



EFFECT OF MATHEMATICAL GAMES ON SENIOR SECONDARY SCHOOLS STUDENTS' ACHIEVEMENT IN MATHEMATICS IN NSUKKA LOCAL GOVERNMENT AREA OF ENUGU STATE

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Abstract

This study investigated the effects of mathematical games on senior secondary school students' achievement in mathematics (probability). The study was carried out in Nsukka Local Government Area of Enugu State. This research was guided by two research questions and two hypotheses. The design of the study was quasi-experimental involving a pretest and post-test, non-randomized control and experimental groups of two intact classes. The population of the study comprised all the senior secondary school students in the local government area. A sample size of 164 SS2 students drawn from two government coeducational secondary schools in Nsukka was used. Probability Achievement Test (PAT) was the instrument for data collection. The data collected were analyzed using mean and standard deviation and analysis of covariance (ANCOVA). The results revealed that using mathematical games improved students' achievement in mathematics. However, the study showed that using mathematical games also had differential effect on gender achievement in favour of the male counterparts. This implied that mathematical games should be included as a teaching approach in secondary schools since it helps them to learn better.

Keyword: Mathematical Games, Senior Secondary Schools, Students' Achievement, Mathematics

Introduction

Mathematics has long been considered a challenging subject for many students, often associated with anxiety and Lack of motivation. It is evident that various teaching methods have been employed to improve students' engagement and understanding. Mathematics on its own plays a vital role in the development of an individual, firms and the government. The importance of mathematics is without comparison. It is due to its importance that the government made it a prerequisite for admission into higher institutions of learning. Mathematics is part of everyone's life. This could be a strong reason why Noraini (2011) asserted that culture of science, technology and engineering (STEM) education in schools should be established in order to promote critical and creative thinking skills.

The players in education over the time had made mathematics a compulsory subject in the primary, secondary and all tertiary institutions. It is obvious that due to the importance of mathematics to individuals, groups and government at large, mathematics becomes one of the compulsory subjects a candidate seeking for admission into any higher institution in Nigeria must pass at a credit level in order to secure such admission. The importance of mathematics cannot be overemphasized. The individual needs mathematics in everything he/she does in life ranging from budgeting, buildings, farming etc. this means that no individual can survive or exist without mathematics. The government applies mathematics in everything it does. The

preparation and analysis of annual budget, the registration and analysis of voters, the registration of births and deaths, the national population census, the developmental plans etc are all mathematically rooted. According to Obasi (2016), as water is essential to fish is as mathematics is essential to the nation.

Despite the importance and compulsory nature of mathematics, many students are still afraid of mathematic and as a result, have very low achievement in it. Mohammed (2014) opined that the mass failure of the students in mathematics may be attributed to teachers' influence. Teachers' influence in mass failure of students in mathematics can result from poor teaching techniques, inability to make the subject practicable and simple, poor knowledge of the course and so on. According to Egbuhuzor et al (2013), some teachers strike fears into the students by their teaching methods. It has been observed that insufficiency and unavailability of mathematics teachers, the unavailability of instructional materials among other factors which were believed to be the major causes of poor achievement of students in mathematics had been solved by both the government and the private sector. Adedapo (2019) reported that the major challenge affecting students' performance in mathematics is method. The method the teachers use go a long way in shaping the success or failure of the students in mathematics. This calls for investigation into better teaching techniques or strategies in order to accelerate the success of the students in mathematics.

The use of mathematical games tend to introduce reality in the teaching and learning situations. According to Uchechukwu (2023), students who receive instructions using games achieve higher than those who receive instructions without games in probability. The mathematical games for various studies have been outlined but not limited to "ludo", "whot", "Ayo". Having observed that the research on games showed that students taught probability using games performed better than those taught probability without games, mathematical game becomes a factor for this study as a method.

Gender was another factor considered to be influencing achievement in mathematics. According to Edebor (2012), there is a disparity in the academic achievement of students in mathematics based on gender. His research showed that female students achieved higher than their male counterparts in mathematics. On the other hand, Jacobs (2018) reported that male students achieve higher in mathematics than female students following his research. As a result, gender becomes another factor that was considered to affect students' achievement in mathematics.

Purpose of the study

The main purpose of this study is to determine the effect of mathematical games on students' achievement in mathematics (probability) . Specifically, the study aims at;

1. Determining the mean achievement scores of students taught probability using games and those taught without games.
2. Determining the effect of games on male and female students' achievement in probability

Research questions

1. What is the mean difference in achievement scores of students taught mathematics using mathematical games and those taught without mathematical games?
2. What is the mean difference in the achievement scores of male and female students 'taught mathematics using mathematical games?

Research Hypothesis

The following hypothesis were formulated and were tested to guide the study at 0.05 level of significance:

HO₁ ; There is no significant difference between the mean achievement scores of students taught probability using mathematical games and those taught without mathematical games.

HO₂; There is no significant difference between the mean achievement scores of male and female students taught probability using mathematical games.

Literature review

Theoretical Framework

Jerome Bruner's Discovery Theory of Learning

The "Structure of Discipline" and "Discovery Learning"

Bruner seemed to think that the academic disciplines or topics have a tendency to arouse curiosity in human beings in general, including children. When he said, "interest can be created and stimulated," he means that academic subjects have intrinsic attraction, and that they do not always have to be related to children's daily experience in order for children to be interested in learning. He says that "intellectual activity anywhere is the same, whether at the frontier of knowledge or in a third-grade classroom". Thus, educators need not make subjects or topics more accessible or palatable by presenting them in real-life settings of children's daily experience. Instead, subjects and topics must be presented according to the structures of the academic disciplines which are the essence and reflection of accumulated human curiosity. A child, for example in learning history, in this scheme, must be treated as a historian inquiring into the issues and problems of history.

Lev Vygotsky's theory of learning

Vygotsky's sociocultural theory of human learning describes learning as a social process and the origination of human intelligence in society or culture. The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in cognitive development. Vygotsky's model of teaching and learning has significantly influenced "early literacy" programs, such as Reading Recovery and Guided Reading. Yet, this theory is in contradiction to what is happening in many schools today. Too many schools have teacher-centered classrooms. The teacher/information centered model (is)...learning centered on the information possessed by the teacher, which flows one way, from teacher to student. To counter this prevalent view, Vygotsky maintains meaningful and productive collaborative activities that need to be engaged in by both students and teachers. Learning can occur through play, formal instruction, or work between a learner and a more experienced learner. Teachers must actively assist and promote the growth of their students, so the students can develop the skills they need to fully participate in our society.

Empirical Studies

In a study carried out by Igwe (2015) on the impact of games on students' engagement and response in Ohaukwu Local Government Area of Ebonyi State-Nigeria; the study showed that games enhance students' performance in mathematics. The study also showed that female students performed better than their male counterparts in the experimental group. On the part of location, the study highlighted that those students in urban area performed better than the counterparts in the rural area. This shows that location is a factor affecting students' achievement in mathematics. He recommended that games should be employed in teaching

and learning mathematics in Nigeria as it enhances learning. The purpose of this study was to investigate the impact of games in enhancing learning in secondary schools.

In another study, Lawrence, (2016) in his research said. The study was designed to examine the effect games in teaching and learning chemistry in Kogi State. The sample for the study consists of one hundred and five (105) chemistry students of two intact classes. One group was the experimental group and the other, control group. A total population of 262 students were considered. Chemistry Achievement Test(CAT) was used as instrument for data collection. The CAT was made up 15 item multiple choice questions lettered A-D. The instrument was validated and used by the researcher to collect data. Mean and standard deviation were used to answer the research questions while t – test was used to test the hypothesis at 0.05 alpha level. The results showed that chemistry students who were taught chemistry with games achieved better than their counterparts who were taught without games. The results also showed that male students performed better than their female counterparts in the post- test. He concluded that method and gender are factors that affect students' achievement in chemistry.

Methods

The design for the study was quasi-experimental design using pre-test and post-test of nonrandomized control group and experimental group of two intact classes in Nsukka LGA of Enugu State. The population for the study was 1890 students. A total of 164 students were sampled, 83 in experimental group and 81 in control group. Probability Achievement Test (PAT) was the instrument for data collection. The PAT was first administered as a pre-test to both the experimental and control groups while post-test was administered to both groups as well after the treatment. The PAT was made up of 20 items of multiple choice objective questions with four (4) options lettered A – D. The SS 2 students were classified into two groups. The experimental group was taught using mathematical games while the control group was taught the same content without mathematical games. Mean and Standard deviation were used to analyse the research questions, while analysis of covariance (ANCOVA) was used to analyse the hypotheses at 95% confidence level.

Results

Research Question One: What is the mean difference in achievement scores of students taught probability using mathematical games and those taught using conventional method? The answer to the research question one is presented in the table below.

Groups	No of Students	Pre-test.		Post-test	
		Mean (x)	Std. Deviation (S)	Mean (x)	Std. Deviation (S)
Experimental	83	41.50	13.70	70.84	9.43
Control	81	42.65	13.54	58.77	12.61
Differences		1.15	0.16	12.07	3.18

As shown in table 1 above, the result of the analysis showed that the pre-test mean score of experimental group was 41.50 with a standard deviation of 13.70 while the pre-test mean score of control group was 42.65 with a standard deviation of 13.54. the post-test mean scores of experimental and control group was 70.84 and 58.77 respectively, with standard deviations of 9.43 and 12.61 respectively. Which indicates that students taught probability using mathematical games (Experimental group) achieved higher than their counterparts taught using conventional method (control group) despite having a lower mean score in pre-test than their counterparts taught probability without mathematical games. Also the standard deviation

of experimental group is lower than that of the control group which indicates that the scores of students in experimental group are not too dispersed from each other i.e. the scores of students in experimental group are more homogeneous than scores of students in control group.

Research question Two: What is the mean academic achievement scores of male and female student taught probability using mathematical games?

The answer to the research question two is presented in the table two below

Table 2: Post-Test Mean Achievement scores of Male and female students in Experimental group.

Sex	No of students	Mean (x)	Std. Deviation (s)
Male	44	72.50	9.20
Female	39	68.97	10.63
Difference		3.53	1.43

From table 2, we can infer that male students had mean score of 72.50 and standard deviation of 9.20 while female students had means score of 68.97 and standard deviation of 10.63. which indicates that male students achieved higher than female students with a difference of **8.53**. However, the difference is subject to ANCOVA result tested at 0.05 level of significance. Also the standard deviation of male students scores is lower than that of the female students which indicates that the scores of the male students are more homogeneous than the scores of the female students.

Hypothesis one: There is no significant difference between the mean academic achievement scores of students taught probability using Ludo game and Whot play cards and those taught using conventional method.

Table 3: Analysis of Covariance (ANCOVA) on Experimental and Control Group in Post-test

Source	Type sum of squares	Df	Mean Square	F	Sig.	Partial Eta Square
Corrected Model	1912.789	4	478.184	3.282	.016	.143
Intercept	34147.987	1	34,147.987	232.259	.000	.749
Pre-test	265.527	1	265.527	1.806	.183	.023
Method	612.241	1	612.241	4.164	.025	.031
Error	23376.975	159	147.025			
Total		164				
Corrected Total		163				
a R square = 143 (Adjusted R Square = 099)						

Decision: Null hypothesis rejected

Table 3 shows that the use of mathematical game is significant: This is because the computed F-value (4.164) was found significant at 0.025 which is less than 0.05 level of significance set for the study. Hence, there is a significant difference between the mean academic achievement scores of students taught probability using mathematical games and those taught using conventional method. Therefore, the null hypothesis was rejected and alternative hypothesis accepted.

Hypothesis Two: There is no significant difference between the mean academic achievement scores of male and female students taught probability using mathematical games.

Table 4: ANCOVA of Male and female Students' post-test in Experimental Group.

Source	Type sum squares	III of	Df	Mean Square	F	Sig.	Partial Eta Square
Corrected Model	1912.789		4	478.184	3.282	.016	.143
Intercept	34147.987		1	34,147.987	232.259	.000	.749
Pre-test	265.527		1	265.527	1.806	.183	.023
Gender	729.310		1	729.310	4.960	.029	.0366
Error	23376.975		159	147.025			
Total			164				
Corrected Total			163				

a. R square = 143 (Adjusted R Square = 099)

Decision: Null hypothesis rejected

Table 4 shows that gender is significant. This is because the computer F-value (4.960) was found significant at **0.029** which is less than **0.05** level of significance set for the study. Hence, there is a significant difference between the mean academic achievement scores of male and female students taught probability using Ludo game and Whot play cards. Therefore, the null hypothesis was rejected and alternative hypothesis accepted.

Discussion of Findings

Research question one sought for the effects of students mean academic achievement scores when taught probability using mathematical and those taught without the use of the games. From table 1, the result of the analysis showed that students taught probability using mathematical games obtained higher mean academic achievement scores than students taught without the use of the game. The result was further subjected to analysis of Covariance (ANCOVA). The null hypothesis (**HO₁**) was rejected and the alternative hypothesis was accepted. This implies that there is a significance difference between the mean academic achievement scores of students taught probability using mathematical games and those taught without the use of the games. This entails that students taught probability using mathematical games performed better than those taught without the use of the games. This is in agreement with the findings of Maduagwu (2018); Nwoke (2020) as well as Nekang (2018) which agreed that game learning approach if effectively employed will improve students performances in a given task and also said that game is ideal for teaching mathematics skills as it provide a concrete way to learn physical knowledge of mathematics in order to understand mathematical concepts.

Considering gender, research question two asked the mean academic achievement scores of male and female student taught probability using Ludo game and Whot play cards. The result indicated that there is a difference in gender performance. The test of null hypothesis two (**HO₂**) showed that there is a significance difference between the performance of male and female students taught probability using mathematical games at 0.05 level of significance.

This indicated that from the data collected, the 44 male and 39 female students taught probability using games achieved differently. That male achieved higher compared to their female counterparts.

Conclusions

Based on the findings from data analysis and interpretation, it is clear that students in experimental group performed better than those in control group. Hence, the researcher concluded that the use of mathematical games (Ludo game and Whot play cards) has effect in the teaching and learning of probability. Since students who received instruction using mathematical games achieved higher Post-test scores in Probability Achievement Test than those who received instruction in conventional classroom approach.

Furthermore, gender is a determining factor on students' performance in mathematics and also teaching strategy among other factors. This contradicts Maduagwu (2018) which stated that there is no significant difference between male and female students taught using games. However, the work was on the use of Tangram puzzle.

Summary of Findings

This study investigated the effect of mathematical games on students' achievement in mathematics (probability) in Nsukka Local Government Area of Enugu State. Keeping other extraneous variables constraint, the result showed that those students in the experimental group performed better than those students in the control group. They were taught using mathematical games. Hence, this method used affected the performance of the students.

The result also showed that gender is a determining factor in students' performance using mathematical games. Schools should adopt game method in teaching and learning probability in secondary schools.

Recommendations

1. Schools should be provided with mathematical games.
2. Teachers should be trained on the use of games in teaching mathematics.
3. Government and curriculum planners should integrate the use of mathematical games in school curriculum and also in writing of books.

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