UNIJERPS
Unizik Journal of Educational Research and Policy Studies VOL.19 (1);
January - June, 2025 https://unijerps.org
2023 Impact Factor:* 6.834;** 2022 ***Impact Factor: 5.156; ***2021 Impact Factor: 5.641;***
2020 Impact Factor: 5.355. *Indexing and Impact Factor URL:*
http://sjifactor.com/passport.php?id=21363

EFFECT OF GAME-BASED METHOD ON PUPILS' INTEREST IN MATHEMATICS IN NKANU-WEST LOCAL GOVERNMENT EDUCATION AUTHORITY, ENUGU STATE

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ABSTRACT

Mathematics plays a crucial role in daily life and has become an essential subject due to its significance in modern technological advancements. This study was necessitated by the persistent unsatisfactory pupils' achievement in mathematics. The purpose of this study was to determine the effect of Game-Based Method (GBM) on pupils' interest in Mathematics in Nkanu-West Local Government Education Authority. Two research questions were answered and three null hypotheses tested for the study. The study adopted a quasi-experimental design that employed a pre-test, post-test non-randomized control group. The population comprised 1,177 basic five pupils in the 52 government-owned primary schools in Nkanu-West LGEA. A total of 186 (91 males and 95 females) basic five pupils from four out of 52 government-owned public primary schools in the study area were sampled using multistage sampling procedure. The instrument used to collect data for this study was Mathematics Interest Scale (MIS). The instrument was validated by three experts from Department of Early Childhood and Primary Education, Educational Measurement, Evaluation and Research Unit of Department of Educational Foundations and an experienced Mathematics Teacher. Cronbach alpha was used to establish a reliability coefficient of 0.78 for MIS. Data was collected with the help of the research assistants who were Mathematics teachers in the sampled schools. Mean and standard deviation were used to answer the research questions, while Analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The findings revealed that game-based method significantly enhanced the interest of pupils in Mathematics. Also, game-based method was found to be a gender friendly method that enhanced the interest of primary school pupils in Mathematics in Nkanu-West LGEA. It was concluded that game-based instructional Method is an effective instructional method that can be used to improve and sustain pupils' interest in the subject. Based on the findings, it was recommended among others that Mathematics teachers should be encouraged by the government to adopt the use of game-based method in teaching pupils so as to make them develop a better interest in the subject.

Keywords: Effects; Game-Based Method; Pupils' Interest; Mathematics

Introduction

Education is considered as the first step for every human activity as it plays a vital role in the development of human capital development as well as an individual's well-being and opportunities for better living. The extent to which recipients gain the knowledge, skills, and competences necessary to contribute effectively to

national development is determined by the quality of the education provided to the citizens. Hence, according to Ugwude and Okika (2017), education is a worldwide complex process of socialization that transforms individuals into social beings equipped with the necessary tools to participate fully in the dynamics of life. The educational strength of a nation depends on the quality of her educational system. In Nigeria, the educational system is systematically structured into pre-primary, basic or primary, secondary and tertiary education.

Primary education is the second formal schooling system a child is exposed to after home education. It welcomes the child to the process of socialization under the tutelage of a teacher. Primary education is a pupil-centred learning that prepares and grooms the mind of a child for future academic endeavours. According to the Federal Republic of Nigeria (FRN, 2013), primary education is the education given in an institution for children aged six to 11 plus. The FRN went further to explain that; the rest of the education system is built upon primary education and is the key to the success or failure of the whole system. This is evident by the fact that, basic literacy and numeracy skills as well as sound attitudes are developed in proper perspectives in primary education. FRN recognizes the importance of primary education and as a result, gave it prominence in the National Policy on Education as one of the levels of education in the Nigerian educational system.

Currently, Nigeria operates 9-3-4 educational system. Primary education is embedded in the 9-3-4 system under '9' as Lower Basic (Primary 1-3), Middle Basic (Primary 4-6); which runs up to Upper Basic (Junior Secondary 1-3). The 9-Year Basic education emphasizes value re-orientation, poverty eradication and employment generation capabilities in learners, where science, technology, Mathematics, vocational education and training are specifically designed to provide the contents, learning experiences and skills for the socio-economic transformation of the Nigerian nation (Igbokwe, 2015).The structure of the 9-Year Basic Education Curriculum was such that subjects offered range between 10 and 16 from lower Basic 1 to upper Basic 3 and almost every subject stands on its own. For example, Basic Science, Basic Technology, Physical and Health Education, Computer Studies, Civic Education, Home Economics, Agricultural Science, Business Studies and Christian Religious Studies/Islamic Studies were all separate subjects. Across the Lower Basic (Primary 1-3), Middle Basic (Primary 4-6) of the 9-3-4 education system, Mathematics, English language and one major Nigerian language (Hausa, Yoruba or Igbo) are among the core subjects offered by every pupil in the primary school system.

Mathematics is not only considered as an important subject in primary education but also regarded as the father of all science and technology subjects across all levels of education (Clements and Sarama, 2016). This is because Mathematics is a science subject that deals with numbers, symbols and figures. It is also the science of numbers, time and space. The counting and measuring of

numbers tend to portray Mathematics as old as mankind. Mathematics as a science subject is important and its usefulness in our present society cannot be over emphasized. It is overtly that the subject Mathematics has been proved as an essential subject in primary schools in Nigeria today. According to Malik and Salman (2018), Mathematics is a concenter subject which serves as a foundation for pupils' level of thinking, skill development and problem solving. Any nation that must develop their manpower scientifically and technological wise must have a strong mathematical foundation at the basic school level. Malik (2017) opined that, Mathematics is a unifying subject that prepares pupils for a useful and meaningful living, and that it is the language and key to everyday activities of mankind in science and technology. Mathematics is also seen by society as the foundation of scientific and technological knowledge that is vital in the socio-economic development of the nation (Anaduaka, Olaoye, and Sunday, 2018). Because of its importance, Mathematics is a compulsory subject at primary and secondary schools in Nigeria.

A cursory look at the various timetables of most primary schools in Nigeria showed that Mathematics is given a lot of instructional time on daily basis. In primary school, Mathematics is broken down into six themes, which are Numbers and Numeration, Basic Operations, Measurement, Algebraic Process, Practical and Descriptive geometry and Everyday Statistics. The aforementioned themes of primary school Mathematics curriculum equip pupils with the necessary cognitive, affective, psychomotor domains with quantitative reasoning to handle computation of numbers and figures. The teaching of the various themes of primary school Mathematics stands to give Nigerian children the opportunity to acquire the requisite arithmetic skills to function effectively in today's ever-changing knowledge-driven world.

Despite the importance of Mathematics to societal development, many pupils fear, fail and possibly dislike the subject (Areelu, 2014). Mathematics has always been perceived as the most difficult subject in the school curriculum (Poopola and Ajani, 2019). This has resulted in learners having a negative attitude towards the subject and this attitude seems to have existed from one generation to another. Pupils, who have failed Mathematics at one time or the other, preserve this image of failure and justify their failure by devaluing the importance of the subject which influences their interest (Ajani and Konku, 2012).

Interest is a feeling or emotion that causes attention to focus on an object, event, or process. It is used as a general concept that may encompass other more specific psychological terms, such as curiosity and to a much lesser degree surprise. According to Ezeudu (2015), interest could be defined as an activity one enjoys and devotes his/her time in studying or doing. It can also be seen as a feeling one has in the cause of wanting to know or learn more about something or somebody. Interest differs from ones personal attitude which refers to the manner of behaving towards somebody or something. Chauhan as cited in Okereke and Okigbo (2019), described interest as an activity that

drives or motivates the individual for action. Generally, if one has interest in something, one will want to learn or hear more about it and will take pleasure doing it. Studies on interest in Mathematics are concerned with identifying different approaches that may be used to generate and sustain pupils' interest in Mathematics for higher achievement. Okereke and Okigbo also submitted that interest can be seen as the feeling one has in the course of wanting to know or learn more about somebody or something Essien, Akpan and Obot (2015) stated that interest in an activity or object that can be sustained depending on whether the individual whose interest is engaged stands to gain or lose by doing so. Pupils' interest may be marred based on the type of teaching method employed by the teacher while teaching such as conventional teaching method (teacher direct method).

Conventional teaching method such as teacher direct instruction method entails the use of board with chalk followed by dictation. This is supported by Achuonye (2015) who observed that, conventional method is very prevalent in primary schools in Nigeria. The reasons for utilizing conventional teaching method include; it saves time, permits flexibility, requires less rigid space, permits adaptability and permits versatility. Despite the reason for utilizing the method, it has some disadvantages. In conventional method, learners are more passive than be active, the cooperation and interaction between the teachers and the pupils are minimal. Yap (2016) stressed that in conventional teaching method, instructor initiate discussion in the classroom and focus exclusively on the knowing the content in textbooks and notes. The author added that this method of teaching limit the room for more creative thinking and also seldom consider individual differences. Similar to this, Feider and Silverman cited in Farha (2016) argued that conventional teaching method makes pupils uninterested in class, discouraged, bored and do poorly in test. The conventional teaching method gives Mathematics an abstract outlook to primary school pupils and could be responsible for their poor achievement in handling Mathematics questions in external examinations.

The short comings of the direct instruction type of conventional method have led to some innovative, pupil-centred and activity-based teaching methods such as game-based, self-instructional, think-pair-share, jig-saw among others according to Dorgu (2015). These innovative methods could make primary school pupils acquire basic analytical skills while participating actively in the process of understanding the components of primary school Mathematics than mere sitting down and listening to their teacher's instructional delivery. Naturally, primary school pupils tend to learn faster in a playful atmosphere due to their age and one of such atmosphere is learning through games. Games or plays are the birth right of every child. Hence, Mathematics educators inferred that the interest of pupils in Mathematics can be improved through game-based teaching method.

In furtherance, Agwagah as cited in Akinsola and Frederick-Jonah (2015) opined that a game is a type of play that follows a set of rules, aims at a definite goal or outcome and involves competition against other

players or against barriers imposed by nature of the game. The importance of introducing games to mathematical instruction, according to Kankia (2018) is that, they relax tension, clear boredom, foster environment where teaching and learning are pleasant, interesting, exciting, stimulating, motivating and at the same time increases academically rewarding. Without doubt, the fun and carefree element embedded in games makes it an interesting learning strategy in the classroom. The global appeal of gaming in the life of children and adults can be harnessed as a rich form of learning experience in a classroom. This learning experience can be called game-based method. Game-based method is defined as an approach to learning with a type of game play that has defined learning outcomes; which is to balance subject matter with game play, the ability of the player to retain and apply the subject matter to the real world (Benoit, 2017). It combines multiple methods into an effective means of acquiring, practicing and applying new knowledge. Game-based method enables pupils to work cooperatively and competitively with active participation and interaction in the course of discovering new knowledge.

More so, Usman and Nwoye (2017) asserted that, teaching and learning Mathematics with games is helpful and arouses the interest of pupils in achieving better in Mathematics. In support, Akinsola and Frederick-Jonah (2015) asserted that another way to create and sustain pupils' interest permanently in Mathematics is by teaching Mathematics with varieties of methods, instructional materials and techniques, especially games. This apart from making Mathematics learning more interesting, it will improve pupils' achievement in Mathematics. It is important to mention that game-based learning strategies come in different forms and instructional settings. Examples of game-based learning strategies include go fishing game, clock game, dice games, online computer and mobile games, board and card games, pencil and paper games, egg in a crate game, and slide game approach among others. These games can be played by male and female pupils in primary schools. Specifically, the study focused on board and card game.

Board and card game is a type of game that has to do with the use pack of cards with mathematical problems written on the card and is being played on a board or desk. According Hunsucker (2016), board and card game is an analogue system designed to create a game play experience with the use of cards. The kind of cards used in board game is dependent on the kind of mathematical concepts that pupils are studying, and during the game, the board acts as an external representation of the game state. The board is placed in the center of the table in reach and view of all players. The board changes throughout the game as players take their turns and manipulate their positions in order to ensure that every pupil participates in the gaming. A team player with the highest number of wins automatically becomes the overall winner. The use of this kind of game may increase pupils' interest in Mathematics.

The effect of gender on interest would be investigated because previous studies; (Ibe, 2014; Nwagbo

and Chekelu, 2011; Opara, 2017) indicated that interest of pupils can also be influenced by gender. The importance of examining instructional strategy in relation to gender is basically on the socio-cultural difference between males and females. The general diversity of differences in the academic outcome of students can be said to be gender-related. Gender is attributes that distinguished male and female. Gender is the classification of human beings into masculine and feminine characteristics. According to Onyali and Nnebedum (2018), gender is a physical, biological and behavioural characteristic which differentiate masculinity and femininity. Researchers are still trying to unravel the phenomenon behind gender differences in academic achievement and are yet to decide why male and female learners perform excellently in certain subjects and differ in some. This disparity is the reason why 21st century teachers must always consider gender friendly instructional strategies in order to reduce the stereotyping of school subjects. According to Robertson (2012), boys prefer more challenging competitive games such as geo-board game and power tac toe game, board and card game, cards among others whereas girls prefer the more social related games such as ludo game, ayo game and slide game with less conflict. Although, Mathematics is usually given a masculine perspective, female pupils are gradually making massive impact across Science, Technology, Engineering and Mathematics (STEM) subjects across all levels of education.

Gender as a variable in pupils' achievement and retention in Mathematics has received research attention over the years. Many researchers used different strategies in teaching pupils Mathematics and yet found divergent achievement and retention status by gender in their studies. While Egara and Mosimege (2024)) found out that there is gender parity concerning pupils' retention in Mathematics, Okeke (2018) also found out that there was no significant interaction effect of gender on student's retention. The effect of pupils' gender on academic achievement, interest and retention in Mathematics is still a major controversy among educators and researchers as result of conflicting reports from such gender-related studies. Some research finds significant differences in favour of boys, while a few in favour of girls and others are neutral (Akinsola and Frederick-Jonah, 2014). This situation calls for primary school teachers to set up a stimulating gaming environment that is developmentally appropriate for children so as to make every pupil learn the instructional contents of the subject matter without fears of stereotyping. Though some researches has been carried out on the effect of game-based instructional method on interest of students (Hui and Mahmus, 2023; Letsa-Agbozo, Susuoroka, and Donnoe, 2023; Ojonugwa and Abdullahi, 2023; Oyarinde, 2019; and White and McCoy, 2019), the researcher observed that empirical investigation on the effects of game-based instructional method on pupils' interest in Mathematics has not been given adequate attention. Recently, gender related issues in Mathematics have generated serious concerns for educators judging by the number of studies done to that effect. Still, there is no consensus as to whether it affects

pupils' interest in Mathematics or not. These contrasting views on gender differences of pupils in Mathematics interest calls for further investigation to find out if gender has any influence on pupils' achievement, interest and retention using game-based method in Mathematics in Nkanu-West Local Government Education Authority of Enugu State.

Research Questions

The following research questions guided the study:

1. What is the difference between the mean interest rating scores of basic five pupils taught Mathematics with game-based method and those taught with teacher direct instruction method?
2. What is the difference between the mean interest rating scores of male and female basic five pupils taught Mathematics with game-based method?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean interest rating scores of basic five pupils taught Mathematics with game-based method and those taught with teacher direct instruction method.
2. There is no significant difference between the mean interest rating scores of male and female basic five pupils taught Mathematics with game-based method.
3. There is no interaction effect of instructional methods (game-based and direct instruction methods) and gender on interest of basic five pupils in Mathematics.

Materials and Method

The study adopted a quasi-experimental design that employed a pre-test, post-test non-randomized control group. The population comprised 1,177 basic five pupils in the 52 government-owned primary schools in Nkanu-West LGEA. A total of 186 (91 males and 95 females) basic five pupils from four out of 52 government-owned public primary schools in the study area were sampled using multistage sampling procedure. The instrument used to collect data for this study was Mathematics Interest Scale (MIS). The instrument was validated by three experts from Department of Early Childhood and Primary Education, Educational Measurement, Evaluation and Research Unit of Department of Educational Foundations and an experienced Mathematics Teacher. Cronbach alpha was used to establish a reliability coefficient of 0.78 for MIS. Data was collected with the help of the research assistants who were Mathematics teachers in the sampled schools. Mean and standard deviation were used to answer the research questions, while Analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.

Presentation of Results

Research Question 1: What is the difference between the mean interest rating scores of basic five pupils taught Mathematics with game-based method and those taught with teacher direct instruction method?

Table 1: *Difference between the mean interest rating scores of basic five pupils taught Mathematics with game-based method and those taught with teacher direct instruction method.*

Group	Pre-test			Post-test		
	N	Mean $\bar{x}$	SD	Mean $\bar{x}$	SD	Mean Difference
Experimental	97	38.35	5.97	51.43	4.02	13.08
Control	89	36.85	8.74	46.50	4.69	9.65
Mean Difference		1.50		4.93		3.43

Table 1 shows that basic five pupils taught Mathematics with game-based methods had pretest mean interest rating score of 38.35 and posttest mean interest rating score of 51.43 with gained mean interest rating score of 13.08, while those in the control group taught with teacher direct instruction method had pretest mean interest rating score of 36.85 and posttest mean interest rating score of 46.50 with gained mean interest rating score of 9.65. The use of game-based method reduced the variation of score from 5.97 to 4.02 in the posttest interest rating. There was a low score variation in the posttest interest rating of pupils in the experimental group (4.02) compared to those taught Mathematics using teacher direct instruction method (4.69). The difference between the gained mean interest rating scores of basic five pupils was 3.43 in favour of game-based method. This implies that game-based method is more efficient in promoting basic five pupils' interest in Mathematics than teacher direct instruction method.

Research Question 2: What are the differences between the mean interest rating scores of male and female basic five pupils taught Mathematics with game-based method?

Table 2: *Difference between the mean interest rating scores of male and female basic five pupils taught Mathematics using game-based method*

Group	Gender	N	Pre-test Mean	SD	Post-test Mean	SD	Mean Difference
Experimental	Male	91	36.31	7.48	51.15	9.11	14.84
	Female	95	40.48	9.48	51.72	9.24	11.24
	Mean Difference		-4 .17		-1.57		3.60

From table 2, it is observed that the mean gain of male pupils is 14.84 with their posttest mean standard deviation of 9.11 and that of their female counterpart is 11.24 with their posttest mean standard deviation of 9.24. It can be observed that though the female pupils mean interest scores in both pre-

test and post-test are higher than those of the male counterparts, the male pupils made a remarkable improvement in Mathematics. The male pupils' interest in Mathematics was reflected in their mean gain score. Hence, the male pupils did better using game-based method.

Hypothesis 1: There is no significant difference between the mean interest rating scores of basic five pupils taught Mathematics with game-based method and those taught with teacher direct instruction method.

Table 3: *Test of Significant Difference between the Mean Interest Scores of Pupils taught Mathematics using Game-Based and Teacher Direct Instruction Method*

Source of Variation	SS	Df	Mean Square	F	Pvalue	Decision
Corrected Model	11121.823[a]	4	2780.456	20.185	.000	
Intercept	9865.850	1	9865.850	71.621	.000	
Pretest	15.638	1	15.638	.114	.737	
Method	8696.161	1	8696.161	63.130	.000	S
Gender	733.571	1	733.571	5.325	.063	NS
Method * Gender	**1456.846**	**1**	**1456.846**	**10.576**	**.002**	**S**
Error	15841.377	181	137.751			
Total	294304.000	186				
Corrected Total	26963.200	185				

Table 3 shows that F (1, 181) = 63.130, P = 0.000 < 0.05 alpha level, therefore, hypothesis 1 was rejected. The inference drawn is that there is a significant difference in the mean interest scores of pupils taught Mathematics using game-based method and those taught using teacher direct instruction method. This is in favour of game-based method (experimental group).

Hypothesis 2: There is no significant difference between the mean interest rating scores of male and female basic five pupils taught Mathematics with game-based method.

Data relating to Hypothesis 2 is contained in Table 3.

From Table 3, it can be seen that at 0.05 level of significance, 1df numerator and 173df denominator, the calculated F is 5.325 with P-value of .063 which is greater than 0.05. Therefore, the null hypothesis 2 was not rejected. Thus, there is no significant difference between the mean interest scores of male and female Mathematics pupils taught using game-based method.

Hypothesis 3: There is no interaction effect of instructional methods (game-based and direct instruction methods) and gender on interest of basic five pupils in Mathematics.

Data relating to Hypothesis 3 is contained in Table 3.

From Table 3, it can be seen that at 0.05 level of significance, 1df numerator and 173df denominator, the calculated F is 10.576 with P-value of 0.002 which is less than 0.05. Therefore, the null hypothesis 3 was rejected. Thus, there is an interaction effect of instructional methods (game-based and direct instruction methods) and gender

on interest of basic five pupils in Mathematics.

Discussion of Findings

From research question 1, it was shown that the mean gain for the pupils in the experimental group is 13.08 and that of the control group is 9.65. this shows that the experimental group pupils which were taught Mathematics using game-based method had a higher mean interest score than the group taught Mathematics using teacher direct instruction method. This is in line with the findings of Umoru and Ubom (2013) whose study revealed that the difference in the mean interest scores on geometry favoured the experimental group taught using games and simulation than their counterparts in the conventional teacher method. This is also in consonance with the findings of Ezeugwu, Onuorah, Asogwa and Ukoha (2016) who revealed that the use of game-based instructional technique in teaching affects students' interest in algebra than the teacher-centered method of instruction. This is as a result of the interactive nature of game-based method which allows the pupils to participate actively in the class activities.

From research question 2, it is observed that the mean gain of male pupils is 14.84 and that of their female counterpart is 11.24. It can be observed that though the female pupils mean interest scores in both pre-test and post-test are higher than those of the male counterparts, the male pupils made a remarkable improvement in Mathematics. The male pupils' interest in Mathematics was reflected in their mean gain score. Hence, the male pupils did better using game-based method. This is in line with the findings of Ezeugwu, et al (2016) whose study revealed that game-based instructional technique favoured both the male and female students in the experimental group.

Findings from hypothesis 1 in Table 8 shows that at 0.05 level of significance, 1df numerator and 173df denominator, the calculated F is 63.130 with Pvalue of 0.000 which is less than 0.05. Therefore, the null hypothesis one was rejected. Thus, there is a significant difference in the mean interest scores of pupils taught Mathematics using game-based method and those taught using teacher direct instruction method in favour of game-based method. This is in agreement with the findings of Ezeugwu, et al (2016) whose study revealed that there is a significant difference in the mean interest scores of students taught Mathematics using game-based instructional technique and those taught using teacher direct instruction method in favour of game-based instructional technique.

From the findings in hypothesis 2, it can be seen that at 0.05 level of significance, 1df numerator and 173df denominator, the calculated F is 5.325 with P-value of .063 which is greater than 0.05. Therefore, the null hypothesis two was not rejected. Thus, there is no significant difference between the mean interest scores of male and female Mathematics pupils taught using game-based method. This is in consonance with the findings of Ezeugwu, et al (2016) whose study revealed that there was no significant difference between the mean interest scores of male and female Mathematics students taught using game-based instructional technique.

From the findings of hypothesis 3, it can be seen that at 0.05 level of

significance, 1df numerator and 173df denominator, the calculated F is 10.576 with P-value of 0.002 which is less than 0.05. Therefore, the null hypothesis eight was rejected. Thus, there is an interaction effect of instructional methods (game-based and direct instruction methods) and gender on interest of basic five pupils in Mathematics. This is in disagreement with the findings of Ezeugwu, et al (2016) whose study revealed that there was no interaction effect between teaching method and gender on students' interest in algebra. This could be as a result of the slight difference in the mean interest score of male and female pupils taught Mathematics using game- based method.

Conclusion

Based on the findings of this study, the researcher concluded that game-based method is an effective instructional method that can be used to improve the interest of pupils in Mathematics. It could be adopted as an alternative instructional method in the teaching of Mathematics. The male and female students in the experimental group had no significant difference in their interest in the subject. This means that the interest of pupils in Mathematics did not depend on gender but on teaching method employed by the teacher. This means that game-based method is a gender friendly method that can be used to effectively teach Mathematics to both male and female pupils. From the foregoing, game-based method may be a valuable tool for enhancing interest.

Recommendations

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

1. Mathematics teachers should be encouraged to adopt the use of game-based method in teaching pupils so as to make them develop a better interest in the subject.
2. Government, Non-Governmental Organizations and Parents Teachers Associations should fund development of game-based method of teaching in the schools, equip the schools with necessary facilities and train manpower to produce software for Mathematics teaching in Nigerian schools.
3. Schools should train Mathematics teachers on the use of game-based resources for teaching and learning particularly, the use of different software package on Mathematics concepts and processes to encourage the potentials of game-based instruction in Nigerian schools.
4. Game-based literacy programme should be provided by the government and education stakeholders for both pupils and teachers for full integration of game-based resources in education programme.

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