

EFFECTS OF MASTERY LEARNING AND GAME BASED LEARNING STRATEGIES ON PERFORMANCE IN GEOMETRY AMONG JUNIOR SECONDARY SCHOOL STUDENTS IN ZARIA.

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Abstract

This study investigated the effects of mastery learning approach and game-based learning strategy on performance in geometry among junior secondary school students in Zaria Kaduna State, Nigeria. A quasi-experimental study which used pre-test, post-test control group design was adopted. Out of a population of four thousand, four hundred and seventy-nine (4479), a sample size of two hundred and twelve (212) students was drawn. Two objectives, two research questions and two hypotheses were formulated and tested. The Geometric Performance Test was validated by lecturers at professorial and doctoral levels in the department of mathematics education Ahmadu Bello University Zaria. t-test statistics, was used for hypothesis testing at $\alpha=0.05$ level of significance. The findings among others showed that a significant difference existed in the performance scores in favor of the Mastery Learning Approach. Also, there was significant difference in the performance of students taught with Game based Strategy compared to the control group. Based on the findings of the study, it was recommended among others that Kaduna State Government should train teachers in the effective use of Mastery Learning and Game based Strategies in teaching geometry through series of workshops and seminars in order to improve the performance of JSS students.

Keywords: Mastery, Game Base Learning, Geometry, Secondary School

Introduction

In Nigeria, the significance of mathematics in producing graduates cannot be over emphasized.

One of the major challenges of science and mathematics education is how to make it functional. According to Musa and Eya, (2016) there are certain subjects that are classified as core subjects, while others are known as electives. Core subjects are those subjects which students compulsorily offer while electives subjects consist of sub jects from which students can freely make their choice. At the Junior Secondary School level, Mathematics is a core subject which should be taught well. This is because; the concept of Mathematics plays an important role to an individual day-to-day life and also to the nation at large.

Geometry contributes immensely to helping students develop the skills of critical thinking, problem-solving ability, conjecturing, deductive reasoning, logical argument and proof. Nwelsese and Nwajala, (2014) stressed that Geometric representation can be used to help students make sense of other areas of Mathematics. Geometry is an important source of Mathematical thinking. It helps to sharpen man's intuition and ability to think logically as well as kindle his interest in observations. It comprises of theories and logical proofs which could be very interesting if well understood Geometry constitutes 38% of the Mathematics curriculum and it is the worst performed topic in all Nigerian external and internal examinations making the overall subject performance very poor, Filgona and Sababa (2017). Since geometry involves a lot of applications to real world situations and proofs, it is student-based strategies that can best handle the difficult and challenging concepts Mastery Learning in Education is a method of learning where students achieve a mastery of the subject matter they are learning about before moving on to new material. It helps keep students on track to completing the learning objectives of a particular class and allows teachers to provide a form of individualized learning for all students without taking time away from the overall teaching goals for the year. According to Adeyemo and Babajide (2014), this strategy allows students to study material unit after unit until they master.

As outlined by Momozoku (2017), game-based learning refers to a series of instructional designs that use elements from gaming and simulations. They can be done with board games, computer assisted board games, or fully computerized environments. This implies that games can be Digital or Non digital. Game-based learning is an enjoyable and competitive social activity with goals, rules and educational objectives. Game-based strategies enable students discuss and take practical decisions, facilitate the development of the imagination and developing the spirit of tolerance and planning Children and adults of all ages can benefit from the mental stimulation that game-based learning provides.

Regarding the issue of gender in geometry, conclusions has been so controversial about attitude and performance of boys and girls most especially at the Junior Secondary Schools. For instance, Bello (2014) noticed higher cognitive task in Mathematics in favor of males. As outlined by him, this ideology begins right from the primary school and this has reduced the likeness of the girl child for the study of mathematics and geometry in particular. On the other hand, Idris (2014) noticed girls outperformed the boys in Algebraic class while Ahmed (2014) noticed no significant difference. Amidst all these controversies this research work also intends to find out answers to gender related issues when JSS students are exposed to Mastery Approach and Game based strategy of learning.

According to Bello (2015), conventional method of teaching is often the most efficient way to present or review with the entire class. Teachers chose the conventional method

when they have a limited amount of time, when the background information is not easily assessable. But this method could do better for adults which is the reason why this research work seeks strategies that involve students full and optimal participation. Performance is about achieving the goal entirely, while the levels and degree of goal attainment is just the progress carried out towards its final aim. Performance is not only a matter of what students achieve but also how they are achieving it. A high-performance result comes from appropriate behavior and the effective use of required knowledge, skills and competence of geometry. According to Ashiru (2016), one way to tackle the issue of improving performance of students in geometry and mathematics is to consider student's attitude towards mathematics.

Statement of the Problem

From the experience of the researcher as a teacher in a public secondary school for over a decade, students always dodge answering questions that involve geometry. Also, as an examiner with West African Examination Council, students rarely answer question that involve geometrical concepts. Teaching strategies play an important role in classroom instruction. Without the use of various strategies teachers would be aimlessly projecting information that doesn't connect with learners or engage them. Strategies help learners participate, connect and add excitement to the content being delivered. Considering justification for why the research is conducted at Junior Secondary School level of education; Attitude towards mathematics begins to develop as soon as children are exposed to the subject at the Junior Secondary School level. Therefore, the use of strategies like The Mastery Learning and Game-Based would influence learners of Junior Secondary School level in Zaria, Kaduna State, Nigeria.

It is imperative to note that despite the fact that recent studies show improved performance in General Mathematics, students still dodge from answering questions that involves geometry. As reported by Bello (2014), the importance of geometry in science and technology cannot be overemphasized. Mohammed (2017) reported that academic performance of students in geometry at the Senior Secondary School Certificate Examination has consistently been low. For this reason, it is not out of place to continue the search for practicable strategies like The Mastery Learning and Game-Based Strategies. These strategies have been found to be effective in some subjects but little attempt has been paid to its use in teaching geometry at the junior secondary school in Kaduna State.

Objectives of the Study

The objectives of the study are to:

1. Investigate the effect of mastery learning approach on performance of JSS students when compared with those taught using conventional strategy.
2. Find out the effect of game-based strategy on academic performance of JSS Students toward learning of geometry when compared with those taught with the conventional method

Research Questions

the following research questions were addressed -

1. What is the effect of mastery learning approach on Junior Secondary School student's academic performance toward geometry when compared to conventional method?
2. To what extent is the effect of game-based strategy on Junior Secondary School student's performance toward geometry when compared to those taught with conventional method?

Null Hypotheses

The following null hypotheses were formulated and tested at $P \leq 0.05$ level of significance.

- H₀₁ There is no significant difference between the academic performance of Junior Secondary School Students taught geometry using Mastery Learning Approach and those taught using Conventional Methods.
- H₀₂ There is no significant difference between the mean performance scores of Junior Secondary School Students taught geometry using game-based strategy and those taught using conventional method.

Research Methodology

This study used a quasi-experimental research with pretest posttest control group design comprising three groups; two experimental group and one control group. The three groups were pretested on performance before the administration of treatment. The essence of which was to ensure uniformity and equivalence in performance and interest level at entry point. The treatments were administered to students in the experimental groups only; while students in the control group were taught using the Conventional method which implied no treatment (X_0). A Posttest (O_2) was administered after treatment to both groups of students to determine their performance.

Sample and Sampling Technique

Names of the twelve-state owned coeducational secondary schools in Giwa Educational Zones were compiled. The names of schools were written on pieces of papers from the Zone and were put in a basket and shuffled. Simple random sampling technique involving the draw from the hat method was used. Three schools were drawn and assigned experimental group 1, experimental group 2 and control group. The

assignment of subjects was not random since the classes were intact. The schools drawn were Government Junior Secondary School Hunkuyi, Government Junior Secondary School Bomo and Government Junior Secondary School Jaama respectively. Consequently, a class was also randomly selected because every class in each of the school had a minimum of three arms.

Table 1: Sample for the Study

School	Status	No. of Male	No. of Female	No
A	Experimental I	43	30	73
B	Experimental II	52	21	73
C	Control	40	26	66
Total				212

Instrumentation

Geometric Performance Test (GPT)

The Geometric Performance Test was adopted by the researcher. It consisted of 20 multiple choice items with four options drawn from the topics to be taught to the subjects. The topics were properties of solids mensuration, properties of plane shapes and perimeters of plane shapes. Students were required to choose the options that bear the correct answers to the questions and the test was designed to last for a period of 75 minutes. Three learning domains were used because they are more easily assessed with multiple choice test items Ginga, (2017).

Table 2: Table of Specifications

Content	Knowledge 40%	Comprehension 40%	Application 20%	Total
Properties of Solids	2	2	1	5
Mensuration	2	2	1	5
Properties of plane shapes	2	2	1	5
Perimeters of Plane shapes	2	2	1	5
Total	8	8	4	20

Source: (Ginga, 2017)

These contents were taught both to experimental and control groups. The experimental groups received the treatment using mastery and Game-based while the control groups were taught using Conventional method.

Validation of the Instrument

Geometry Performance Test (GPT) was validated by three lecturers who were experts in Mathematics Education. They are senior lecturers with Ph.D.'s from the Department of Science Education, Ahmadu Bello University, Zaria. Their criticism and observation were incorporated into the test items. Initially, the pretest and posttest constructed contained 80 items which later became 20 items after validation, reliability check and item analysis.

Reliability of GPT

The results of the pilot testing were used to determine the reliability coefficient of the GPT. To do so, the test-retest method with interval of two weeks was used. Pearson Product Moment Correlation Coefficient (PPMCC) was used for the analysis. Reliability coefficient of 0.88 was obtained. The instrument was relevant and reliable.

Results

Research Question 1: What is the difference between the mean performance scores of JSS students taught geometry with Mastery Learning Strategy and those taught using conventional method?

To answer the research question, performance scores of students taught geometry with Mastery Learning Strategy and those taught using conventional Method were subjected to descriptive statistics of mean and standard deviation were computed and the summary is shown in Table 4A

Table 4A: Mean and Standard Deviation of performance scores of students of EG1 and Control Group.

Group	N	Mean	SD	Mean Diff.
EG1	73	22.5	3.85	
				4.36
Control	66	18.19	3.19	

Table 4A shows that students taught geometry with Mastery Learning Strategy has a mean score of 22.55 while students taught with Conventional Method has a mean score of 18.19 with a mean diff. of 4.36.

Null Hypothesis One; There is no significant difference between the performance scores of students taught geometry with Mastery Learning Approach and those taught using Conventional Method.

Table 4B shows the summary of the analysis results of the posttest mean performance scores of students taught geometry with Mastery Learning Approach and those taught using conventional Method subjected to independent t-test.

Table 4B: Summary of independent t-test analysis of students taught using Mastery Learning Strategy and those of conventional Method.

Group	N	Mean	SD	Df	t-Cal	P-value	Remark
EG1	73	22.55	3.85	137	6.43	0.001	S
CG	66	18.19	3.19				

$P \leq 0.05$ level

The mean score of Mastery Learning group was 22.55 and a Standard Deviation of 3.85 while the Conventional Method group had a mean score of 18.19 and a Standard Deviation of 3.19. It reveals that there was a significant difference between performance of students taught geometry with Mastery Learning and those taught with Conventional Method. This was because the PValue of 0.001 was less than 0.05 level of significance at df 137. Therefore, the null hypothesis which states that, there is no significant difference between performance scores of students taught geometry with Mastery Learning Approach and those taught using Conventional Method was rejected.

Research Question 2: What is the difference between the mean performance score of male and female students taught geometry using game-based strategy?

To answer this research question, posttest mean performance score of male and female students taught using game-based strategy were subjected to descriptive statistics. Mean and Standard Deviation were computed and summary is shown in 4C

Table 4C: Mean and Standard Deviation of Male and Female Students in the Game-Based Strategy Group

Group	N	Mean	SD	Mean Diff.
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Male	52	17.32	3.17	0.38
Female	21	16.94	2.83	

Table 4C indicates that the academic performance of male and female students exposed to gamebased strategy have a mean score of 17.32 and 16.94 respectively with the mean difference of 0.38.

Null Hypothesis 2: There is no significant difference between the mean performance scores of male and female Junior Secondary School students taught geometry using game-based strategy.

Table 4D: Summary of Independent t-test Analysis of Mean Scores of Male and Female Students in Game-Based Strategy Group

Group	N	Mean	SD	Df	t-cal	P-Value	Remark
Male	52	21.63	3.76	71	1.25	0.80	NS
Female	21	21.19	3.96				

$P \leq 0.05$ level

Table 4D shows that the mean score of males was 21.63 with standard deviation of 3.76 while the female mean score was 21.19 with standard deviation of 3.96. It further reveals that there is no significant difference between the mean performance scores of male and female students taught geometry using the game-based strategy. This was because the P-Value of 0.80 is higher than the 0.05 level of significance at df of 71. Therefore, the null hypothesis which states that there is no significant difference between the mean performance scores of male and female students taught geometry using game-based strategy was retained.

Discussions

The study investigated the effects of mastery learning and game-based instructional strategies on performance towards geometry among Junior Secondary School Students in Kaduna State, Nigeria. The findings obtained from the hypothesis tested are discussed as follows:

The result of H_{01} showed that there is Significant difference between the performance of students taught geometry with Mastery Learning Approach and those taught using Conventional Method. This finding fell in line with Ashiru (2016) who stressed that strategies that involves student’s participation influenced performance scores rapidly.

Also in line with Momozohku (2017), Akinsola and Animmashahun (2014), Haruna (2012) also opined that student centred learning is such that created high level of student's participation and increased their performance. Mohammed (2017) also stressed that teacher's use of stimulating strategies would go a long way in sustaining students in learning mathematics and geometry in particular. Bunkure (2012) also in his study on effect of constructivist teaching strategy on academic performance, retention and attitude of Senior Secondary School physics students of Kano State found that students in the experimental group show better performance than the control group taught with Conventional method. These finding can be concluded that the instructional methods used which are learnerscentered must have brought the significant effect in performance of students compared to those in Conventional Method.

The analysis of hypothesis 2 reveals that there is no significant difference between the mean performance scores of male and female student taught geometry using the game-based strategy. This is in line with the findings of Chinanson, Kurumeh and Obida (2011) and Muhammed (2014) which shows that when students become engaged in participatory learning, both male and female performed equally. The reason for the equal academic performance of male and female students is the games strategy which may not be unconnected with the fact that both see themselves as equal and capable of active participation in the classroom. This finding is supported by Ginga (2017) who observed significant difference between males and females taught using constructivist approach. Also, Wael (2014) reported that there was no significant difference in performance of male and female students at the pretest, posttest and post posttest levels. Bora (2014) indicated that there was a significant effect of gender on students' performance and the findings of Augie (2016) confirmed that when male and female students were exposed to mathematical concepts using different strategies, their performances will vary significantly. In contrast, the findings of Tekerek, Yen, Terz, Ercan (2011) shows that there was difference between the performance scores of male and female Senior Secondary School 2 students taught algebraic processes using social constructivist strategy. Olagunju (2001) investigated sex, age, and performance of male and female in mathematics. The results showed no significant difference in their performance.

Conclusions

This work was concluded by summarizing the following major findings;

A significant difference was found in the mean performance scores in geometry for JSS students taught using mastery learning approach and those taught using Conventional methods. Again, there was no significant difference in the performance of males and females when taught geometry using the game-based strategy.

Recommendations

Based on the findings of the study the following recommendations were made:

1. Students should take the advantage of mastery learning and game-based instructional strategies to engaged actively in learning geometry practically develop manipulative skills connecting geometric concepts. This will help them retain well, change their attitude towards geometry and improve their performance generally in mathematics.
2. Teacher should engage students in an active process of learning which involves their participation like mastery learning and game-based strategies which will establish an applicative spirit in them. This will improve their retention level, change their attitude positively and also promote their performance in geometry.
3. Parents and SBMC should engage in providing schools with accessible, modern and enough teaching and learning resources to support game based and mastery learning strategies.

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