, and functions.The many features offered by Geogebra software suggest that it can be an excellent tool for aiding users in precisely, swiftly, and efficiently visualizing abstract geometric shapes. For all levels of schooling, Geogebra is dynamic Mathematics software that combines geometry, algebra, spreadsheets, graphing, statistics, and calculus into a single, user-friendly product.The use of Geogebra in mathematics instruction, especially in geometry, has a large and beneficial effect on promoting students' comprehension. In particular, Geogebra is a fantastic tool for exploring, constructing, and visualizing mathematical topics (Tamam&Dasari, 2021).

The following examples of how geometry software can assist students in understanding and visualizing Mathematicsproblems include: demonstrating straightforward geometric relationships, such as the fact that the sum of a triangle's interior angles is 180 degrees; demonstrating that the limit of the sum of rectangles that roughly represent the area beneath a curve is equal to the actual area under the curve; and fostering a long-lasting understanding of geometry through use of these geometry packages. Using geogebra software also enables the user to export the current file into a web-ready format (a java applet), which can subsequently be published to a web server, as well as to allow students and teachers to discuss and evaluate each other's work.In addition to facilitating the development of a social discussion about the work, Geogebra also helps students comprehend geometry ideas more thoroughly than they would without it (Jelatu, 2018).

In support of Apperson, Laws, and Scepansky (2006), Roberts (2012) and White (2012) provided evidence that using technology to teach and learn Mathematics has the advantage of giving students more opportunities to learn. According to the researchers, integrating technology into Mathematics instruction and learning improves student engagement, changes

students' attitudes about learning, and benefits teachers who use it in their classes. In a research titled "the use of Geogebra software in teaching Mathematics" conducted by Tamam and Dasari (2020), data were gathered using the documentary technique. Twelve related articles were collected, and they revealed the benefits of using Geogebra in learning Mathematics. The data collected was analyzed by the researchers using content analysis. It was found in the studies that there are several significant results obtained, the use of Geogebra in teaching Mathematics made it easy for students to understand geometry, and students tend to be happier in learning geometry. The study found that Geogebra is actually helpful for both students and teachers, because it is simple to use and accessible from anywhere at any time. Future researchers are advised to use quasi-experimental research since it can be more thoroughly scrutinized and the results will be more insightful.

Another study by Celen (2020) was titled "Students' Opinions on the Use of GeoGebra Software in Mathematics Teaching". In order to investigate the effects of using a free program called GeoGebra in the learning of coordinate geometry among students with high visual-spatial ability and low visual-spatial ability, the researcher used a quasi-experimental study with a non-equivalent control group post-test only design. The study included 53 secondary school students from Wilayah Persekutuan Kuala Lumpur in total. According to the findings of an independent sample t-test, the mean mathematical accomplishment syllabus showed a significant difference. Additionally, results showed that there were discernible differences in student performance between the geogebra group and the traditional group. According to this study, using geogebra helped pupils understand coordinate geometry more effectively.

A study carried out by Daulay, Syafipah, Nasution, Tohir, Simamora, Saragih (2021) on Geogebra assisted blended learning on students' spatial geometry ability revealed that Geogebra software increased students' interest to learn Mathematics. Research was conducted using an experimental design. The results of the study demonstrated that teaching geometry to students using algebra boosted their interest in mathematics in general and geometry in particular. The use of Geogebra in the teaching and learning of geometry has also been found to generally and favorably alter students' attitudes, self-efficacy, and self-regulation toward geometry.

Geometry is the study of the properties of shapes and of the relationship between shapes. At the junior secondary school level, students are led to discover geometrical properties and relationships for themselves. At the senior secondary level the discovery process continues but it is reinforced by the use of formal proofs in certain cases. This gives students opportunities to develop and apply skills in deductive reasoning. Students at this stage discover the properties of and relations between quadrilaterals in particular and polygons in general. These discovery methods are also used to identify the theorem of Pythagoras, scale drawing, angles of elevation and depression, bearing and distances which are solved using practical methods. Notwithstanding, many students are faced with the challenge of not understanding some concepts in geometry using practical methods.

Statement of the Problem

Despite its significance as a tool for societal and national development, Mathematics is a subject that many students avoid, struggle with, and possibly even detest (Areelu, 2014).In agreement, Popoola and Ajani (2011) thought that Mathematics was the most challenging course in the curriculum. Due to this, students developed a bad attitude about the subject, which appears to have persisted from generation to generation. Most students are faced with the

challenge of not understanding some concepts in Mathematics, reasons range from abstract nature of Mathematics, inadequate use of instructional material, unqualified Mathematics teachers, and negative attitude of students toward Mathematics among others. Additionally, the West Africa Examination Council Chief Examiners' Report for May/June (2012, 2015, 2019, 2020, and 2021) noted that candidates performed poorly on the Geometry questions.

One of the major factors which have been identified for such poor performance is lack of understanding of some mathematical concepts among which is the concept of geometry. The traditional, teacher-centered teaching approach is very passive in nature and does not actively engage students in the processes of learning and problem-solving. Teachers must use a variety of instructional tactics to ensure that students make the long-term changes required at the conclusion of each lesson in order for the topic to be delivered in the classroom effectively and for students' achievement to increase. The present study investigates how teachers can adopt Geogebra software to instruct their students in order to remove some factors causing the difficulties in geometry learning, in filling the existing gaps in research which has not been established in Oyo State in particular and Nigeria in general; hence this study.

Purpose of the Study

This study's major goal was to find out how well Ogbomoso Education Zone students in Oyo State performed in geometry after using Geogebra software. In particular, the study aimed to:

1. Compare,prior to using Geogebra software,the mean performance scores of students using the Geogebra Learning Approach (GLA) with the Conventional Learning Strategy (CLS) in geometry.
2. Determine whether students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) differ in their mean performance scores for Geometry.
3. Determine whether male and female students who are using the Geogebra Learning Approach (GLA) in geometry have different mean performance scores.

Research Questions

The study was guided by the following three research questions:

1. Before using Geogebra software, what was the difference between the mean performance scores of the students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry?
2. What is the difference between the mean performance scores of students using the conventional learning strategy (CLS) and the Geogebra learning approach (GLA) in geometry?
3. What differences exist between the mean performance scores of male and female students using the Geogebra Learning Approach (GLA)?

Research Hypotheses

The following three null hypotheses were formulated and testedat 0.05 level of significance:

1. There is no significant difference in the mean performance scores of the students utilizing Geogebra Learning Approach (GLA) and Conventional Learning Strategy (CLS) in geometry before utilizing Geogebra Software.

2. There is no significant difference in the mean performance scores of students utilizing Geogebra Learning Approach (GLA) and Conventional Learning Strategy (CLS) in geometry.
3. There is no significant difference in the mean performance scores of male and female students utilizing Geogebra Learning Approach (GLA) in geometry.

Scope of the Study

All senior secondary public co-educational schools in Ogbomoso Education Zone one (1) of Oyo State was included in this study.The study looked at how using Geogebra software affected how well children learned geometry. Additionally, because they were more reliable for use in the study, only Senior Secondary School II (SS II) students were used as respondents. Since there was no interruption of any kind and Senior Secondary III students (SS III) were writing their West African Senior Secondary School Certificate Examinations (WASSSCE) at the time this study was being conducted, the respondents also had enough time to expose them to the treatment. Out of the seventy (70) senior secondary schools in the three local government areas that made up Ogbomoso Education Zone One (1) of Oyo State, the study was restricted to determining the impact of using Geogebra software on students' performance in learning geometry.

Significant of the Study

The study would be of great significance because it is hoped that the findings of this research will improve and raise the standard of teaching and learning of geometry. Since the study has identified areas where logistic supports are needed, students' readiness to attempt the tasks will be determined by their performance on the mean performance scores between students using the Geogebra Learning Approach (GLA) and Conventional Learning Strategy (CLS).In order to enhance the teaching and understanding of geometry problems, the study will also provide information that will be useful to Mathematicsteachers, curriculum planners, and curriculum developers. The study is important for the Federal and State Ministries of Education as well as other educational organizations including the Nigerian Educational Research and Development Council (NERDC), the Science Teachers Association, and the Mathematical Association of Nigeria (MAN).To use Geogebra software in teaching geometry, they might need to set up seminars or training sessions for teachers. By being able to solve geometry issues, students' performance in Mathematics, physics, chemistry, technical, and business classes would considerably increase.

Theoretical Framework

This work hinged on the Learning by Discovery of Piaget's cognitive theory which involves three components; first, the brain uses schemas or the mental frameworks as a building block toward knowledge, second, the brain uses adaptation processes like assimilation and accommodation to move between the stages and third, the children experience universal stages of development with regard to cognition (Piaget, 1936). Cognitive theory explains human behaviour by studying the mental processes involved when trying to learn and understand. Cognitive theorists compare the human brain to a powerful computer in order to understand its information processing capabilities. Nowadays, cognitive theory has applications in cognitive science and cognitive learning. The three main elements of the cognitive theory are perception, attention, and memory. The process of selecting, organizing and interpreting stimuli creates a person's perception. The way a person process the information in their environment is known

as that person's attention while the process of gathering, storing, and recalling information creates memory.

Cognitive theory definition affirms that the way people behave is a product of the information they gather externally and the way they interpret that information internally. Jean Piaget's goal was to observe and explain the processes used by infants and children to become individuals capable of reasoning and thinking. According to Piaget, schemas are tied together with a core meaning. As long as people continue to exist in the world, they will gather and process more stimuli (external information). Piaget framed cognitive processing in term of assimilation and accommodation. By the time people use an existing schema to make sense of environmental stimuli, they are assimilating that experience. In other word, assimilation is how someone interprets their life experiences. The way someone adjusts their internal models after interpreting is known as the accommodation process of cognitive theory.

Piaget's work is mainly concerned with the way children learn. The development of the quality of mathematical thinking of leaners was his most essential concern. He suggested that children mental functioning and learning progress pass through quantitatively different stages from infancy through childhood. The first stage is called the sensorimotor stage (0-2 years old). During this stage, the babies and the toddlers develop object permanence. They know that something continues to exist even if it is not immediately visible to the eye. The second stage is the called the preoperational stage (2-7 years old), at the stage, a child might pick up a stick and use it to represent a sword understanding that a stick is still a stick and not a sword. The third stage is concrete operational stage (7- 11 years old). During this stage, concepts are attached to concrete situation. Time, space, and quantity are understood and can be applied, but not as independent concepts. The fourth stage is formal operational stage (11 years old and older). Theoretical, hypothetical, and counterfactual thinking happens at this stage of development. Abstract logic and reasoning, strategy and planning become possible at this stage. Concepts learned in one context can be applied to another at this stage also.

Piaget explained that one can get to know something by doing it, seeing it or imagining it. Hence, a student can learn concepts of Mathematics through the interaction with Geogebra software package. These are related to the four stages of development (cognitive processing in term of assimilation and accommodation). At the formal operational stage, the children develop more general and mathematical abstract ideas which can be expressed in words or in numbers. With the use of Geogebra software package, the role of the teacher changes from that of a lecturer who cares less of his learners to that of a resourceful person who cares most of his students. Piaget explained that at formal operational stage, concepts are attached to concrete situation. When learners are presented with perplexing situations they will want to figure out a solution; an interactive software package like that of Geogebra can be used in such a situation.

The software package encourages students to actively use their intuition, imagination, and creativity. Abstract logic and reasoning which developed in students at the final stage of Cognitive theory can enable students to learn from specific and move to the general. For instance, the teacher presents examples and the students work with the teacher's examples until they discover the interrelationships. According to Piaget learning should be from simple to complex, from known to unknown, and from specific to general. Geogebra software was designed in support of Piaget's submission that classroom learning should take place through inductive reasoning by using specific examples to formulate a general principle.

Piaget asserted that theoretical, hypothetical, and counterfactual thinking happens at the fourth stage of development. To apply his ideas in the classroom, teachers would create his own modern instructional materials and then instruct the learners to create their own. Summarily, Piaget's work generated many suggested implications for teaching in general and Mathematics teaching in particular: these are stage-based teaching, uniqueness of individual learning, conceptual development prior to language, experience involving action, and necessity of social interaction among learners.

METHODOLOGY

Research Design

For this study, a quasi-experimental research approach was used. A pre-post-control, experimental group, and control design.

Population, Sample and Sampling Technique

The senior secondary school students in Ogbomoso Education Zone 1 in Oyo State, Nigeria, were the study's target group. The study area was Ogbomoso Education Zone one (1), which is made up of three (3) Local Government Areas (LGA): Ogbomoso North, Ogbomoso South, and Oriire LGA, each of which has 37, 16 and 17 senior secondary schools respectively.Given that Mathematics is a required subject at the senior secondary level, a sample size of 107 SS II students from the two (2) public senior secondary schools was randomly chosen for the study. Participants included fifty-three (53) students, with the experimental group consisting of 26 and 27 male and female students, respectively, and fifty-four (54) students, with 27 male and 27 female participants for the control group. Therefore, the sample size consist of fifty-three (53) males and fifty-four (54) females students. The topic under consideration (geometry) is in senior secondary school one (SS I) syllabus.

Research Instrument

The research tool used for the study was the Mathematics Performance Test on Geometry (MPTG) adapted from past May/June 2015, 2019, 2020 and 2021 West African Examinations Council (WAEC) General Mathematics Questions.

Validation of Research Instrument

Experts in Mathematics education evaluated the MPTG by looking at each item's relevance, clarity, and linguistic suitability for both face and content validity. Using a test-retest methodology, the instrument (MPTG) was given to 30 SSII students from schools other than those chosen for the study; the test was then given to the sample again after a one-week interval. Using Pearson's Product Moment Correlation formula, the index of reliability was calculated, and it was found to be 0.78.

Procedure for Data Collection

In order to inform and obtain permission for the study's execution, the researchers met with the principals and Heads of Departments (HOD) of Mathematics in the two (2) selected schools. The researcher trained the HODs of Mathematics from the two schools who worked as research assistants in the management of MPTG. A series of lesson plans on the topics of geometry and measurement for the senior secondary school curriculum as well as a set of modules created by the researcher served as the study's instructional materials. The module, which contained the lesson's content, was provided to the students as a reference during the teaching process. Both groups learned the fundamentals of geometry and mensuration during the first phase, which

also included a session on solving mathematical problems. In order to ensure that both groups had the same baseline proficiency in geometry and mensuration before beginning the treatment, a one-hour pre-test was done. The experimental group was taught how to utilize Geogebra during the second phase. The researchers prepared some Geogebra software modules and introduced it to the experimental group that would be using it.

During this second phase, students were made to examine the various parts in the software and their functions. The experimental group then received geometry and mensuration instruction in the third phase using the Geogebra Learning Approach (GLA), whereas the control group received instruction using the Conventional Learning Strategy (CLS). To help students have a solid understanding of geometry and mensuration, six (6) modules were created: two for the first phase, three for the second phase, one for the third phase, and one for the fourth phase, which was the same module as the pre-test.

Data Analysis

The data collected from the administrations of the instrument on the treatment and control groups were used in line with the three (3) generated hypotheses. The hypotheses for the study were subjected to empirical test. The researchers employed the use of inferential statics such as t-test, mean and standard deviation to answer the research questions at an alpha level of 0.05.

Answering Research Questions

Research Question 1

Before using Geogebra software, what was the difference between the mean performance scores of the students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry?

Table 1: T-Test Pretest Performance for GLA and CLS before Utilizing Geogebra Software

Variable	Number	Mean	S.d.	df	t-cal.	t-crit	Dec.
Experimental	53	64.54	2.18	105	0.33	1.98	Retained
Control	54	64.56	2.34				

Table 1 revealed negligible difference of (64.56 – 64.54) = 0.02 between the means of the GLA and CLS groups.

Research Question 2

What is the difference between the mean performance scores of students using the conventional learning strategy (CLS) and the Geogebra learning approach (GLA) in geometry?

Table 2: T-Test Posttest Performance for GLA and CLS after Treatment

Variable	Number	Mean	S.d.	df	t-cal.	t-crit	Dec.
Experimental	53	81.97	5.85	105	2.48	1.98	Rejected
Control	54	68.94	3.57				

Table 2 revealed a significant difference of (81.97 – 68.94) = 13.03 in the mean performance scores for GLA and CLS in geometry after given treatment to the experimental group.

Research Question 3

What differences exist between the mean performance scores of male and female students using the Geogebra Learning Approach (GLA)?

Table 3: t-test Posttest Performance for GLA for Male and Female Students after Treatment

Variable	Number	Mean	S.d.	df	t-cal.	t-crit	Dec.
Male	26	62.83	6.79	51	0.03	2.01	Retained
Female	27	62.81	7.02				

Table 3 revealed insignificant difference of (62.83 – 62.81) = 0.02 in the mean performance scores for GLA in geometry after treatment.

Testing Research Hypotheses

Hypothesis 1

H_{O1}: There is no significant difference in the mean performance scores of the students utilizing Geogebra Learning Approach (GLA) and Conventional Learning Strategy (CLS) in geometry before utilizing Geogebra Software.

Table 1 shows that t-critical, with a value of 1.98, is larger than t-calculated, with a value of 0.33. Consequently, it is decided to retain **H_{O1}**. This suggests that both groups started off with comparable skill levels. The mean performance scores of the students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry prior to using the Geogebra Software did not differ significantly.

Hypothesis 2

H_{O2}: There is no significant difference in the mean performance scores of students utilizing Geogebra Learning Approach (GLA) and Conventional Learning Strategy (CLS) in geometry.

According to Table 2, t-critical is bigger than t-calculated, which has a value of 2.48. Consequently, it is decided to reject HO_2,due to the fact that the mean performance scores of the GLA and CLS groups differ significantly. It follows that the experimental group performs at a greater level than the control group in geometry. The **HO_2** hypothesis is disproved. The mean performance scores of students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry differ significantly.

Hypothesis 3

H_{O3}: There is no significant difference in the mean performance scores of male and female students utilizing Geogebra Learning Approach (GLA) in geometry.

Results from Table 3 show that t-calculated = 0.03 while t-critical = 2.01, and that insignificant difference of 0.02 in the mean performance scores for GLA in geometry after treatment existed. Inasmuch as t-critical is greater than t-calculated, **HO_3**is retained.The implication is that both male and female students have equal level of geometry performance after treatment. There is no significant difference in the mean performance scores of male and female students utilizing Geogebra Learning Approach (GLA) in geometry.

Discussion of Findings

The study examined the impact of Geogebra Software on senior secondary school students' geometry test scores in Ogbomoso Education Zone 1, Oyo State.Findings from the study revealed that negligible difference of 0.02 existed between the means of the GLA and CLS groups. But when the hypothesis was tested the results showed that t-critical of value 1.98 is greater than t-calculated of value 0.33. Therefore, there is no significant difference in the mean performance scores of the students utilizing Geogebra Learning Approach (GLA) and

Conventional Learning Strategy (CLS) in geometry before utilizing Geogebra Software. This implies that both groups have equal ability level at the beginning of the study.

This study also revealed that the experimental group (GLA) performed on average at a higher level than the control group (CLS), with a mean score of 81.97 compared to 68.94, while their respective standard deviations were 5.85 and 3.57. With degree of freedom (df) of 105, t-calculated of value 2.48 and t-critical of value 1.98. The results showed a substantial difference between students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry in terms of their mean performance scores.The results of Tamam and Dasari (2020), Mamman and Surajo (2021), and Gakbish, Golji, and Augustine (2021) were in agreement with this finding.

Tamam and Dasari (2020) analyzed the data by using content analysis. The research gathered revealed that several important findings were made, and the use of Geogebra in the mathematics classroom made it simple for students to understand geometry. Students also tended to be happier and performed better when learning geometry.When Mamman and Surajo (2021) looked into how Geogebra Software affected first-year students at Kano University of Science and Technology, they found that attitude and achievement of students in circle geometry were positive andthose who used Geogebra Software outperformed those who used traditional teaching methods. Likewise, Gakbish, Golji and Augustine (2021) investigated effect of Geogebra software on senior secondary school students' academic achievement in algebra in Pankhin, Plateau State, Nigeria. The result obtained showed that those taught algebra using Geogebra software performed better than those taught without Geogebra software.

Additionally, this study discovered no appreciable differences between the mean performance scores of male and female students using the Geogebra Learning Approach (GLA) in geometry.This was consisted with the finding of Adigun (2018) who conducted research into the challenges faced by senior secondary school pupils in Oyo State on word problems Mathematics test. The study found no discernible difference between the levels of challenges that male and female students faced when taking the word problem Mathematics test. This result of this study was also consistent with the earlier finding of Gakbish, Golji, and Augustine (2021), who reported that there was no discernible difference in the algebra achievement of male and female students taught using Geogebra in their study on the impact of the program on senior secondary students.This proposal concurs with that of Isa, Mamman, Musa, and Bala (2020), who examined the concepts, principles, and academic accomplishment of junior secondary school students in Mathematics in Kano State, Nigeria. The results of their study utilizing the t-test statistics revealed thatthere was no statistically significant difference between male and female performance in the experimental group.

Conclusion

The researchers came to the conclusion that Geogebra is actually helpful for both teaching and studying Mathematics based on the study's findings. Additionally, the mean performance scores of the students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry prior to using Geogebra Software did not differ significantly. Additionally, the results showed a substantial difference between students using the Geogebra Learning Approach (GLA) and the Conventional Learning Strategy (CLS) in geometry in terms of their mean performance scores. The study's final finding is that there is no statistically significant difference in the mean performance scores of male and female students using the Geogebra Learning Approach (GLA) for geometry and mensuration.

Recommendations

Based on the learning outcomes of the students involved in this study, their responses and the experience gathered in the course of carrying out this research, the following recommendations are put forward in conformity with the findings of this study:

1. Mathematics teachers should be encouraged to use Geogebra Software and other Information and Communication Technology (ICT) facilities such as power point and projector in teaching their students in order to ease problems of teaching Mathematics.
2. Government, proprietors, school authorities, and parents should make computer system available for both the teachers and students. There should be conferences, seminars, workshops and in service training for the teachers on how to improve in teaching of Mathematics, including the thorough training on how to use this software package effectively, since it is impossible to give what you do not have.
3. Mathematics teachers should be encouraged to attend workshops, seminars and conferences on how to use Geogebra Software and other soft wares useful for teaching Mathematics and mathematical sciences.

REFERENCES

Adigun, O. T. (2018). Investigation into difficulties confronted by senior secondary school students in the word problem Mathematics test in Oyo State. *abacus. The journal of the Mathematical Association of Nigeria,*43(1), 465-474.

Anastacio, A. (2007). Knowledge without Borders. Opportunities without passports in 37th Annual conference on global engineering at Milwaukee, WI from 10th-13th October.

Arelu, F. (2014). Effects of Tiered Lesson and Group Personalization Instructional on Senior Secondary School Student's Interest and Achievement in Mathematics in Lagos State. Unpublished Ph.D. Thesis, University of Ibadan, Ibadan.

Celen, Y. (2020). Students' opinions on the use of GeoGebra software in Mathematics teaching. *TOJET: The Turkish Online Journal of Educational Technology, 19(4), 84-88.*

Gakbish, J. G., Golji, G. G., & Augustine, M. Y. (2021). Effect of Geogebra Software on senior secondary students academic achievement in algebra in Pankshin LGA of Plateau State.*abacus. The journal of the Mathematical Association of Nigeria,*46(1), 169-176.

Isa,S. G., Mamman, M. A. &Bala, T. (2020).Ethno-mathematics ideas, values and mathematics academic achievement of junior secondary school students in Kano State, Nigeria. *abacus. The journal of the Mathematical Association of Nigeria,*46(1), 220, 230.

Mamman, M. A. &Surajo, I. G. (2021). The effect of Geogebra software on attitude and achievement in circle Geometry among first year students of Kano University of science and technology Wudil, Kano State. *abacus. The journal of the Mathematical Association of Nigeria, 46(1),26-39.*

Ogena, E. B., Lana, R. D., &Sasota, R. S. (2010). Performance of Philippine high schools with special science curriculum in the 2008 trends in international Mathematics and Science study (timss-advanced).

Piaget, J. (1936). Cognitive Development: The Theory of Jean Piaget. Retrieved https://open.library.okstate.edu>2.

Uka, N. K., Iji, C. O., &Ekwueme, C. (2012). Attaining Nigeria Vision 20:20:20 through Mathematics Education. *abacus: The journal of the Mathematical Association of Nigeria,* 37(47), 57-64.

Tella, A. (2013). The effect of peer tutoring and explicit instructional strategies on primary pupils outcomes in Mathematics. *Bulgarian journal of science and education policy (BJSEP).* 7(1), 5-25.

Adeyemi, B. A., Oribobor, O. A. &Adeyemi, B. B. (2012). An overview of Educational Issues in Nigeria: Thoughts and Reflections.

National Policy on Education (NPE) (2013) (5th ed.). Lagos NERDC Press.

Roberts, G. R. (2012). Technology and learning expectations of the net generation. University of Pittsburgh, Johnstown.

White, J. (2012). The impact of technology on students' engagement and achievement in Mathematics classroom. Paper submitted in partial fulfillment of the requirements for the degree of masters of education, Memorial University, NL.

Apperson, J., Laws, E., and Scepansky, J. (2006). The Impact of Presentation Graphics on Students' Experience in the Classroom. *Computers and Education,* 47(1), 116-126.

Hohenwater, M. (2001).GeoGebra- Ein Softwaresystem for dynamics Geometric and Algebra. Master's Thesis, University of Salzburg, Salzburg. In the Turkish online Journal of Educational Technology. Retrieved from www.tojet.net/articles.

Hutkemri&Zakaria, E. (2012). The effect of Geogebra on students' conceptual and procedural knowledge of function. *Indian Journal of Science and Technology*, 5(12), 3802-3808.

Tamam, B. &Dasari, D. (2021).The use of Geogebra software in teaching Mathematics. *Journal of Physics: Conference series* 1882(1): 012042.

Jalatu, S. (2018). Effect of Geogebra-Aided REACT Strategy on Understanding of Geometry Concepts. *International Journal of Instruction*. 11, 325-336.

Popoola, B. A. & Ajani, T. O. (2011). Influence of Pupils' Gender, Environment and School ownership Status on Mathematics Performance of Secondary School Students in Yewa-North, Ogun State. *Journal of Mathematical Association of Nigeria,* 36(1), 56-66.