Effects of Laboratory and Guided-Discovery Strategies on Attitude in Geometry among Senior Secondary School Students, Katsina State, Nigeria

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Abstract
The main objective of this study was to find out the effect of laboratory and guided discovery strategies on attitude in geometry among senior secondary schools students in Katsina State, Nigeria. The quasi experimental group design was used. Two hundred and sixty five (265) sampled students were used from a total population of six thousand one hundred and fifty seven (6,157) students in the study area. Geometrical concepts attitude questionnaires was used as instrument for data collection in this research work. The data collected was analyzed and presented using mean and standard deviation and using Mann-Whitney (U-test) which appropriate when analyzing non-parametric data for only two (2) groups. Pretest result revealed that both experimental groups do not differ significantly in terms of their attitudes. However, posttest result revealed that experimental group one and two differ significantly in terms of their attitudes in favour of experimental group one. This shows that laboratory activity strategy has impact positively on student's attitude in geometry. Based on the findings of this study, it was recommended that: mathematics teachers should be using mathematics laboratory in teaching and learning of geometry in their schools; parent teachers association and non-governmental organization can assist by providing laboratory and its equipment that will enable mathematics teachers to teach geometry using laboratory activity strategy; textbook publishers should publish textbooks that contain the guidelines and procedures for teaching geometry using laboratory activity strategy; curriculum developers and educational planners should emphasize the use of laboratory activity strategy as a solution to the problem of poor attitude of students in geometry in particular and mathematics in general. In addition, further research work on the use of laboratory activity strategy could be extended to junior secondary schools, tertiary institutions as well as to other areas of mathematics curriculum such as trigonometry, statistics, probability, algebra.

Keywords: Laboratory Activity Strategy; Guided-DiscoveryStrategy;Attitude; Geometry.

Introduction
Education can be described as the collection of life-long experiences that equip individuals to adapt to society and live meaningfully. The prosperity of any nation is strongly tied to the quality of its education

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system, and mathematics plays a central role in this regard. As observed by Orialfo (2003), the progress of science and technology in any country is largely determined by the strength of its mathematics education. Mathematics cuts across all aspects of human endeavor and has become a vital subject for daily life. According to the Federal Republic of Nigeria (FRN, 2013), mathematics should be seen as a tool for developing logical thinking, reasoning, and problem-solving skills. With the integration of technology and computers into schools, mathematics instruction needs to be redesigned to align with modern tools, ensuring more effective learning.

Agwagah (2007) stressed that ineffective teaching of mathematics could be addressed through innovative approaches such as the mathematics laboratory and guided discovery strategies. The traditional method of drill and rote memorization often leaves students disengaged, while activity-based approaches create motivation and deeper understanding. Esu (2006) linked students' poor performance in mathematics to challenges such as lack of qualified teachers, poor instructional methods, limited use of instructional materials, and absence of mathematics laboratories. Similarly, WAEC ChiefExaminers' reports (2015) consistently highlighted students' weaknesses in topics like circle geometry and three-dimensional problems. Many candidates avoided such questions, and those who attempted them often displayed misconceptions in their workings.

The persistent low performance in mathematics examinations is a serious concern. WAEC records show that between 2010 and 2020, the percentage of students who obtained credit passes (A1–C6) remained relatively low, while failure rates (F9) were consistently high (WAEC Statistics Office, Katsina State, 2021). These results suggest that the abstract nature of mathematics contributes to students' negative attitudes and poor achievement. Therefore, teaching approaches that emphasize practical experiences, problem-solving, and hands-on activities—such as the laboratory method and guided discovery strategy—are increasingly necessary to improve learning outcomes.

Objective of the Study

This study aimed at investigating the effects of laboratory and guided discovery strategies on attitude in geometry among senior secondary schools students in Katsina State, Nigeria.

Specifically, the objectives of the study are to:

1.investigate the effects of laboratory and guided discovery strategies on the levels attitudinal level changes among senior secondary students in geometry.

Research Question

Based on the stated objective, the following research question was raised to guide the study:

1.Is there any difference in the levels attitude changes of students taught geometry using laboratory activity strategy and those taught using guided discovery strategy?

Null Hypothesis

Thefollowingnullhypothesiswere formulated and tested at $P \leq .05$ level of significance:

$H0_1$:There is no significant difference between the attitude of students taught geometry using laboratory activity strategy and those taught using guided discovery strategy.

Research Methodology

This study employed a **quasi-experimental research design** involving pre-test, post-test, and post-posttest, since it was not a

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pure laboratory experiment. Two intact groups were selected for the study, both comparable in terms of facilities, teacher quality, and prior performance. Group I was taught using the Laboratory Activity Strategy, while Group II received instruction through the Guided Discovery Approach. Both groups were administered a pre-test to establish baseline equivalence before treatment, and a post-test after six weeks of instruction to measure the effect of the strategies.

Population and Sample

The population comprised all Senior Secondary II students in public co-educational day schools within Malumfashi Education Zone. The zone has 23 schools with a total of 6,157 SS II students, made up of 4,252 males and 1,905 females, with an average age of 17 years. From this population, two schools were selected through simple random sampling. The first school was chosen from the two schools in the zone that had mathematics laboratories, while the second was selected from the 21 schools without laboratories. The sampled schools were Government Day Secondary School (GDSS) Malumfashi and GDSS Danrimi, which served as Experimental Groups I and II respectively.

A total of 265 students participated in the study, which is considered an adequate sample size in line with the Central Limit Theorem that recommends a minimum of 30 participants for studies of this nature.

Instrumentation

The instrument used for data collection was the **Geometrical Concepts Attitude Questionnaire (GCAQ I and II)** developed by the researcher. The pre-test version (GCAQ I) consisted of 20 items based on a modified Likert scale to measure students' attitudes towards geometry. The scale had five response options: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD). Positive items were scored from 5 (SA) to 1 (SD), while negative items were scored in reverse order. Scores ranged from a minimum of 20 to a maximum of 100, with 60 as the cutoff for positive attitude.

Treatment Procedures

Two lesson plans were developed—one based on the Laboratory Activity Strategy and the other on the Guided Discovery Strategy—covering the same content and objectives in geometry.

- **Experimental Group I (Laboratory Activity Strategy):** Lessons followed six structured steps: preparation, laboratory set-up, grouping of students (minimum six per group), presentation using laboratory equipment, evaluation, and conclusion. Students engaged in hands-on exploration of geometric concepts with the aid of the mathematics laboratory.
- **ExperimentalGroup II (Guided Discovery Strategy):** Instruction followed the five stages of the 5E model: engagement (problem identification), exploration (problem-solving), explanation (classification of findings), elaboration (generalization), and evaluation (feedback). Learners actively participated in discovering mathematical concepts under teacher guidance.

Data Analysis

Descriptive statistics (mean and standard deviation) were used to answer the research question, while the null hypothesis was tested at 0.05 level of significance. Since the data were non-parametric and involved only two groups, the Mann–Whitney U test was employed to compare students' attitudes between the two strategies.

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Results

Research Question One: What is the difference in the levels attitude changes of students taught geometry using laboratory activity strategy and those taught using guided discovery strategy? The result is presented in Table 1.1

Table 1.1: Ranks and Sum of Ranks on Geometric Attitude Change of Experimental Group I and II.

Variable	N	Ranks	Sum of Ranks.	Df	Ranks Difference
EG I	139	175	21,230		
				263	106
EG II	126	69	8340		

The result in Table 1.1 showed the mean-ranks of laboratory activity strategy to be 175 while the mean-ranks of the guided discovery approach was 69 which showed that a mean-rank difference of 106 in favour of experimental group I, we conclude the decision when the hypothesis one is tested.

Null Hypothesis One (H_{01}): There is no significant difference between the attitude of students taught geometry using laboratory activity strategy and those taught using guided discovery strategy. To test this null hypothesis one, Mann-whitney U-test analysis was used as presented in Table 1.2

Table 1.2: Mann-Whitney U-test Analysis on Geometric Attitudinal Change of Experimental Group I and II.

Variable	N	Ranks	Sum of RanksD.	U_{cal}	U_{crit}	Decision
EG I	139	175	21,230			
				943	-12.4	Significant
EG II	126	69	8,340			

Significant at $P \geq 0.05$

The result in Table 1.2 showed that U_{cal} = 943 and U_{crit} = -12.4 which showed that $U_{cal} > U_{crit}$ (943 > -12.4). Hence, a mean-ranks difference of 106 was significant and it was concluded that, there was significant difference between the geometric attitudinal change of students taught using laboratory activity strategy and those taught using guided discovery approach.

Conclusion

The study concludes that the Laboratory Activity Strategy has a stronger positive effect on students' attitudes towards geometry than the Guided Discovery Strategy. Engaging students in hands-on laboratory activities provided them with concrete experiences that enhanced their interest, motivation, and willingness to learn mathematical concepts.

Summary of the Major Findings

The major findings of the study was the Experimental group one (i.e. those students taught using Laboratory Activity Strategy) have more positive attitude towards learning geometrical concepts than the experimental group two (i.e. those students taught using Guided Discovery Strategy).

Recommendations

Based on these findings, the following recommendations are made:

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1. Mathematics teachers should incorporate laboratory activities into their classroom instruction to foster positive attitudes toward geometry and mathematics in general.
2. The Katsina State Government should provide well-equipped mathematics laboratories in all public senior secondary schools to support effective teaching and learning.
3. Teacher education institutions, such as Colleges of Education and Universities, should integrate the use of laboratory-based strategies in their training programs so that prospective teachers are well-prepared to apply them in practice.
4. By using laboratory activity strategies, teachers can create opportunities for students to explore, question, explain, and evaluate their own learning, thereby improving their performance, attitude, and retention in mathematics.

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