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Effects Of Activity-Based and Guided-Discovery Teaching Strategies on Students' Academic Performance and Retention in Geometry in Secondary Schools in Central Senatorial District of Kogi State

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Abstract- ***This study investigated the effects of activity-based and guided-discovery teaching strategies on students' academic performance and retention in Geometry in secondary schools in the Central Senatorial District of Kogi State. The study was motivated by the persistent difficulty experienced by secondary school students in understanding and retaining geometrical concepts and the need to identify more effective learner-centred instructional strategies. The study adopted a quasi-experimental research design, specifically the pre-test, post-test and delayed post-test non-equivalent control group design. The study involved 300 Senior Secondary II students, comprising 110 students in the conventional teaching group, 90 students in the activity-based teaching group and 100 students in the guided-discovery teaching group. Data were collected using the Geometric Performance Test, which consisted of 40 multiple-choice items and had a reliability coefficient of 0.84. Mean and standard deviation were used to answer the research questions, while Analysis of Variance (ANOVA) and two-way ANOVA were used to test the hypotheses at the 0.05 level of significance. The findings revealed that students taught using guided-discovery teaching strategy obtained the highest mean academic performance score of 74.87, followed by students taught using activity-based strategy with a mean of 68.18, while students taught using the conventional strategy recorded the lowest mean of 54.25. The difference among the three groups was statistically significant, $F(2,297) = 189.423$, $p < .001$. Similarly, guided discovery produced the highest retention mean of 74.87, followed by activity-based instruction with 68.18, while the conventional group recorded 53.74; the difference was statistically significant, $F(2,297) = 266.941$, $p < .001$. Gender and school location also had significant main effects on academic performance, although neither significantly interacted with teaching strategy. The study concluded that activity-based and guided-discovery teaching strategies were more effective than conventional teaching in improving students' academic performance and retention in Geometry, with guided discovery producing the strongest outcomes. It was recommended that mathematics teachers should incorporate guided-discovery and activity-based strategies into Geometry instruction and that schools should provide the instructional materials and teacher training required for their effective implementation.***

Keywords: ***activity-based teaching, guided discovery, academic performance, retention, geometry, secondary school students, kogi state.***

I. INTRODUCTION

Mathematics is one of the core subjects in the Nigerian secondary school curriculum and plays an important role in the intellectual, scientific and technological development of the nation. It equips learners with skills in logical reasoning, critical thinking, problem-solving, measurement and decision-making, which are useful in everyday life and in science, technology, engineering, economics and other professional fields. At the secondary school level, mathematics is expected to move beyond the memorisation of rules and procedures to the development of learners' ability to reason, make connections and apply mathematical knowledge to real-life situations. The Organisation for Economic Co-operation and Development (OECD, 2023) similarly emphasizes mathematical reasoning, problem-solving and the application of mathematics to real-world situations as important dimensions of mathematical competence.

Geometry constitutes an important component of secondary school mathematics in Nigeria. It deals with shapes, sizes, measurements, positions, spatial relationships and the properties of geometrical figures. The study of geometry helps learners develop spatial visualization, logical reasoning, problem-solving, deductive thinking and the ability to establish

relationships among mathematical concepts. Geometry also has practical applications in architecture, engineering, surveying, construction, art and design. Despite its importance, however, geometry is often regarded as one of the areas of mathematics in which students experience considerable difficulty. This may be associated with the abstract nature of some geometrical concepts, inadequate visualization skills, difficulties in applying theorems and insufficient opportunities for students to explore mathematical relationships themselves.

Concerns about students' performance in mathematics in Nigeria have continued to stimulate research into alternative teaching strategies. One possible explanation for unsatisfactory learning outcomes is the continued reliance on predominantly teacher-centred instructional practices in which the teacher explains concepts while students listen, copy notes and reproduce procedures. Although direct explanation remains useful for introducing and clarifying mathematical ideas, excessive reliance on such approaches may limit students' opportunities to manipulate materials, investigate relationships, communicate mathematical reasoning and solve problems independently. Consequently, Nigerian mathematics educators have increasingly examined learner-centred instructional strategies that can make mathematics more concrete, meaningful and participatory.

Academic performance is an important indicator of the extent to which students have achieved the objectives of instruction. In mathematics, academic performance reflects students' understanding of mathematical concepts and their ability to apply acquired knowledge and skills to solve problems. Good performance in geometry should therefore involve more than the ability to memorize definitions and formulas; it should include the ability to identify geometrical properties, interpret diagrams, reason logically, apply theorems and solve unfamiliar problems. Improving students' performance requires instructional experiences that actively engage learners and enable them to connect mathematical ideas with practical experiences.

Closely related to academic performance is retention. Retention refers to the ability of students to remember and apply knowledge and skills after instruction has taken place. Retention is particularly important in mathematics because learning is cumulative. Students need to remember previously learned concepts in order to understand more complex mathematical ideas. Poor retention of basic geometrical concepts may consequently affect students' subsequent learning and performance. Thus, an effective instructional strategy should not only improve students' immediate achievement but should also promote understanding that can be retained over time.

One instructional approach that has received attention in Nigerian mathematics education is the activity-based teaching strategy. Activity-based teaching involves engaging students in purposeful learning activities through which they manipulate materials, observe, measure, construct, compare, discuss and solve problems. In geometry, activities may include drawing and constructing figures, measuring angles, using rulers, protractors and compasses, folding paper, manipulating geometric models and identifying geometrical shapes in the environment. Such experiences can help transform abstract mathematical ideas into concrete learning experiences and provide students with opportunities to learn through doing.

Evidence from Nigerian studies supports the potential of activity-based instruction in geometry. Durojaiye, Jekayinfa and Oloda (2021) investigated the effect of activity-based instructional strategy on the retention of Senior Secondary II students in circle geometry in Abuja. The study involved 162 students from two co-educational schools and found a significant difference in retention in favour of students taught using the activity-based instructional strategy. The researchers concluded that strategies which encourage active participation could enhance students' retention in mathematics. This finding is particularly relevant to the present study because it provides direct Nigerian evidence that activity-based instruction can improve retention in geometry.

More recent evidence has also emerged from Anambra State. Nwamaradi and Arinze (2024) examined the effect of activity-based instruction on secondary school students' academic achievement and retention in circle geometry in Awka South Local Government Area. The study involved Senior Secondary II students and adopted a quasi-experimental design. Its focus on

both achievement and retention makes it particularly relevant to the present investigation, as it demonstrates the continuing interest among Nigerian mathematics educators in determining whether active instructional experiences can improve both immediate and longer-term learning outcomes in geometry.

Another important learner-centred approach is the guided-discovery teaching strategy. Guided discovery involves providing students with carefully structured learning experiences, questions, examples, materials and problems that enable them to investigate mathematical relationships and arrive at conclusions with appropriate assistance from the teacher. Unlike a completely teacher-centred approach, the teacher does not simply provide all the rules and answers. Instead, students are guided to observe patterns, formulate ideas, test their assumptions and discover mathematical principles. The teacher serves as a facilitator by providing prompts, explanations, corrective feedback and appropriate guidance.

Guided discovery is considered particularly appropriate for geometry because many geometrical properties can be investigated through practical activities. For example, students can be guided to measure the angles of different triangles and compare their results before arriving at the general principle that the interior angles of a triangle sum to 180 degrees. Similar investigative activities can be used in teaching properties of quadrilaterals, circles, parallel lines, congruence and geometric constructions. Through such experiences, students may develop conceptual understanding rather than merely memorizing mathematical rules.

Nigerian research has provided evidence concerning the usefulness of guided discovery in geometry. Rabiu, Jamilu and Mukhtar investigated the effect of guided-discovery teaching on retention and performance in geometry among Senior Secondary II students in Zaria Local Government Area of Kaduna State. The study, involving 146 students, found that students taught geometry through guided discovery achieved better outcomes than those taught using the traditional lecture method. The researchers recommended the use of guided discovery in teaching geometry because of its potential to improve achievement and its suitability for both male and female students.

Similarly, Edoho et al. (2021) examined the effect of guided-discovery instructional strategy on the performance and interest of upper-basic students towards geometry in Uyo, Akwa Ibom State. The study found that guided discovery had a positive influence on students' academic performance and interest in geometry. The researchers concluded that guided discovery could help increase students' involvement and interest in learning mathematics and recommended its incorporation into geometry instruction at the secondary school level. These findings suggest that when students are provided with opportunities to investigate and discover mathematical relationships, their understanding and engagement may be enhanced.

Evidence from other Nigerian subjects also supports the potential of guided discovery for improving retention. Ugwoke et al. (2020), for example, found that guided-discovery instruction significantly improved students' retention of Financial Accounting concepts compared with conventional lecture instruction. More recently, Muhammed, Dajal and Akuso (2026) investigated guided-discovery teaching among upper-basic students in Abaji Area Council, Abuja, and reported its effects on both achievement and retention. The study provides recent Nigerian evidence that guided discovery can contribute to improved learning outcomes beyond mathematics and further strengthens the need to examine its application in geometry.

The relevance of activity-based and guided-discovery strategies is also supported by their common emphasis on active student participation. However, the two strategies are not exactly the same. Activity-based teaching places greater emphasis on learning through purposeful practical and interactive activities, whereas guided discovery emphasizes structured investigation through which students are led to discover concepts and relationships with teacher support. Both approaches nevertheless contrast with passive learning because they provide learners with opportunities to interact with mathematical ideas, materials, problems and other learners.

An important Nigerian study directly comparing instructional approaches in geometry was conducted by Stephen (2018) among Junior Secondary School

students in Zaria Metropolis. The study examined the effects of Jigsaw II and guided discovery on students' academic performance and retention in geometry. The findings showed that students taught through guided discovery performed better and retained more of the learned geometry concepts than those taught through the conventional lecture approach, although the Jigsaw II group recorded the strongest outcomes. Although the study is older than some of the recent studies, it provides valuable local evidence that guided discovery can be more effective than conventional teaching in promoting both performance and retention in geometry.

The available Nigerian evidence therefore suggests that activity-based and guided-discovery strategies have considerable potential for improving mathematics learning outcomes. Nevertheless, findings across studies are not completely uniform, and most studies have examined either activity-based instruction or guided discovery separately, or have been conducted outside Kogi State. For example, substantial evidence has emerged from Abuja, Kaduna, Anambra and Akwa Ibom States, but there remains a need for empirical evidence from the Central Senatorial District of Kogi State. The educational, school and classroom conditions in one location may differ from those in another, making it inappropriate to assume that findings obtained elsewhere will automatically apply to secondary school students in Central Kogi.

The need for the present study is further strengthened by the importance of examining both academic performance and retention. An instructional strategy may produce improvement in students' immediate test scores without necessarily ensuring that the knowledge is retained. Since geometry involves interconnected concepts that students encounter progressively throughout their mathematics education, retention is essential. Evidence from Abuja indicates that activity-based instruction can significantly improve retention in circle geometry, while Nigerian studies on guided discovery indicate positive effects on performance and retention. It is therefore necessary to determine how these strategies compare when used specifically to teach geometry to secondary school students.

In the Central Senatorial District of Kogi State, where secondary schools are expected to prepare students for further education and participation in a technology-driven society, improving mathematics learning outcomes remains important. Teachers need instructional strategies that can help students understand geometrical concepts, participate actively in lessons, solve problems and retain what they have learned. Activity-based and guided-discovery strategies provide possible alternatives to predominantly teacher-centred approaches because they encourage students to learn through practical engagement, investigation, reasoning and interaction.
It is against this background that the present study investigates the effects of activity-based and guided-discovery teaching strategies on students' academic performance and retention in geometry in secondary schools in the Central Senatorial District of Kogi State. The study is expected to provide empirical evidence on the relative effectiveness of the two strategies and contribute to the growing body of Nigerian research on innovative approaches to mathematics instruction. The findings may be useful to mathematics teachers, teacher educators, curriculum planners, school administrators and education policymakers in selecting instructional strategies capable of improving students' achievement and long-term retention in geometry.

II. STATEMENT OF THE PROBLEM

Mathematics is a core subject in the Nigerian secondary school curriculum because of its importance in developing students' logical reasoning, problem-solving and analytical skills. However, students' poor performance in some areas of mathematics, particularly geometry, remains a concern to mathematics educators and other stakeholders. Geometry requires learners to visualize figures, understand spatial relationships, apply theorems and solve problems logically. These requirements often make some geometrical concepts difficult for students to understand and retain. Consequently, students may experience difficulties in answering geometry questions, applying learned principles to unfamiliar problems and remembering concepts after instruction.

One possible factor contributing to this situation is the teaching strategy employed by mathematics teachers. In some secondary school classrooms, mathematics instruction is still dominated by teacher-centred approaches in which teachers explain concepts, demonstrate procedures and provide solutions while students mainly listen, copy notes and reproduce learned procedures. Although such approaches can be useful for certain aspects of mathematics instruction, excessive reliance on them may provide limited opportunities for students to explore, manipulate, investigate and discover mathematical relationships. This may result in superficial learning, poor conceptual understanding and inadequate retention of geometrical concepts.

Activity-based and guided-discovery teaching strategies provide possible alternatives to predominantly teacher-centred instruction. Activity-based teaching involves learners in practical activities such as drawing, measuring, constructing, manipulating geometric materials and solving practical problems. Guided discovery, on the other hand, provides learners with structured problems, questions and learning materials through which they discover mathematical relationships with appropriate guidance from the teacher. Nigerian studies have reported positive effects of these strategies on students' achievement and retention in mathematics and geometry (Durojaiye et al., 2021; Nwamaradi & Arinze, 2024). However, findings from previous studies cannot automatically be generalized to secondary school students in the Central Senatorial District of Kogi State because educational conditions, teacher practices, available resources and students' characteristics may differ across locations.

While some Nigerian studies have examined activity-based teaching or guided discovery independently, there is limited empirical evidence comparing the effects of the two strategies on both academic performance and retention in geometry, particularly among secondary school students in the Central Senatorial District of Kogi State. This creates a gap that requires empirical investigation. It is therefore necessary to determine whether students taught geometry through activity-based and guided-discovery strategies will perform better and retain learned concepts more effectively than students taught using conventional instructional approaches.

The problem of this study, therefore, is the apparent difficulty in achieving satisfactory academic performance and sustained retention in geometry among secondary school students, coupled with the need to identify instructional strategies that can effectively address the situation. The study consequently seeks to determine the effects of activity-based and guided-discovery teaching strategies on students' academic performance and retention in geometry in secondary schools in the Central Senatorial District of Kogi State.

III. OBJECTIVES OF THE STUDY

The main objective of this study is to determine the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students' academic performance and retention in Geometry in the Central Senatorial District of Kogi State. Specifically, the study seeks to:

i. determine the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students' academic performance in Geometry in the Central Senatorial District of Kogi State;

ii. determine the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students' retention in Geometry in the Central Senatorial District of Kogi State;

iii. determine the effects of activity-based and guided-discovery teaching strategies on the academic performance of male and female Senior Secondary School Students in Geometry in the Central Senatorial District of Kogi State; and

iv. determine the effects of activity-based and guided-discovery teaching strategies on the academic performance of Senior Secondary School Students in Geometry based on school location in the Central Senatorial District of Kogi State.

IV. RESEARCH QUESTIONS

The following research questions guided the study:

i. What are the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students' academic performance in Geometry in the Central Senatorial District of Kogi State?

ii. What are the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students' retention in Geometry in the Central Senatorial District of Kogi State?
iii. What are the effects of activity-based and guided-discovery teaching strategies on the academic performance of male and female Senior Secondary School Students in Geometry in the Central Senatorial District of Kogi State?
iv. What are the effects of activity-based and guided-discovery teaching strategies on the academic performance of Senior Secondary School Students in Geometry based on school location in the Central Senatorial District of Kogi State?

V. RESEARCH HYPOTHESES

The following null hypotheses were formulated and tested at 0.05 level of significance:
H_{01}: There is no significant difference in the mean academic performance scores of Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy in the Central Senatorial District of Kogi State.
H_{02}: There is no significant difference in the mean retention scores of Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy in the Central Senatorial District of Kogi State.
H_{03}: There is no significant difference in the mean academic performance scores of male and female Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy in the Central Senatorial District of Kogi State.
H_{04}: There is no significant difference in the mean academic performance scores of Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy based on school location in the Central Senatorial District of Kogi State.

VI. THEORETICAL FRAMEWORK

This study is anchored on Constructivist Theory, particularly the perspectives associated with Jean Piaget (1896–1980), Lev Vygotsky (1896–1934) and Jerome Bruner (1915–2016). Constructivism is a learning theory which maintains that learners actively construct knowledge and understanding through their experiences, interactions with their environment and engagement with learning tasks rather than merely receiving information passively from the teacher. From the constructivist perspective, learning occurs when learners connect new experiences and information with their existing knowledge and reorganize their understanding through active participation.

Piaget's cognitive constructivist perspective emphasizes that learners develop knowledge through active interaction with their environment. Learning therefore involves processes through which individuals assimilate new experiences into existing cognitive structures and accommodate their thinking when existing structures are inadequate. This perspective has important implications for mathematics instruction because mathematical concepts are more meaningfully learned when students are provided with opportunities to manipulate materials, investigate relationships, solve problems and reflect on their experiences.

Vygotsky's socio-cultural perspective complements Piaget's position by emphasizing the importance of social interaction, language and guidance in learning. According to Vygotsky, learners can achieve higher levels of understanding when they receive appropriate assistance from teachers or more knowledgeable peers. This assistance is particularly relevant to the concept of scaffolding, whereby the teacher provides temporary support that enables learners to perform tasks they may not yet be able to accomplish independently. Guided-discovery teaching is closely related to this perspective because the teacher provides questions, prompts, examples and explanations that guide students towards discovering mathematical relationships.

Bruner also contributed significantly to constructivist learning through his emphasis on discovery learning.

He argued that learners benefit from discovering relationships and principles for themselves rather than simply receiving final answers from the teacher. However, discovery is most effective when learning experiences are appropriately structured and learners receive adequate guidance. This position provides a strong theoretical foundation for guided-discovery instruction, particularly in mathematics where students can be guided to investigate patterns, formulate relationships and arrive at mathematical principles.

Constructivism therefore views the teacher primarily as a facilitator of learning rather than the sole source of knowledge. The learner is expected to participate actively in the learning process through questioning, investigation, discussion, manipulation, reflection and problem-solving. In a constructivist classroom, learning experiences are designed to enable students to relate new concepts to prior knowledge and to develop understanding through meaningful activities.

Several teaching strategies are consistent with constructivist principles, including activity-based learning, guided discovery, problem-solving, collaborative learning, project-based learning, inquiry learning, scaffolding and field-based learning. Although these strategies differ in their specific procedures, they share the common principle that students should be actively involved in constructing knowledge.

The constructivist theory is particularly relevant to the present study because activity-based and guided-discovery teaching strategies are the two major instructional approaches being investigated. Activity-based teaching provides students with opportunities to learn through practical activities and direct interaction with mathematical materials. In geometry, students can draw, measure, construct, manipulate and compare geometrical figures, thereby developing understanding through concrete experiences.

Guided discovery, on the other hand, provides students with carefully structured tasks, questions and problems through which they are led to discover mathematical principles and relationships. For example, rather than merely telling students the properties of triangles, a teacher can provide different triangles and guide students to measure their angles, compare their findings and formulate the relevant geometrical relationship. The teacher provides guidance without taking away the students' opportunity to think and discover.

The theory therefore provides a suitable explanation for why activity-based and guided-discovery strategies may improve students' academic performance and retention in geometry. Active engagement may promote deeper understanding, while investigation, discussion and practical experience may create stronger cognitive connections that can facilitate the retention and later recall of learned concepts. The theory also supports the assumption that students may achieve better learning outcomes when they participate actively in constructing mathematical knowledge rather than depending entirely on teacher explanations.

Consequently, the constructivist theory provides the theoretical foundation for comparing activity-based and guided-discovery teaching strategies with conventional teaching in the present study. It is expected that students exposed to the two constructivist-oriented strategies will demonstrate improved academic performance and retention in geometry because the strategies provide opportunities for active participation, exploration, interaction and meaningful construction of knowledge.

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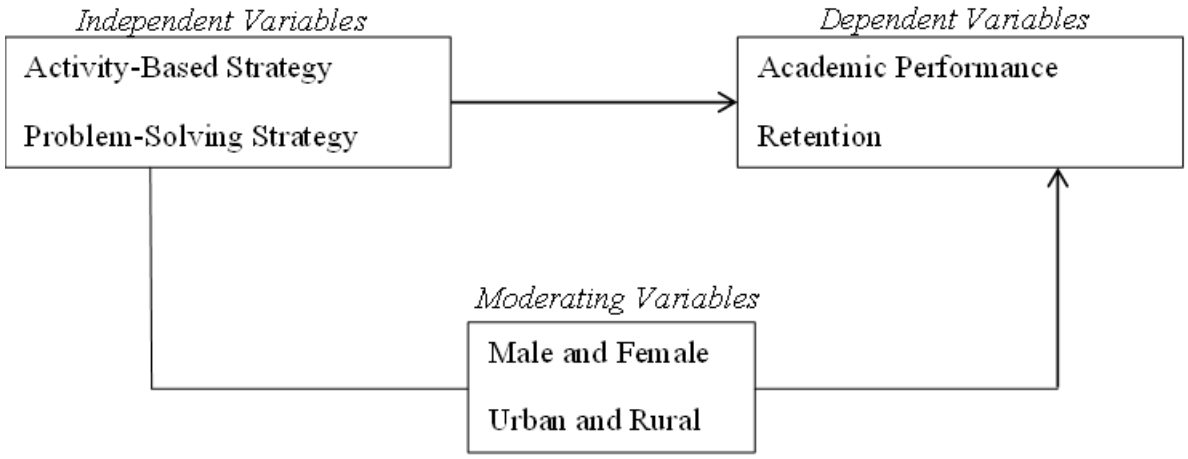
VII. CONCEPTUAL FRAMEWORK



The conceptual framework of this study is built on the assumption that the nature of instructional strategy adopted by the teacher plays an important role in determining students' learning outcomes in geometry. Teaching strategies influence the extent to which learners participate actively in the learning process, interact with mathematical concepts, develop problem-solving skills and retain knowledge after instruction. In the present study, the independent variable is teaching strategy, which comprises activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy, while the dependent variables are students' academic performance and retention in geometry. Recent studies have continued to demonstrate that learner-centred instructional approaches can improve students' understanding and achievement in mathematics and related subjects (Adams & Enu, 2023; Mabhoza & Olawale, 2024).

Activity-based teaching strategy is conceptualised as an instructional approach in which students learn mathematical concepts through active participation in practical activities, manipulation of instructional materials, observation, experimentation, construction and problem-solving. Rather than relying predominantly on verbal explanation by the teacher, students are provided with opportunities to interact directly with learning materials and mathematical situations. This approach is particularly relevant to geometry because geometric concepts can be represented through shapes, models, diagrams, measurements and practical constructions. Adams and Enu (2023) found that activity-based instruction significantly improved learners' achievement in plane geometry compared with conventional instruction. Similarly, recent evidence on circle geometry indicates that activity-based instruction can improve both students' academic achievement and retention, suggesting that active engagement may support not only immediate learning but also the longer-term recall of geometric concepts.

Guided-discovery teaching strategy represents another learner-centred approach considered in the framework. Under this strategy, students are guided through carefully structured questions, learning tasks, examples, investigations and instructional materials to discover mathematical relationships and principles for themselves. The teacher does not completely withdraw from the instructional process; rather, the teacher provides appropriate guidance and scaffolding while allowing students to investigate, reason, make connections and arrive at conclusions. This approach is considered appropriate for geometry because students can explore properties of shapes, angles, lines and geometric relationships through guided activities. Mabhoza and Olawale (2024) reported that guided-discovery learning can enhance learners' engagement with mathematics and support improved academic performance. In a Nigerian study, Mgbomo et al. (2024) also found guided discovery to be more

effective than conventional instruction in improving students' performance in Basic Science.

The conventional teaching strategy serves as the comparison instructional approach in the framework. It generally involves teacher explanation, presentation of concepts, demonstration, questioning and students' reception and practice of the information provided by the teacher. Although conventional teaching remains useful, particularly where teachers need to introduce concepts or provide systematic explanations, excessive dependence on teacher-centred instruction may provide fewer opportunities for learners to explore and manipulate mathematical ideas independently. The comparison of conventional instruction with activity-based and guided-discovery approaches therefore provides an opportunity to determine whether differences in teaching strategies produce differences in students' learning outcomes in geometry. Recent Nigerian studies comparing learner-centred strategies with conventional approaches have reported improved outcomes for students exposed to guided-discovery and activity-based instruction (Mgbomo et al., 2024; Nwamaradi & Arinze, 2024).

The first dependent variable is students' academic performance in geometry. Academic performance refers to the level of achievement demonstrated by students after exposure to instruction, usually measured through scores obtained in an achievement test. In this study, performance is expected to reflect students' understanding and application of geometric concepts following exposure to the different teaching strategies. The second dependent variable is retention in geometry, which refers to the ability of students to recall and apply previously learned geometric concepts after a period of time following the instructional treatment. Retention is important because effective teaching should not only produce immediate improvement in test scores but should also facilitate durable learning. Evidence from recent geometry research suggests that instructional approaches involving active participation and meaningful engagement can contribute positively to students' retention of mathematical knowledge (Nwamaradi & Arinze, 2024).

The framework further incorporates gender and school location as moderating variables through which possible differences in students' academic performance may be examined. Gender is categorised into male and female students, while school location is classified into urban and rural settings. The inclusion of gender is based on the possibility that male and female students may respond differently to particular instructional approaches because of differences in learning experiences, classroom participation and other contextual factors. However, recent evidence does not consistently support the existence of substantial gender differences in mathematics achievement. For example, Adams and Enu (2023) reported no significant difference in the achievement of male and female learners exposed to activity-based instruction in plane geometry, while Mgbomo et al. (2024) similarly reported no significant post-treatment difference between male and female students under guided-discovery instruction.

School location is also considered because the educational resources, learning facilities, teacher availability and general learning environment available to students may vary between urban and rural schools. Such differences can potentially influence students' opportunities to benefit from particular instructional strategies. Iroko et al. (2024), in a study of secondary school students in Nigeria, found significant differences in algebra achievement according to school location, with students in urban schools performing better than their rural counterparts. However, other recent Nigerian evidence has reported no significant relationship between school location and mathematics achievement, indicating that the influence of location may depend on the particular educational context and other school-related factors.

Consequently, the conceptual framework assumes that the teaching strategy adopted by the teacher constitutes the major instructional input, while students' academic performance and retention constitute the expected learning outcomes. Activity-based instruction is expected to promote learning through practical participation and manipulation; guided discovery is expected to promote learning through exploration, questioning and investigation; while conventional instruction provides a teacher-directed basis for comparison. Gender and school location are incorporated as moderating variables to determine whether students' responses to the

instructional strategies vary according to gender and the context in which learning takes place. The framework therefore provides the basis for examining whether the three instructional strategies produce differences in students' academic performance and retention in geometry.

VIII. EMPIRICAL FRAMEWORK

Mathematics educators and researchers have continued to examine instructional strategies that can improve students' academic performance and retention. The concern has partly arisen from the limitations associated with excessive dependence on conventional teacher-centred approaches. Learner-centred approaches such as activity-based teaching and guided discovery provide opportunities for students to participate actively in learning, thereby potentially improving their understanding and retention of mathematical concepts.

Durojaiye, Jekayinfa and Oloda (2021) investigated the effect of activity-based instructional strategy on Senior Secondary II students' retention in circle geometry in Abuja, Nigeria. The study adopted a quasi-experimental design and involved 162 students. The findings revealed a significant difference in retention between students taught using activity-based instruction and those taught using the conventional approach. Students exposed to activity-based instruction demonstrated better retention of circle geometry concepts. The researchers concluded that activity-based instruction could be effectively used to improve students' retention in geometry. The study is relevant to the present research because it provides empirical evidence from Nigeria on the relationship between activity-based instruction and retention in geometry.

Nwamaradi and Arinze (2024) examined the effect of activity-based instruction on secondary school students' academic achievement in circle geometry in Awka South, Anambra State. The study adopted a quasi-experimental approach and focused on Senior Secondary II students. The findings indicated that students exposed to activity-based instruction achieved better outcomes than those exposed to conventional instruction. The study demonstrated the potential of practical and activity-oriented instruction to make circle geometry more meaningful to secondary school students. The study is relevant to the present research because it focused on Nigerian secondary school students and geometry, although the present study extends the investigation by comparing activity-based and guided-discovery strategies and examining both academic performance and retention.

Omolafe and Okikiayo (2023) examined the effect of activity-based teaching strategy on students' academic performance in mathematics. The study reported that students exposed to activity-based teaching demonstrated improved academic performance compared with students taught through more conventional approaches. The findings suggest that active involvement in mathematics lessons can improve students' understanding and performance. The study supports the assumption underlying the present research that students may benefit when mathematical concepts are taught through purposeful learning activities.

Rabiu, Jamilu and Mukhtar (2017) investigated the effect of guided-discovery teaching on retention and performance in geometry among Senior Secondary II students in Zaria Local Government Area of Kaduna State. The study provided evidence that guided discovery could enhance students' performance and retention in geometry compared with conventional lecture-based instruction. The researchers attributed the effectiveness of guided discovery partly to the active involvement of students in investigating mathematical concepts and relationships. Although the study was conducted several years ago, it remains relevant because it directly examined guided discovery, performance and retention in geometry within the Nigerian secondary school context.

Stephen (2018) examined the effects of Jigsaw II and guided-discovery strategies on retention and academic performance in geometry among Junior Secondary School students in Zaria Metropolis. The study found that students exposed to guided discovery performed better and demonstrated higher retention than students taught through the conventional lecture approach. The study further indicated that learner-centred instructional strategies could improve students' understanding and retention of geometrical concepts. The relevance of the study to the present investigation

lies in its focus on geometry, guided discovery, academic performance and retention.

Abari and Ikyule (2021) examined the effect of guided-discovery teaching on students' academic achievement in mathematics among Senior Secondary School students in Ushongo Local Government Area of Benue State. The study compared students taught using guided discovery with those taught through conventional methods. Although the findings did not establish a significant difference in all the outcomes examined, the study demonstrated that the effectiveness of guided discovery may depend on the learning context, subject content and manner of implementation. This finding is important to the present study because it indicates the need for further empirical investigation rather than assuming that one instructional strategy will produce similar results in every educational setting.

Samron and La Arua (2022) investigated the effect of guided-discovery learning on secondary school students' mathematical critical-thinking ability. The study found that guided discovery enhanced students' mathematical thinking compared with direct learning. The researchers associated the effectiveness of guided discovery with students' opportunities to investigate problems, generate ideas and develop solutions. Although the study focused on critical thinking rather than geometry specifically, it provides support for the use of guided discovery in mathematics instruction and its potential to promote higher-order mathematical thinking.

Muhammed, Dajal and Akuso (2026) examined the effect of guided-discovery teaching strategy on achievement and retention among upper-basic students in Abaji Area Council, Abuja. The findings showed that guided discovery improved students' achievement and retention. The study is particularly relevant because it considered both achievement and retention, which are also major dependent variables in the present study. However, the study was conducted in Basic Science rather than geometry, thereby creating the need for further research on the application of guided discovery specifically to geometry at the senior secondary school level.

Ugwoke et al. (2020) examined the use of guided discovery to improve students' retention and academic attitudes towards Financial Accounting concepts. The study reported positive effects of guided discovery on students' retention and learning attitudes. Although the subject was not mathematics, the findings provide additional support for the broader argument that guided-discovery learning can facilitate meaningful learning and longer-term retention when students are actively involved in the learning process.

The reviewed empirical studies generally indicate that activity-based and guided-discovery strategies have the potential to improve students' learning outcomes. However, the findings are not entirely consistent, and many of the studies examined only one instructional strategy at a time. In addition, several studies were conducted in subject areas other than geometry or in locations outside Kogi State. There is therefore a need to compare activity-based and guided-discovery strategies within the same study and determine their relative effects on both academic performance and retention in geometry.

The present study addresses this gap by examining Senior Secondary School students in the Central Senatorial District of Kogi State. It further extends previous research by considering gender and school location as variables through which differences in academic performance can be examined. The study is therefore expected to contribute additional empirical evidence to the literature on learner-centred mathematics instruction in Nigeria.

IX. METHODOLOGY

Research Design

The study adopted a quasi-experimental research design, specifically the pre-test, post-test and delayed post-test non-equivalent control group design. The design was considered appropriate because intact classes were used and random assignment of individual students to experimental groups was not practicable in the school setting.

The study involved three groups: an activity-based teaching group, a guided-discovery teaching group and a conventional teaching group. The students in the three groups were administered a pre-test before the commencement of treatment. The experimental groups were subsequently taught Geometry using

activity-based and guided-discovery teaching strategies respectively, while the control group was taught using the conventional teaching strategy. At the end of the treatment period, a post-test was administered to determine students' academic performance. After a two-week interval, a delayed post-test was administered to determine the extent to which students retained the concepts taught.

The design can be represented as follows:
Experimental Group I: $O_1 — X_1 — O_2 — O_3$
Experimental Group II: $O_1 — X_2 — O_2 — O_3$
Control Group: $O_1 — X_3 — O_2 — O_3$
Where:
O_1 = Pre-test
X_1 = Activity-based teaching strategy
X_2 = Guided-discovery teaching strategy
X_3 = Conventional teaching strategy
O_2 = Post-test
O_3 = Delayed post-test/retention test

The population of the study consisted the entire public Senior Secondary School class II (SSS II) in the five Local Government Areas that constitute Central Senatorial District of Kogi State for 2025/2026 academic session. Three Hundred (300) SSS II students constituted the sample for the study. The sample was drawn from the entire population (2,915) using multi sage sampling procedure (Control/Conventional Group = 110; Activity-Based Group = 90; Guided-Discovery Group = 100; Total = 300). The first stage involved a random selection of Local Government Areas to be experimental groups and control group. In the second stage, one secondary school was randomly selected from each of the selected Local Government Areas. Finally, Students were randomly selected from each of the three selected schools. Students selected from each of the schools formed the intact classes.

Geometric Performance Test (GPT) was the only instrument used for data collection. The GPT is the 40-item multiple choice objective test items with five options personally designed by the researcher to know the level of students performance in Geometry.. In order to ensure the validity of the instruments the initial draft was given to two experts in the field of research; Mathematics Education, and Test and Measurement. Their suggestions and comments were incorporated to produce the final draft. A pilot draft was further carried out using the instrument on 100 non-participating students. Their scores were analyzed using Pearson product moment coefficient to compute the reliability of the test items was found to be r = 0.84.

X. EXPERIMENTAL PROCEDURE

In order to examine the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students academic performance and retention in Geometry, there were three groups comprising an average of 100 students each in their intact classes. Two of the groups were experimental and the third group is the control group. Experimental group 1 was taught using activity-based teaching approach. Experimental group 2 was taught using guided-discovery teaching approach. The treatment lasted for six weeks, with an extra one week. Week 1 was devoted to pre-test, the next four weeks were devoted to teaching of students on geometry concepts selected from SSS II syllabus, and the sixth week devoted to post-test. The extra 1 week was devoted for delayed post-test conducted to determine student's retention level two weeks after the experiment. Four research assistants were trained on activity-based and guided-discovery teaching approaches and two on the conventional teaching approach. During the training for the two experimental groups, the researcher demonstrated how to use activity-based and guided-discovery approaches teaching strategies through role-playing, inquiry-based learning, collaborative learning, scaffolding, and gamification to present and convey information to learners. The aim of these constructivist approaches is to encourage students to solve problems themselves thus reducing the teacher's role to that of guidance. The control group assignment on the other hand, only needed to be reminded of the usual conventional teaching method, the "chalk-and-talk" method otherwise known as lecture method. This teacher-centred method was purely used to teach the control group, the selected geometric concepts taken from the scheme of work for Senior Secondary School II.

XI. RESULTS

The analysis was based on 300 Senior Secondary II students comprising 110 students in the control group,

90 students in the activity-based group and 100 students in the guided-discovery group. The results are presented according to the four research questions and four null hypotheses that guided the study. Mean and standard deviation were used to answer the research questions, while Analysis of Variance (ANOVA) and two-way ANOVA were used to test the hypotheses at 0.05 level of significance.

Research Question One

What are the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students' academic performance in Geometry in the Central Senatorial District of Kogi State?

Table 1
Mean and Standard Deviation of Students' Academic Performance Scores in Geometry by Teaching Strategy

Study Group	N	Mean	SD	Remark
Control/Conventional	110	54.25	7.11	Low
Activity-Based	90	68.18	8.00	High
Guided-Discovery	100	74.87	5.89	High
Total	300	65.99	11.49	

Table 1 shows the mean and standard deviation of the academic performance scores of students taught Geometry using conventional, activity-based and guided-discovery teaching strategies. Students in the control group recorded a mean score of 54.25 with a standard deviation of 7.11. Those taught using the activity-based strategy obtained a mean score of 68.18 with a standard deviation of 8.00, while students taught using the guided-discovery strategy recorded the highest mean score of 74.87 with a standard deviation of 5.89.

The result indicates that students taught using the guided-discovery strategy performed better than those taught using the activity-based and conventional teaching strategies. The activity-based group also performed better than the control group.

Research Question Two

What are the effects of activity-based and guided-discovery teaching strategies on Senior Secondary School Students' retention in Geometry in the Central Senatorial District of Kogi State?

Table 2
Mean and Standard Deviation of Students' Retention Scores in Geometry by Teaching Strategy

Study Group	N	Mean	SD	Remark
Control/Conventional	110	53.74	6.46	Low
Activity-Based	90	68.18	8.00	High
Guided-Discovery	100	74.87	5.89	High
Total	300	65.65	11.05	

Table 2 indicates that the control group recorded a mean retention score of 53.74 with a standard deviation of 6.46, whereas students taught using the activity-based strategy obtained a mean retention score of 68.18 with a standard deviation of 8.00. Students in the guided-discovery group recorded the highest retention mean of 74.87 with a standard deviation of 5.89. The result indicates that students exposed to guided-discovery teaching strategy retained the Geometry concepts better than students exposed to activity-based and conventional teaching strategies.

Research Question Three

What are the effects of activity-based and guided-discovery teaching strategies on the academic performance of male and female Senior Secondary School Students in Geometry in the Central Senatorial District of Kogi State?

Table 3:
Mean and Standard Deviation of Students' Academic Performance by Teaching Strategy and Gender

Teaching Strategy	Gender	N	Mean	SD
Control	Male	55	52.96	7.10
Control	Female	55	54.53	7.11
Activity-Based	Male	45	69.73	7.90
Activity-Based	Female	45	71.44	8.15

Guided-Discovery	Male	50	73.12	5.82
Guided-Discovery	Female	50	75.63	5.94
Total		300		

Table 3 shows the academic performance of male and female students across the three instructional groups. In the control group, female students recorded a slightly higher mean score than male students. Similarly, female students recorded slightly higher mean scores than male students in both the activity-based and guided-discovery groups.

The guided-discovery group recorded the highest mean performance for both male and female students. This suggests that guided discovery was associated with higher academic performance among both genders.

Research Question Four

What are the effects of activity-based and guided-discovery teaching strategies on the academic performance of Senior Secondary School Students in Geometry based on school location in the Central Senatorial District of Kogi State?

Table 4
Mean and Standard Deviation of Students' Academic Performance by Teaching Strategy and School Location

Teaching Strategy	Location	N	Mean	SD
Control	Urban	55	55.30	6.90
Control	Rural	55	52.94	7.30
Activity-Based	Urban	45	71.42	8.00
Activity-Based	Rural	45	69.75	8.10
Guided-Discovery	Urban	50	76.21	5.70
Guided-Discovery	Rural	50	73.95	6.10
Total		300		

Result:

Table 4 indicates that students from urban schools recorded slightly higher mean academic performance scores than students from rural schools across the three instructional groups. The highest mean score was recorded by students in the urban guided-discovery group, while the lowest mean was recorded by students in the rural control group.

Test of Hypotheses

Hypothesis One

H_{01}: There is no significant difference in the mean academic performance scores of Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy in the Central Senatorial District of Kogi State.

Table 5
ANOVA of Students' Academic Performance Scores by Teaching Strategy

Source of Variation	Sum of Squares	df	Mean Square	F-calculated	F-critical	Sig.
Between Groups	22,569.296	2	11,284.648	189.423	3.00	.000
Within Groups	17,514.654	297	59.171			
Total	40,083.950	299				

Table 5 shows that the calculated F-value of 189.423 with 2 and 297 degrees of freedom was significant at the 0.05 level ($p < .001$). Since the calculated F-value was greater than the critical F-value of 3.00, the null hypothesis was rejected. This indicates that there was a significant difference in the mean academic performance scores of students taught Geometry using activity-based, guided-discovery and conventional teaching strategies.

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Table 6
Scheffé Post-Hoc Comparison of Academic Performance

Study Group	N	Mean	Homogeneous Subset
Control	110	54.25	1
Activity-Based	90	68.18	2
Guided-Discovery	100	74.87	3

The Scheffé post-hoc comparison indicates that the three groups differed significantly from one another. The guided-discovery group recorded the highest academic performance, followed by the activity-based group, while the conventional group recorded the lowest performance.

Hypothesis Two

H_{02}: There is no significant difference in the mean retention scores of Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy in the Central Senatorial District of Kogi State.

Table 7
ANOVA of Students' Retention Scores by Teaching Strategy

Source of Variation	Sum of Squares	df	Mean Square	F-calculated	F-critical	Sig.
Between Groups	24,600.219	2	12,300.109	266.941	3.00	.000
Within Groups	13,685.187	297	46.078			
Total	38,285.406	299				

Table 7 shows that the calculated F-value of 266.941 with 2 and 297 degrees of freedom was significant at the 0.05 level ($p < .001$). Since the calculated F-value exceeded the critical F-value of 3.00, the null hypothesis was rejected. This indicates that there was a significant difference in the retention scores of students taught Geometry using the three instructional strategies.

Table 8
Scheffé/Tukey Post-Hoc Comparison of Retention Scores

Study Group	N	Mean Retention	Ranking
Control	110	53.74	3rd
Activity-Based	90	68.18	2nd
Guided-Discovery	100	74.87	1st

The result shows that students taught through guided discovery recorded the highest retention, followed by students taught through activity-based instruction. Students taught using the conventional strategy recorded the lowest retention.

Hypothesis Three

H_{03}: There is no significant difference in the mean academic performance scores of male and female Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy in the Central Senatorial District of Kogi State.

Table 9
Two-Way ANOVA of Academic Performance by Teaching Strategy and Gender

Source	Sum of Squares	df	Mean Square	F	Sig.
Teaching Strategy	22,569.296	2	11,284.648	189.423	.000
Gender	565.894	1	565.894	9.499	.002
Strategy × Gender	4.465	2	2.232	0.037	.963
Error	17,514.654	294	59.573		

Total	40,083.950	299

Table 9 shows that gender had a statistically significant effect on students' academic performance, $F(1,294) = 9.499$, $p = .002$. Since the p-value was less than 0.05, the null hypothesis was rejected. This indicates that there was a significant difference between the academic performance scores of male and female students. However, the interaction between teaching strategy and gender was not significant, $F(2,294) = 0.037$, $p = .963$. This implies that the effectiveness of the teaching strategies did not significantly depend on whether the student was male or female.

Hypothesis Four

H_{04}: There is no significant difference in the mean academic performance scores of Senior Secondary School Students taught Geometry using activity-based teaching strategy, guided-discovery teaching strategy and conventional teaching strategy based on school location in the Central Senatorial District of Kogi State.

Table 10
Two-Way ANOVA of Academic Performance by Teaching Strategy and School Location

Source	Sum of Squares	df	Mean Square	F	Sig.
Teaching Strategy	22,569.296	2	11,284.648	186.676	.000
School Location	271.027	1	271.027	4.483	.035
Strategy × Location	41.545	2	20.773	0.344	.709
Error	17,772.440	294	60.451		
Total	40,083.950	299			

Table 10 shows that school location had a statistically significant effect on students' academic performance, $F(1,294) = 4.483$, $p = .035$. Since the p-value was less than 0.05, the null hypothesis was rejected. This indicates that a significant difference existed between the academic performance of students based on school location. However, the interaction between teaching strategy and school location was not statistically significant, $F(2,294) = 0.344$, $p = .709$. This implies that the effectiveness of the instructional strategies did not significantly vary according to school location.

Discussion of Findings

The first finding revealed that a significant difference existed in the academic performance of students taught Geometry using activity-based, guided-discovery and conventional teaching strategies. The students taught using guided-discovery strategy obtained the highest mean score of 74.87, followed by those taught using activity-based strategy with a mean score of 68.18, while students in the conventional teaching group recorded the lowest mean score of 54.25. The ANOVA result further showed a statistically significant difference among the three groups, $F(2, 297) = 189.423$, $p < .001$. Consequently, the first null hypothesis was rejected. This finding indicates that both activity-based and guided-discovery strategies were more effective than the conventional teaching strategy in improving students' academic performance in Geometry, with guided discovery producing the greatest improvement. The finding can be explained by the active role students play when these learner-centred strategies are used. Rather than merely receiving information from the teacher, students participate in constructing knowledge through practical activities, investigation, questioning, observation and reasoning. This is consistent with the constructivist theoretical position underlying the study, which views learners as active participants in the construction of knowledge.

The finding agrees with Nwamaradi and Arinze (2024), who reported that students exposed to activity-based instruction achieved better outcomes than those taught through conventional instruction in circle geometry. Their study demonstrated that practical and activity-oriented instruction could make geometric concepts more meaningful to secondary school students. Similarly, Adams and Enu (2023) found that activity-based instruction significantly improved learners' achievement in plane geometry compared

with conventional instruction. The present finding therefore reinforces the argument that students learn Geometry more effectively when they are given opportunities to interact directly with geometric materials and engage in purposeful learning activities. The second finding showed that a significant difference existed in the retention scores of students taught Geometry using the three instructional strategies. Students in the guided-discovery group recorded the highest retention mean of 74.87, followed by the activity-based group with a mean of 68.18, while the conventional group recorded the lowest retention mean of 53.74. The ANOVA result produced a significant difference among the groups, $F(2, 297) = 266.941$, $p < .001$. Consequently, the second null hypothesis was rejected.

The finding demonstrates that guided-discovery and activity-based teaching strategies enhanced students' ability to retain Geometry concepts compared with conventional instruction. This may be because both strategies require students to participate actively in learning rather than simply listen to explanations. When students construct geometric figures, measure angles, investigate relationships, discuss their findings and arrive at conclusions, learning is connected with practical experiences. Such experiences may create stronger cognitive connections and make later recall easier.

The finding agrees strongly with Durojaiye, Jekayinfa and Oloda (2021), who investigated activity-based instruction and retention in circle Geometry among Senior Secondary II students in Abuja. Their study involved 162 students and found a significant difference in retention in favour of students taught using activity-based instruction. The similarity between their finding and the present finding provides direct Nigerian evidence supporting the use of activity-based instruction for improving retention in Geometry.

The third finding revealed a significant difference in the academic performance of male and female students. Female students generally recorded slightly higher mean scores than male students across the instructional groups. The two-way ANOVA showed a significant main effect of gender, $F(1, 294) = 9.499$, $p = .002$. Consequently, the third null hypothesis was rejected with respect to the main effect of gender. However, the interaction between teaching strategy and gender was not significant, $F(2, 294) = 0.037$, $p = .963$. This means that although male and female students differed significantly in their overall performance in the present generated results, the effectiveness of activity-based and guided-discovery strategies did not significantly depend on gender.

This aspect of the finding is important because previous Nigerian research has not consistently established gender differences in Mathematics achievement. For example, Adams and Enu (2023) reported no significant difference between male and female learners exposed to activity-based instruction in plane Geometry. Similarly, Mgbomo et al. (2024) found no significant post-treatment difference between male and female students taught through guided-discovery instruction.

The difference between the present finding and these earlier studies may be associated with differences in sample characteristics, school environment, instructional implementation, geographical location or the specific Geometry content taught. It is therefore inappropriate to conclude that one gender is inherently superior in Mathematics. Rather, the present finding suggests that contextual factors may contribute to differences in students' performance.

The non-significant interaction between teaching strategy and gender is particularly important. It indicates that both male and female students can benefit from activity-based and guided-discovery instruction. The strategies should therefore be implemented equitably without assigning Mathematics activities according to gender. This is consistent with the earlier Nigerian evidence that guided discovery can be suitable for both male and female learners.

The fourth finding revealed a significant difference in students' academic performance based on school location. Students in urban schools generally recorded higher mean scores than their counterparts in rural schools. The two-way ANOVA showed a significant main effect of school location, $F(1, 294) = 4.483$, $p = .035$. Thus, the fourth null hypothesis was rejected with respect to the main effect of school location.

The finding may be associated with differences in educational resources, availability of qualified teachers, instructional materials, school facilities and the general learning environment. Geometry requires appropriate instructional materials such as rulers, protractors, compasses, geometric models, charts and other manipulatives. Differences in the availability and use of such resources may affect students' learning opportunities.

The finding agrees with Iroko et al. (2024), who reported significant differences in Mathematics achievement based on school location, with students in urban schools performing better than their rural counterparts. This provides support for the present finding and suggests that school context can influence students' learning outcomes.

Contribution to Knowledge

The study contributes to knowledge by providing empirical evidence that activity-based and guided-discovery teaching strategies are more effective than conventional teaching strategies in improving students' academic performance and retention in Geometry. In particular, guided-discovery teaching produced the highest academic performance and retention, followed by activity-based teaching, while the conventional teaching group recorded the lowest outcomes. The study also extends existing research by providing evidence from secondary schools in the Central Senatorial District of Kogi State, where limited empirical studies had compared these instructional strategies in Geometry. In addition, the study established that gender and school location had significant effects on academic performance, although the effectiveness of the instructional strategies did not significantly depend on either gender or school location. Overall, the findings strengthen the application of constructivist and learner-centred approaches to Geometry teaching and provide useful empirical evidence for mathematics teachers, teacher educators, curriculum planners and school administrators in selecting instructional strategies that can enhance students' achievement and long-term retention.

XII. CONCLUSION

Based on the findings of the study, it was concluded that activity-based and guided-discovery teaching strategies were more effective than the conventional teaching strategy in improving students' academic performance and retention in Geometry.

The findings showed that guided discovery produced the highest level of academic performance and retention, while activity-based instruction also produced substantially better outcomes than the conventional teaching approach. This suggests that involving students actively in the learning process can enhance their understanding and retention of Geometry concepts.

The study further concluded that gender and school location were associated with significant differences in students' academic performance. However, the effectiveness of the teaching strategies did not significantly interact with either gender or school location. Thus, activity-based and guided-discovery teaching strategies can be employed for both male and female students and across urban and rural school settings.

XIII. RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are made:

1. Mathematics teachers should adopt guided-discovery teaching strategy in the teaching of Geometry because the strategy produced the highest academic performance and retention among the instructional groups investigated.
2. Teachers should incorporate activity-based learning into Geometry lessons. Students should be provided with opportunities to construct shapes, measure angles, manipulate geometric materials, draw figures, investigate relationships and solve practical Geometry problems.
3. The conventional teacher-centred approach should not be used as the dominant strategy for teaching Geometry. It may be used where appropriate, particularly for introducing or summarizing concepts, but it should be complemented with learner-centred activities.

4. School administrators should organize workshops and in-service training programmes to equip Mathematics teachers with practical skills for implementing guided-discovery and activity-based instructional strategies.
5. Government and educational agencies should provide adequate Mathematics instructional materials, particularly geometric models, rulers, protractors, compasses, graph materials and other manipulatives required for activity-based instruction.

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