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Geoboard And Pattern Blocks Utilization On Secondary School Students' Performance In Mathematics In Obio Akpor Local Government Area Of Rivers State

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ABSTRACT
This study evaluated the utilization of geoboard and pattern blocks on senior secondary school students' performance in Mathematics in Obio Akpor Local Government Area of Rivers State. The sample consisted of one hundred and fifty Senior Secondary School two students (75 male and 75 female) which were selected by random sampling from among all the students taught from three purposively selected secondary schools in Obio-Akpor Local Government Area of Rivers State. The instrument for data collection was pretest posttest Mathematics Performance Test. Data were collected using two standardized instruments from West Africa Examinations Council and National Examination Council: Mathematics Performance Test comprising 50 multiple-choice items drawn from the senior secondary school two Mathematics scheme of work. The reliability of the instrument was tested outside the sample with the coefficients of 0.84 using Pearson's Product Moment Correlation method. The experiment spanned six weeks: week one involved pre-testing; four weeks were devoted to treatment delivery; post-testing occurred in week six using reshuffled items. The instruments were validated by three Mathematics experts, and two experts from measurement and evaluation. The study adopted a quasi-experimental pretest posttest control group design using intact classes, reflecting school constraints that prevent disruption of normal lesson periods. This research was guided by two objectives, two research questions and two hypotheses. The research questions were answered using mean and standard deviation, while analysis of co-variance was used to test the hypotheses at 0.05 level of significance. Findings showed that the usage of manipulatives either geoboards or pattern blocks led to better performance than the traditional method. Hence, the study recommended that teachers should integrate geoboards and pattern blocks in a structured sequence pattern that progresses from concrete to abstract, with frequent formative checks.

Keywords: Geoboard, pattern blocks, manipulative, performance

INTRODUCTION

Mathematics is often perceived by majority of students as a difficult subject. In view of this, Mathematics teachers around the world are facing difficult times in trying to reverse this trend. Imparting the desired mathematical knowledge to students in classrooms has been quite challenging. Expectations of students nowadays goes beyond what was required in the past. It is therefore worthy of note that teachers are facing enormous challenges in familiarizing themselves with the use of hands-on methods of teaching Mathematics (Okoye & Onyeka, 2022).

Mathematics is an important subject, yet many learners show little interest in it, which negatively affects their academic performance. This lack of interest may be caused by several factors, including learners' attitudes, teachers' attitudes, and teachers' inadequate mastery of the subject matter. Many learners perceive Mathematics as one of the most difficult subjects to understand. In some cases, teachers make the teaching and learning process boring and discouraging by presenting Mathematics in an abstract manner, with little or no practical demonstration. As a result, learners may become less motivated and lose interest in the subject (Ndioho & Olajide, 2020).

The proficiency gained in the study of Mathematics is extensively used in all spheres of human life. Mathematics plays a key role in shaping how individuals deal with the various spheres of private, social, and civil life (Anthony & Walshaw, 2019). This justifies the compulsion of the study of the subject by all students who go through basic and secondary education in most countries. Mathematics is therefore a core subject at these levels of education in Nigeria which corroborates the work of Wonu and Arokoyu (2016) who opined that Mathematics is the foundation for Science and Technology.

Mathematics Education in Nigeria has come a long way. In the traditional society, before the introduction of formal education, Mathematics was used mainly in taking stock of daily farming and trading activities (Akem, 2021). Okoye (2021) who stated that science is the bedrock that provides the springboard for the growth of technology, thereby making Mathematics as the gate and key to sciences. However, there is no doubt that Mathematics has extensive application in life and related fields. "Mathematics is a gateway to science" (Adewoye, 2020). Despite the recognition accorded Mathematics at all levels, however, it is unfortunate that most learners, especially in primary and secondary schools exhibit nonchalant attitude towards the subject. A study conducted by National Mathematics Centre of Nigeria (2019) on performance of students in examination over some years have confirmed students' poor performance in physical sciences (Mathematics, Physics & Chemistry), which form the foundation of future work in the much need Nigerian technology. According to Olajide, Ekwueme and Ndioho (2020), manipulatives are instructional objects designed to help learners understand mathematical concepts through physical interaction which helps students gain developmentally appropriate hands-on experiences that support concept learning during handling and exploring these materials such as geoboard and pattern blocks in the teaching and learning of Geometry. Mayberry (2022) expressed that most students learn geometry based on rote-learning approach. The student may hold the visualization and the verbal definition but prefer the visual prototype when classifying and identifying geometric figures (Ozerem, 2022). This is indicative of rote learning.

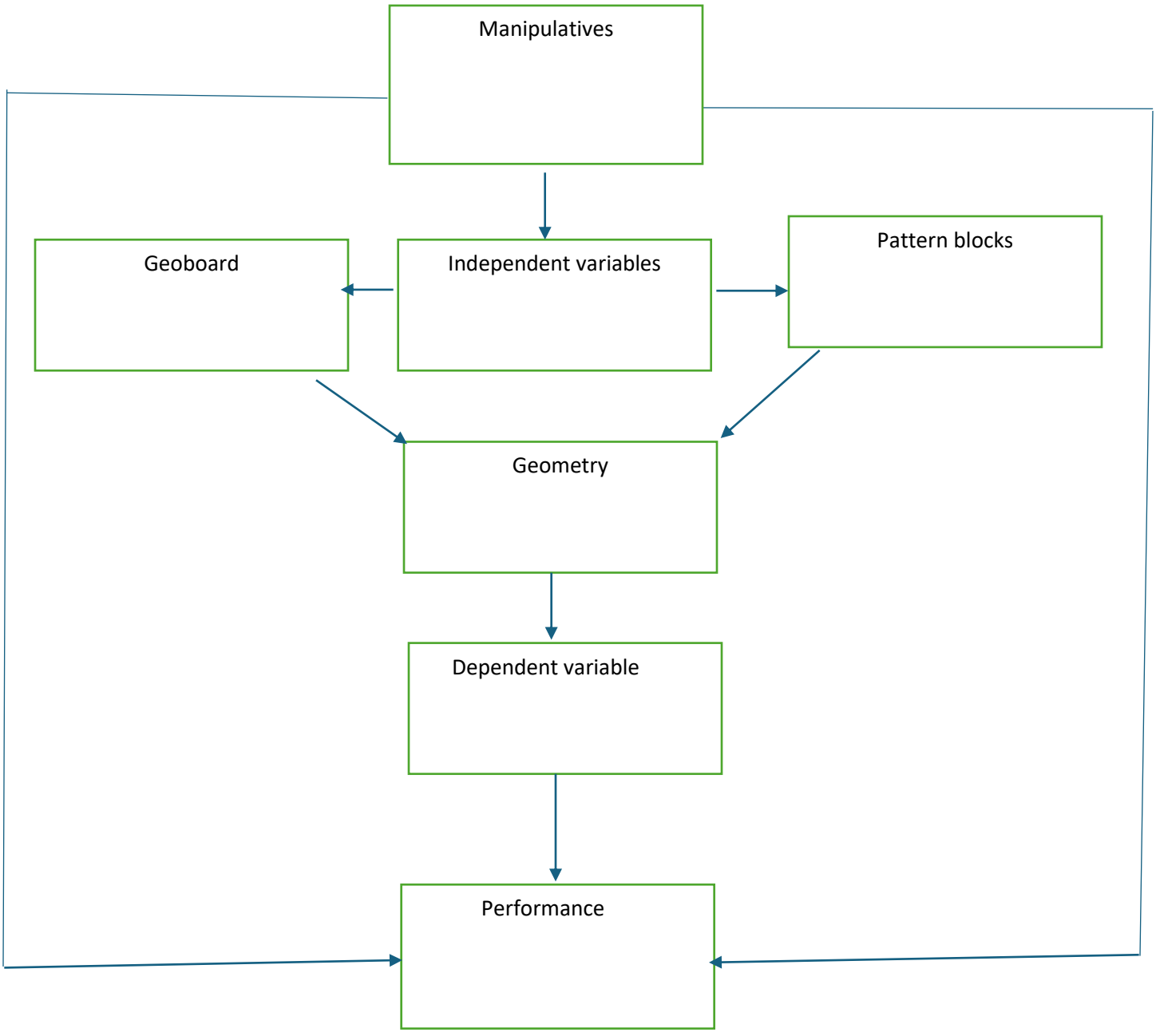

Figure 1: The schematic diagram between geoboard and pattern blocks on performance
Source: Researchers 2026

Figure 1 illustrates the comparison on how geoboard and pattern blocks can enhance students' erformance in geometry, thereby providing insights into effective teaching strategies in public senior secondary schools in Obio Akpor Local Government Area, Rivers State.

However, geoboard and pattern blocks help learners increase their motivation level to learn geometric concepts. Geoboards and pattern blocks have a broad influence on the students' performance. Geoboard

consists of a physical board with a certain number of nails half driven in, around which are wrapped geo bands that are made of rubber. Normal rubber bands can also be used.

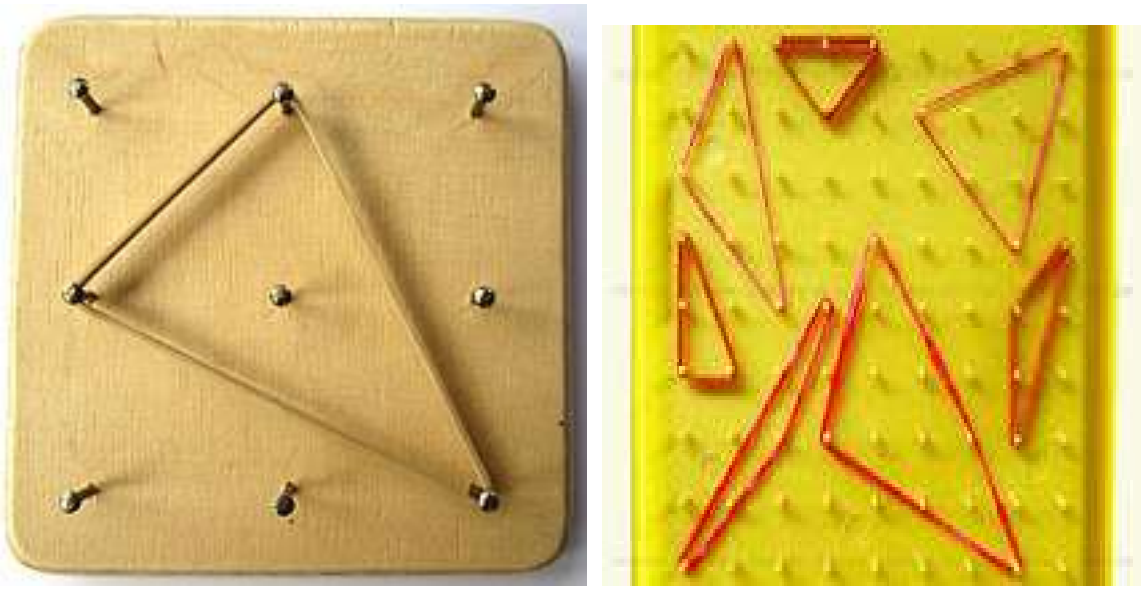

Figure 2: Geoboard
Source: Researchers 2026

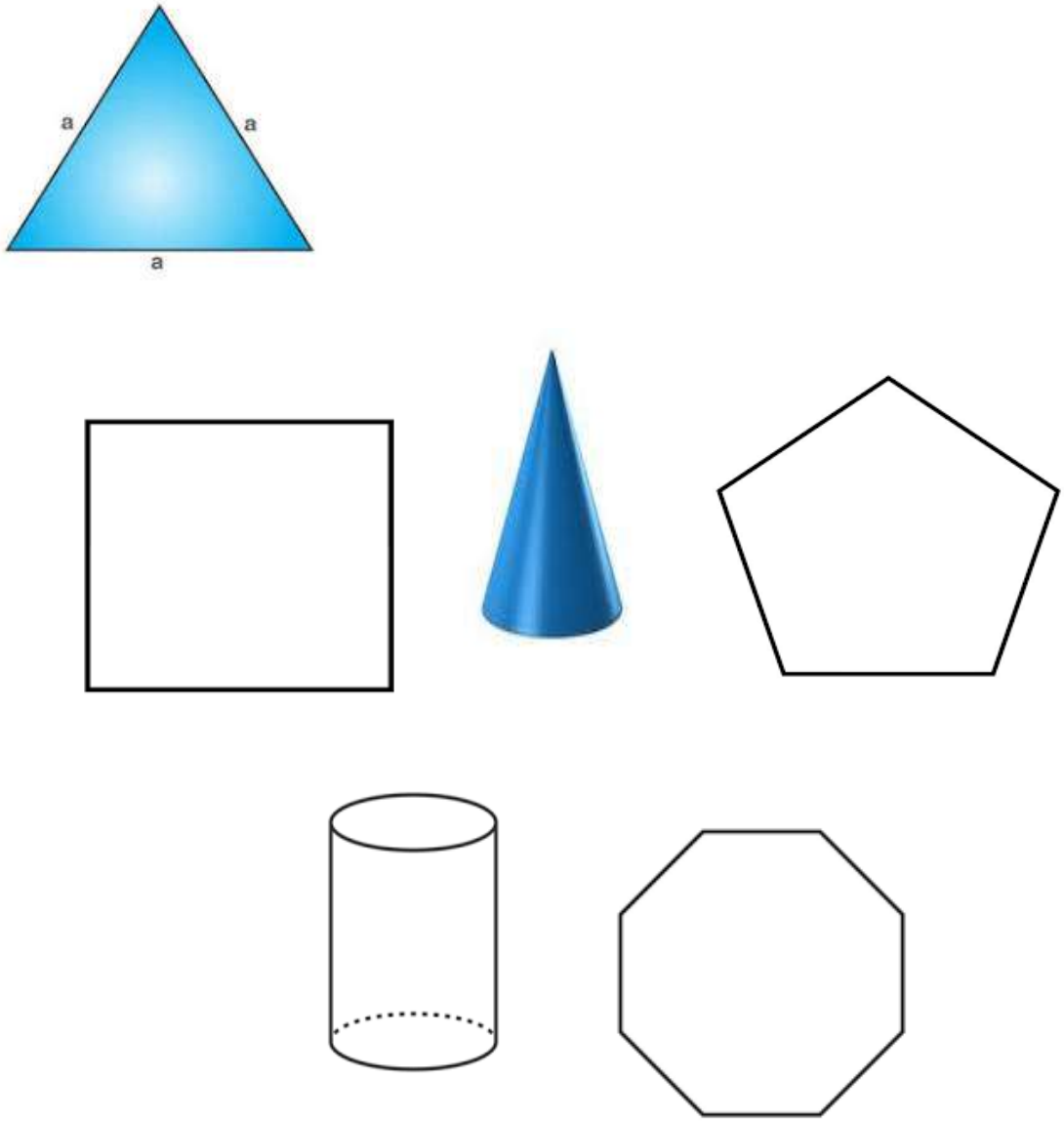

Figure 3: Some Pattern Blocks
Source: Researchers 2026

Furthermore, pattern blocks and geoboard encourage active learning because students are not merely listening to explanations or looking at diagrams. Instead, they are physically involved in constructing, testing, comparing, and adjusting shapes. This practical engagement helps learners develop deeper conceptual understanding which also allows teachers to observe students' thinking, identify misconceptions, and guide them toward more accurate mathematical reasoning.

Statement of the problem

The study carried out by Olajide, et al., (2020) examined how some important topics like Geometry can be well taught in secondary schools without making the classroom boring for leaners which can be achieved by using manipulatives such as Geoboard to teach plane Geometry.

However, observation showed that Mathematics teachers who are expected to employ appropriate hands-on teaching method in carrying out classroom instruction for content elucidation, do not do so. Could this be one of the reasons for the observed students' poor academic performance in Mathematics examination (internal and

external), which has continuously been poor in both the junior secondary school level? It is also, evident that this poor performance has an upsurge in the senior secondary school as can be seen in the West African Examination Council (WAEC) Chief Examiners` reports of 2013-2018 as cited by (Usman & Musa, 2019). Recent study by Bamgbose and Adesina (2022), on analysis of achievement of students in general Mathematics in the May\June West Africa Senior Secondary Certificate Examination (WASSCE) in Nigeria between 2016 to 2020 also indicated abysmal achievement in Mathematics, with 36% of students obtaining credits and above while 62% to 68% had pass and below. The situation has degenerated to a level that calls for a close look at all the critical factors in teaching and learning of Mathematics to all well-meaningful educators. However, the problem of the teachers' factor had continued unabated. This observed students' poor academic performance in Mathematics examination (internal and external) over the years had prompted the investigation of this study on the utilization of geoboard and pattern blocks on students' academic performance in Mathematics. Therefore, the gap of this study is how to provide empirical evidence on the efficacy of the use of Geoboard and pattern blocks in solving the problem of poor performance of students in Mathematics in Obio Akpor local government area of Rivers state, Nigeria.

Aim and Objectives of the Study

This study aims at examining the utilization of geoboard and pattern blocks instructional materials on senior secondary school students' performance in geometry.

Hence, the specific objectives of the study were to:

1. determine the effects of geoboard and pattern blocks utilization on students' performance in geometry compared to demonstration method of teaching.
2. compare the difference between the mean performance of students taught geometry using geoboard and pattern blocks with those taught using demonstration method.

Research Questions

Two research questions were raised and answered in this study:

1. What effects do geoboard and pattern blocks utilization have on students' performance in geometry compared to demonstration method of teaching?
2. What are the differences between the mean performance of students taught geometry using geoboard and pattern blocks and those taught using demonstration method?

Hypotheses

The study is guided by two null hypotheses formulated and tested at 0.05 level of significance.

1. There is no significant difference in the effects of geoboard and pattern blocks utilization on students' performance in geometry compared to the traditional method of teaching.
2. There is no significant difference between the mean performance of students taught geometry using geoboard and pattern blocks with those taught using demonstration method.

METHODOLOGY

This study adopted quasi-experimental research design because of different extraneous variables the researchers controlled during this study. Specifically, the design is pre-test - post-test and control group design. The design was considered appropriate for this study because intact classes were used instead of randomly composed samples. The use of intact classes was to ensure no alteration of regular class periods since senior secondary school authorities in Rivers State do not allow lesson periods to be altered. The study made use of two experimental group and one control group. The experimental groups were taught geometry on the topics; Properties of plane shapes, perimeter of plane shapes, and area of plane shapes using geoboard and pattern blocks, while the control group was taught using demonstration method. The population of four thousand nine hundred and twenty eighty (4,928) from the approved public senior secondary schools were used for the purpose of this study. A sample of one hundred and fifty (150) Senior Secondary School two (SSS2) students which were intentionally selected by the researchers from among all the students taught were used by Simple Random Sampling Technique from three secondary schools in Obio-Akpor Local Government Area of Rivers State. Pre-test examinations were administered on all the SS2 students of the three schools to ascertain their level of performance. The raw scores of students on the pre-test were collected and analysed using a descriptive statistic to determine the mean scores for each of the three schools before the experiment. The instrument used for data collection were Mathematics Performance Test which consisted of 50-items questions

based on senior secondary school two Mathematics scheme of work for senior secondary school two students in Obio Akpor Local Government Area developed by the researchers with the total marks of 50. Face and content validity of the instrument (Mathematics Performance Test) was critically appraised by experts in Mathematics and in Measurement and Evaluation. The reliability of the instrument was tested using 20 students from a selected secondary school in Obio Akpor local government of Rivers State, who were not part of the sampled respondents with reliability coefficient of 0.84. The study took up to six weeks; first week was used for pre-test (administration of the instrument to both experimental and control groups), while the actual treatment for both the experimental and control groups took four weeks. The sixth week was used for administration of the reshuffled 50 multiple choice Mathematics Performance Test.

Mean and standard deviation were used in answering the research questions while analysis of covariance (ANCOVA) was used in testing the hypotheses at 0.05 alpha level of significant. The null hypothesis was accepted when the associated p-value is greater than 0.05 set alpha level of significant and was rejected when p – value is less than the set alpha level of 0.05.

RESULTS AND DISCUSSION

Research Question one: *What effects do geoboard and pattern blocks utilization have on students' performance in geometry compared to the traditional method of teaching?*

Table 1: Effects of geoboard and pattern blocks on students' performance in geometry compared to the traditional method of teaching

Group		Pre-test		Post-test		Mean gain
	n	Mean	Std	Mean	Std	
Geoboard	50	30.40	2.58	46.50	3.68	16.10
Pattern Blocks	50	30.38	2.57	44.24	3.43	13.80
Traditional Method	50	30.44	2.60	34.90	3.25	4.46
Total	150					

Table 1 shows that the mean score at pre-test stage of students taught with geoboard instructional material was 30.40 and a standard deviation of 2.58, students taught with pattern blocks instructional material had a mean score of 30.38 and a standard deviation of 2.57, while students taught with lecture method had a mean score of 30.44 and a standard deviation of 2.60. This indicates equal abilities in the groups of students at pretest stage. Meanwhile, at post-test stage students taught with geoboard instructional material had a mean score of 46.50 and standard deviation of 3.68, students taught with pattern blocks instructional materials had a mean score of 44.24 and a standard deviation 3.43, while students taught with lecture method had a mean score of 30.90 and a standard deviation of 3.25. This indicates a mean gain of 16.10, 13.86 and 4.46 of students exposed to geoboard, pattern blocks and lecture method respectively. Therefore, this means that students taught with geoboard and pattern block performed better than their counterparts in the lecture method at the posttest stage because of the treatment, as well as the utilization of instructional materials.

Research Question Two: *What are the differences between the mean performance of students taught geometry using geoboard and pattern blocks and those taught using the traditional lecture method?*

Table 2: Mean performance of students taught geometry using geoboard, pattern blocks and traditional method

Group	n	Mean	SD
Geoboard	50	46.50	3.68
Pattern block	50	44.24	3.43
Traditional method	50	34.90	3.25
Total	150		

Table 2 revealed that geoboard had a mean score of 46.50 and standard deviation of 3.68, pattern block had a mean score of 44.24 and a standard deviation of 3.43, while lecture method group had a mean score of 34.90 and a standard deviation of 3.25. This implies that students taught geometry using geoboard performed better than their counterparts in pattern block and lecture method.

Hypothesis

Hypothesis one: There is no significant difference in the effects of geoboard and pattern blocks utilization on students' performance in geometry compared to the traditional method of teaching.

Table 3: ANCOVA results of students taught with geoboard, pattern blocks instructional materials and those taught with traditional method of teaching in geometry

Source	Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	3792.344	3	1264.115	122.918	.000
Intercept	29.830	1	29.830	2.901	.091
Pretest	10.624	1	10.624	1.033	.311
Group	3791.879	2	1895.940	184.354	.000
Error	1501.496	146	10.284		
Total	268384.000	150			

Table 3 of the ANCOVA results revealed F-value of 184.354 and P-value of 0.000< 0.05 (which is less than) the chosen level of significant was gotten between 1 and 146 degrees of freedom. Therefore, the null hypothesis is rejected; hence the p-value < 0.05 level of significant. This therefore indicates that there is significant difference in the effects of geoboard and pattern blocks utilization on students' performance in geometry compared to the lecture method.

Hypothesis Two: There is no significant difference between the mean performance of students taught geometry using geoboard and pattern blocks with those using lecture methods.

Table 4 ANCOVA results of mean performance of students taught Geometry using Geoboard, Pattern Blocks and those taught using traditional method

Source	Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	3781.128	3	1260.376	120.710	.000
Intercept	29.721	1	29.721	2.901	.091
Pretest	10.523	1	10.523	1.033	.311
Group	3781.128	2	1890.564	182.150	.000
Error	1501.215	146	10.282		
Total	268384.000	150			

Table 4 of the ANCOVA results revealed F-value of 182.150 and P-value of 0.000< 0.05 (which is less than) the chosen level of significant was gotten between 1 and 146 degrees of freedom. Therefore, the null hypothesis is rejected; hence the p-value < 0.05 level of significant. This therefore indicates that there is significant difference in the mean performance of students taught geometry using geoboard and pattern blocks, and those taught using lecture method.

CONCLUSION

This study evaluated the relative efficacy of geoboards and pattern blocks, in comparison with the lecture method, for improving senior secondary students' learning outcomes in geometry. The evidence indicates that manipulative-based instruction substantively enhances achievement and retention, with Geoboard-based pedagogy yielding the greatest gains, followed by pattern-block instruction, and then demonstration method instruction. These results align with constructivist accounts of learning; wherein concrete experiences support the formation of robust conceptual structures and foster durable understanding.

RECOMMENDATION

Teachers should integrate geoboards and pattern blocks in a structured sequence that progresses from concrete to abstract, with frequent formative checks.

Curriculum designers should embed manipulative-based tasks and assessment opportunities across geometry units and provide exemplar lesson plans aligned to learning objectives.

School leaders should allocate budget lines for procuring and maintaining classroom sets of geoboards and pattern blocks and ensure storage/access logistics that support routine use.

Teacher professional development should focus on task design, questioning strategies, and classroom management techniques for active, discovery-oriented lessons.

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