IMPACT OF ANIMATION METHOD ON SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS IN SOKOTO STATE, NIGERIA

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Abstract
The study investigated the impact of animation method on secondary school students' academic performance in Mathematics in Sokoto state, Nigeria Two objectives with corresponding research questions and hypotheses guided the study. Quasi experimental design was used for the study. The study involved one experimental group and one control group. The population consist of 12,030 SS II students within the Sokoto metropolis and a systematic sampling was used to select the sample schools, while intact classes were used for both experimental and control groups as sample of the study which amount to 257. Students Algebraic Performance Test (SAPT) was administered to the students as pretest and posttest for data collection, which was validated by the experts and reliability index of 0.83 was found using Pearson Product Moment Correlation (PPMC). Mean and Standard deviations were used to analyze the two research questions and independent t-test was used to test the hypotheses with the aid of SPSS. The findings of the study include: there was no significant difference in the academic performance of students taught using game and those taught using conventional lecture method. The study recommended that games should be adopted as instructional method to complement conventional method in the teaching and learning of algebraic concepts in Mathematics.
Keywords: Animation Method, Academic Performance, Mathematics.

Introduction
The inclusion of mathematics as a core subject in the secondary school curriculum is due to the vital role mathematics play in the achievement of the objectives of the secondary schools education, such as promoting of science and technology, provision of trained manpower in the areas of science, technology and commerce, and the acquisition of necessary skills, abilities and competence both mental and physical as prerequisite for the individual to live on and contribute to the development of his society (Federal Republic of Nigeria, 2014). Mathematics is one of the school subjects that any nation needs for industrial and technological advancement, useful for most vocational and higher specialized course of learning (Odili, 2006; Sidhu, 2006). Mathematics is the queen of science and technology and also a tool for scientific

and technological development (Attah, 2009). Mathematics is the study of quantity, structures, space and change (Nwoke & Nnaji, 2011). Mathematics is developed through the abstraction and logical reasoning, from counting, calculation, measurement and the study of the shape and motion of physical objects (Charles, Gladys & Marks, 2016). Mathematics provides all the necessary structure and methodology for the study of virtually all the important modern disciplines, and that it also provides an important key to understanding of the world in which we live (Zakariya, 2014).

Mathematics as a subject can be broadly divided in to three significant branches namely Arithmetic, Algebra, and Geometry. Algebra is considered to be one of the oldest components in the history of mathematics. Algebra deals with the study of symbols, exponentials, known and unknown variables, and equations. The number theory, Geometry, and their analysis put together to make an extensive part of mathematics which is known as "Algebra" in other word, Algebra is part of mathematics that deals with symbols and the rules to calculate those symbols. Muhammad ibn Musa al-Khwarizmi was a Muslim mathematician and astronomer who lived in Baghdad around the 9th century, he was regarded as the "father of algebra**"** he was a Persian mathematician who wrote a book named Kitab Al Muhtasar fi Hisab Al Gabr Wal Muqabala in Arabic language which was later translated in to English as "The compendious book on calculation by completion and balancing" from which the word Algebra was derived. The book provides a systematic solution for linear and quadratic equations. According to Al-Khwarizmi, the word algebra is described as 'reduction' and 'balancing' of subtracted terms that is a transposition to other sides of the equation (cancellation of like terms) Nethravati, (2020). Algebra is a generalization of arithmetic, device for dealing with quantitative relationships (Lassa, 2012).

Enhancing teaching and learning outcomes through relevant instructional strategies has been a major concern in the business of education. This is greatly desired to enable teachers prepare learners that will be productive academically both during and after their learning period. This therefore calls for great transformation in the teaching approaches adopted by teachers especially at secondary schools' level to prepare students for the 21st century challenges in education. One of these challenges is thinking and devising the ways through which today's schools can be transformed to adequately prepare students for lifelong learning to confront the challenges of the 21st century demand in terms of science and technology (Muhammad, Ibrahim & Gana. 2017). This shows that game has the power to engage students in developing evidence-based reasoning, analytical and critical thinking skills, problem-solving skills, systems thinking and interaction with peers, all of which are 21st century learning skills. Game can lead students to become participatory leaners and producers instead of passive recipients which will eventually transform the role of students from passive receiver of knowledge to active producer. Michelle (2012), opined that all games have four defining traits: a goal, rules, a feedback system, and voluntary participation. The voluntary participation here means that players agree on the goals, rules, and feedback of a game.

Therefore, teaching and learning of mathematics using game help students in improving their critical thinking skills and help them acquire a more advanced level of education in learning

mathematics. It has become the concern of every educationist looking for ways out of the poor performance of students in mathematics, in the improvement of teaching and learning process, by introducing teaching aids, one of such teaching aids is the mathematical game. Mathematical game is a game whose rules, strategies, and outcomes are defined by clear mathematical terms (Charles, 2022). With game, learners will understand, remember and perform very well in mathematics this is because game is practical in nature and will illustrate mathematical concepts physically. Using game can help make mathematics more interesting to the students and less stressful for both the teacher and students which will improve student performance from low to high. Yusha'u (2013) stated that Students low performance could be attributed to many factors, these include: Students lack of readiness to learn and have success in mathematics, students' beliefs about mathematics, students' lack of interest in learning mathematics, lack of motivation from parents, teachers and colleagues, and lack of mathematics foundation.

Game is a system in which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome (Salen & Zimmerman, 2003). A game is a form of play which is guided with certain rules that players are to abide with in order to achieve the set objectives. Play creates a zone of proximal development of the child. In play a child behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself" also, what a child can do with assistance today she will be able to do by herself tomorrow (Vygotsky, 1978). Game are competitive interaction among participants to achieve pre-specified goals (Orim & Ekwuem, 2011). Therefore, a game could be viewed as a structured form of play usually undertaken for entertainment or fun, and sometimes used for educational purpose. Orim and Ekwueme (2011) have given some reasons for using games in teaching and learning mathematics as:

Practical; using game to teach mathematics ensures that students are practicing facts and formulas even if their practice is limited to the classroom, motivation; many students' find mathematics tedious and boring, using games to teach mathematics generates excitement, making mathematics as fun subject for students, anxiety; mathematics is a subject that create anxiety for students of all ages, because games focus on fun, rather than performance, games are excellent methods of reducing math-related anxiety in students, understanding: students may not understand certain mathematical concepts, using games to teach mathematics can help students develop a better understanding of both concepts and applications.

The importance of game in the teaching and learning of mathematics cannot be overemphasized this is because game is a form of play and the materials used in making the game are available so long that a students could get his hands on them and do more practices after school hours. The type of game used in this study is card game which is made from card board paper which is readily available materials for both mathematics teachers and students to use during and after class hours and is going to be played by both teacher and students. Therefore, the study was aimed at investigating the impact of animation method on secondary school students' academic performance in mathematics in Sokoto state, Nigeria.

Okigbo and Agu (2010) studied effects of mathematics game and instructional analogy as advance organizers on student's achievement in secondary school mathematics. The purpose of the study was to compare mathematics achievement of students taught mathematics with games, analogies to those taught with modified lecture method. The result revealed that there is significant difference between the achievement of male and female mathematics students taught with games, the result further shows that both game and analogy enhance achievement in mathematics. However, Justin, Onuorah, Uchenna and Ikemsinachi (2016), studied the effect of mathematics games-based instructional techniques on students achievements and interest in Algebra at basic education level. The result showed that the use of Game-based instructional technique in teaching affected student's achievement and interest in Algebra. Bassam and Abu Hmaid (2017), investigated 'the effectiveness of teaching mathematics using interactive video games on fifth grade students' achievement. The result indicated significant improvement in the achievement of the experimental versus control group. Students who used video games reported greater motivation compared to the ones who studied math in a regular way.

Statement of the Problem

The researchers observed that, the inability of most students to solve algebra related questions contributed immensely to the poor performance of student in mathematics. This could be as a result of the use of unknowns or variables especially when factorizing quadratic equation whose coefficients is either one or less than one as most students could not finds the sum and product of a number when performing factorization of quadratic equation.

Objectives of the Study

The main purpose of this study is to find out the impact of animation method on secondary school students' academic performance in mathematics in Sokoto state, Nigeria specifically, the objectives of the study are to:

1. ascertain the academic performance of secondary school students taught factorization of quadratic equation using animation method against the conventional method in Sokoto state.
2. ascertain the academic performance between males and females secondary school students taught factorization of quadratic equation using animation in Sokoto state.

Research Questions

The following research questioned were raised for the study:

1. What is the difference in the academic performance of secondary school students taught factorization of quadratic equation using animation method against the conventional lecture method in Sokoto state?
2. What is the difference in the academic performance between males and females secondary school students taught factorization of quadratic equation using animation method against the conventional lecture method in Sokoto state?

Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant difference in the academic performance of secondary school students taught factorization of quadratic equation using animation method and those taught using conventional lecture method in Sokoto state.
2. There is no significant difference in the academic performance between males and females secondary school students taught factorization of quadratic equation using animation method and those taught using conventional lecture method in Sokoto state.

Methodology

The study employed quasi-experimental research design. Experimental group were subjected to the treatment teaching using game, and the control group were subjected to the treatment teaching using conventional lecture method. Pretest and post-test were administered to both the experimental and control groups at the beginning and at the end of the study which lasted for a period of 6 weeks. This study comprises of all senior secondary school two students in Sokoto state, with the estimated population of 12,030 SS 2 both males and females students in public schools of Sokoto metropolis. Systematic sampling was used to select six senior secondary schools within the six educational zones in the state. Also, SS2 intact classes were selected as samples of the study from each of the schools selected which amount to 257**.**

The student algebraic performance test (SAPT) was developed by the researcher`s which consist of five items and each was scored 4 marks for each correct answer. The lowest possible score is 0 and the highest possible score is 20. All the 5 items are theory questions based on factorization method of solving quadratic equation which was subjected to the teaching using game, and conventional method. Instrument was validated by the experts that teaches mathematics at secondary school and expert in mathematics education. Test-retest was used to establish the reliability of the instrument was computed using Pearson product moment coefficient correlation and the reliability coefficient was found to be 0.83 for students algebraic performance test. Descriptive statistics was used in answering the research questions, while t-test statistics was used to test the hypotheses at 0.05 level of significance.

Results

Research question 1: What is the difference in the academic performance of secondary school students taught factorization of quadratic equation using animation method against the conventional lecture method in Sokoto state?

Table 1: Statistics of student's performance taught game and conventional methods.

Method	N	Mean	Standard Deviation	Mean difference
Game (EG)	113	14.98	3.29	3.96
Conventional method (CG)	144	11.02	3.56	

Table 1: showed the performance of students taught factorization of quadratic equation using game and those taught using conventional method. The result revealed that the mean performance of students taught game in the experimental class has mean score of 14.98 which

is greater than the mean performance of the control class as 11.02. Therefore, the difference between the academic performance of students taught factorization of quadratic equation using game and those taught using conventional method was 3.96. To find if difference exist, the result is further subjected to t-test statistical analysis.

Hypotheses 1 (H_{01}): There is no significant difference in the academic performance of secondary school students taught factorization of quadratic equation using animation method and those taught using conventional lecture method in Sokoto state.

Table 2. Summary of t-test analysis between students taught factorization of quadratic equation using game and those taught using conventional method

Groups	N	Mean	SD	DF	t_{cal}	P-Value	Decision
Game (E G)	113	14.98	3.30	255	9.15	0.00	Rejected
Conventional	144	11.02	3.60				

α=0.05

Table 2: is a summary of t-test analysis conducted to compare the academic performance of students in game and conventional method. The table revealed that p- value of 0.000 is less than the α – value of 0.05 ($p= 0.000 < \alpha = 0.05$) hence the null hypothesis which says (there is no significance difference in mean performance between students taught factorization of quadratic equation using game and those taught using conventional method) was rejected.

Research Question 2: What is the difference in the academic performance between males and females secondary school students taught factorization of quadratic equation using animation method against the conventional lecture method in Sokoto state?

Gender	N	Mean	Standard Deviation	Mean difference
Game (EG) Males	41	15.61	3.43	0.98
Game (EG) Females	72	14.63	3.18	

Table 3: present the summary of the descriptive statistics of mean and standard deviation conducted to compare the mean performance of males and females when taught factorization of quadratic equation using game, the result indicated that males have the higher mean score of 15.61 against their female's counterpart with mean score of 14.63 with mean difference of 0.98 To find if difference exist, the result is further subjected to t-test statistical analysis.

Hypothesis 2 (H_{02}): There is no significant difference in the academic performance between males and females secondary school students taught factorization of quadratic equation using animation method and those taught using conventional lecture method in Sokoto state.

Table 4: Summary of student's performance between males and females taught factorization of quadratic equation using game

Groups	N	Mean	SD	DF	t_{cal}	P-Value	Decision
Game (EG) Males	41	15.61	3.42	111	1.54	0.13	Retained
Game (EG)Females	72	14.63	3.20				

Source: Field Work (2022) α=0.05

Table 4: Is a summary of t-test analysis conducted to compare the academic performance of male and female students taught using game. The table shows that, p-value of 0.13 is greater than α – value of 0.05. Therefore, the null hypothesis which says that (there is no significance difference between males and females taught factorization of quadratic equation using game) is hereby retained.

Discussion of the Findings

The findings of this research which was analyzed using descriptive statistics and t-test independent has showed that; there is significance difference in mean performance of students taught factorization of quadratic equation using game and those taught using conventional method in favor of game. This is in line with the findings of Mukaila (2016) who conducted research on student's attitudinal change towards the use of instructional animated object based card game in learning Mathematics. The result showed that experimental group responded positively and demonstrated high mastery of card game procedure.

There is no significance difference between males and females taught factorization of quadratic equation using game. This corresponds with the findings of Okigbo and Agu (2010) who carried out research on studied effects of mathematics game and instructional analogy as advance organizers on student's achievement in secondary school mathematics. The result revealed that both game and analogy enhance achievement in mathematics.

Conclusion

Based on the results of the analysis, the following conclusions were drawn from the findings of the study: There was no significant difference in the academic performance of students taught using game and those taught using conventional method. There was significant difference between the academic performance of males and females taught using game.

Recommendations

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

1. Card game and animation should be adopted as instructional method to complement conventional method of teaching to teach factorization method of quadratic equation. This will improve students understanding concept which will make them have interest in mathematics.
2. Mathematics teachers are strongly advice to make use of card game to teach factorization method of solving quadratic equation because it develops a better understanding of concept, bring excitement and also reduce the level of mathematics abstraction.

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