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Effects of Gamification and Mastery Learning Strategies On Student's Performance and Retention in Mathematics in Oju Local Government Area of Benue State

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ABSTRACT: *This study is aimed at finding effects of gamification and mastery learning strategies on students' performance and retention in mathematics. The study was Quasi-Experimental Non-Randomized Pretest-Posttest Control Group Design. The population for this study consisted of all the 3, 524 Upper Basic II mathematics in Oju Local Government Area of Benue State, Nigeria in 2021/2022 academic session in Benue State, Nigeria. Purposive sampling technique was used to obtain a sample of six schools. The sample for the study was 74 Upper Basic II students from the selected schools. The instrument used for data collection was mathematics. Achievement and Retention Test" (MART). The researcher trained the teachers in the experimental group on the technique of GLS and MLS before the treatment. The instrument was pilot tested to asserted the reliability. The reliability co-efficient alpha was 0.85. Data was analyzed using mean and standard deviation to answer the research question while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 significant level. The result of the study show that there is significant difference in the mean performance scores of students in mathematics using gamification, mastery learning and conventional Strategies and there is significant difference in the student's mean retention scores in mathematics taught using gamification,and mastery learning than conventional Strategies. The research concluded that MLS is an effective teaching method, which teachers should be encouraged to use and should be implemented in the teachers' education programmes in Nigeria and other African nations.*

KEYWORDS: gamification strategy, mastery learning strategy, conventional strategy,upper basic students, performance and retention.

INTRODUCTION

Beginning from the late 1950s, well-meaning Nigerians namely Herbert Malculay, Tafawa Balewa, Obafemi Awolowo and the conscience group of the nation began to express concerns about the yawning gap between the needs and aspirations of the people and the type of education system provided by the British in Nigeria. According to Fafunwa (1974), the education system in Nigeria, instead of developing positive knowledge, attitudes, values and skills in the society in which the African child lives, tends to alienate him from his cultural environments. Fafunwa

describe the British Education as been theoretical and as such irrelevant to the philosophy and goals of the Nigerian society.

Akinlayi (2013) opined that the trends continued until early 1970s, and that no emphasis was placed on either teaching pupils how to live together and participate in the life of the society, or on teaching them to be 'societe' once they have become 'literate' and 'numerate'. It was felt that acute personal awareness and needs can never be satisfied by specialists curriculum of the school based specially and exulusively on textbooks and conventional teaching methods.

The introduction of mathematics was characterized by the desire to use the subject to address contemporary national and the world problems. According to Utulu (2011) the school has an obligation to provide a curriculum designed to develop effective living in the society. Utulu maintains further that such a curriculum is expected to equip the learner with skills, understandings, attitudes, habits and appreciations that will help contribute to this goal. The Nigerian mathematics Programme is not an exception in this as it has a set of goals and objectives which one can confidently describe as being of direct relevance to the philosophy and objectives of Nigerian education.

Furthermore, the dynamic nature of human environment and problems are fortunately a major concern of mathematics. This also forms part of its philosophical background as it is meant to encourage learners to understand better and cope with the ever occurring changes in the political, social, economic scientific, technological and other facets of life, so as to effectively face the challenges and opportunities in world of rapid change.

Thus the philosophical background of mathematics assert and creates vantage opportunity for the discipline to package a content that is integrated in nature, with its products becoming integrated individuals who can stand the test of time as trades, teachers, engineers, doctors, bankers, politicians, or whatever they choose to become. It also encourages the making of learners to be socially relevant, economically viable and politically honest and scientifically and technologically equipped in a rapidly changing world. (Obodo, 2014 ;Zaria, 2011 & Odili, 2016)
In line with the foregoing, the National Policy on Education (2013) has vividly expressed the philosophy of Nigerian education as being based on the integration of individuals into a sound and effective citizens with equal education opportunities for all. Specifically, education is aimed at building main objectives ; a free and democratic society, a just and egalitarian society, a united, strong and self-reliant nation, a great and dynamic economy and a land of bright and full opportunities for all citizen.

In as much as one hopes that other subjects of study could play important roles in ensuring the realization of this philosophy, obodo avers that we cannot overlook the specific and crucial role that mathematics could play in laying a good and solid foundation for such task, particularly bearing in mind the philosophical background of mathematics. For instance, mathematics

emphasizes on the quality of instruction at all levels has to be oriented towards inculcating some values which include: respect for the worth and dignity of individuals , man's ability to make rational decisions, moral and spiritual values in interpersonal and human relations, shared responsibility for the common good of societial development and respect for the dignity of labour.and development of science and technology.

The recognition of these values in the National Policy on Education as being essential in the realization of our national goals implies that a subject like mathematics which is a value-oriented or affective based discipline, as presented in its philosophical background is capable of playing a key role in the task, especially if it is properly taught.

In addition, the recognition of the importance of the foregoing is reflected in the process and content build up to mathematics curricula at most of the levels of Nigeria's educational system. According to Utulu (2016) the curricula has been spirally built using concentric cycles. This is to reflect the fact that because the knowledge to be acquired by human beings does not come in separate fragment, they must therefore be passed on as a whole.

Mathematics is viewed as a discipline which attempts to modify or change the learners' behaviours in the directions of acceptable values and attitudes through a process of studying human beings relationship with his or her changing environment and problems with the desire to provide solutions to various complementing problems in order to ensure his/her survival, having been equipped with the necessary tools such as values, attitudes, skills and knowledge (Singh, 2013).

Over the years, mathematics occupied an important position in the school curriculum in Nigeria. The subject has been recognized as an effective tool in other facets of live.. Abidoye (2015) opines that mathematics is a subject that equips learners with critical and problem-solving skills which enable students to tackle problems and issues that may arise in their socio-economic life. That is why, the Federal Government of Nigeria (FGN) (2013), in the National Policy on Education, listed mathematics among core subjects for the Basic Education Curriculum.

With these national objectives in mind, Mezieobi, Fubara and Mezieobi (2015) contend that the teaching of mathematics in schools will help students at all levels to develop the ability to adapt to their changing environment and problems. The authors maintains that mathematics emerges as a school subject of prime importance for study in order to modify the functionality of the past inherited educational system and experiences. Akintunde (2014) also opines that since mathematics is interested in everything about man in relation to all aspects of his environment; the subject incorporates all aspects of reforms and innovations geared towards the sustenance of man and his environment.

In achieving the aforementioned objectives of mathematics, the subject prepares young people to be more humane, rational, responsive and responsible participating citizens in a world that has become increasingly interdependent. In support of this notion, Folade (2017) asserts that mathematics enable man to learn about the challenges of survival in their environment. The introduction of mathematics according to Folade was meant to involve pupils in more meaningful and purposeful learning activities based upon investigation, examination and observation of their own immediate neighbourhood, embodying both social, physical, economic, political cultural, religious, scientific and technological environments. By so doing, pupils are given an early opportunity of knowing about the societal problems, experience them and make decision on appropriate solution and practical social action that would be beneficial to themselves and the entire society.

In spite of all the laudable objectives and benefits of teaching mathematics in the school curriculum, the teaching of the subject has been affected by poor teaching strategies. These strategies does not connote sheer passing on of, or impacting of, desirable knowledge to a passive learner recipient who must on demand regurgitate the rote memory acquired and stored knowledge, hence poor performance in the subject. Shajmija further maintains that effective teaching of mathematics may involve a negligible measure of cognitive knowledge particularly the lower order knowledge. Mathematics teaching, more than any other subject, emphases higher level knowledge and affective and character development. In this circumstances, therefore, teaching in mathematic refers to a predominantly student controlled or directed interactive learning performance oriented activities inside and outside the formal classroom situation in which the learner actively participates and make a conscious and deliberate effort to induce and acquire significant learning under the teacher. (Shamija.2011; Ryan, R.M & Deci, E.L;1985).

Amid the pervasiveness of a multitude of negative values, poor attitude to work, disrespect to constituted authority and absence of a sense of patriotism. The introduction of mathematics a value laden subject was thought to provide a value re-orientation platform to inculcate socio-economic and affective competence in our people. All these are hindered by poor teaching strategies in mathematics (Mezieobi, Fubara & Mezieobi, 2015;Asan,2019).

In Nigeria, there has been reduction in the number of students wishing to continue with mathematics. Efforts have been made from various contributions of mathematics educators and professional associations like Mathematical Association of Nigeria and Science Teachers Association of Nigeria towards making mathematics simple and interesting to students.

In order to fully achieved the aims of education as enunciated in the National Policy on Education (2013), educational activities should be learner centered for maximum self-development and self-fulfillment and teaching should be practical, activity-based, experiential and information and communication technology supported. Different strategies like peer tutoring, concept mapping, mind mapping, cooperative teaching, and inquiry strategies among

others which are more interactive have been suggested and empirical studies have been carried out on their effect on students performance and retention. However, the researcher is interested on the effect of gamification and mastery learning strategies on students' performance and retention in mathematics.

Gamification strategy is the application of game-like mechanics to non-game situations or context (Deterding, Dixon Khaled, & Nacke, 2011). Learning is like game, it has rules, levels and sometimes rewards. In gamification strategies, students need to follow the rules in order to move up a level and sometime they get rewarded for their effort. The teaching strategies to gamify learning include; use of levels, create challenge, give second chance, student choice, badges and rewards. This strategy is not just about gaming but the understanding the tools that gaming experts use to engage their users to play and finding out what motivates their students, then try to integrate those elements into a daily lesson, Kapp (2012) affirms that gamification strategies embed challenges, emphasizes students choice and giving second chance will make students not only feel like they are in a game but will be actively engaged, motivated, promoting learning and solve problems as well. This engagement characteristic makes gamification strategies relevant to higher education context, in which it can be considered as a potential solution to foster the engagement of students through more interesting and easier to follow learning activities. Gamification represents the integration of "Game-base mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" in non-game contexts (Kapp, 2012). We are living in an era in which learners grew up as digital natives and have different learning styles, and new attitude to the learning process. These realities require modern pedagogical paradigms and trends in education in order to fulfill student's requirements, needs and preferences, to keep them engaged and motivated during their learning process, and gamification is a trend aiming to maintain an active learning (Goh, Y.H &Mona, M, 2014 ; Sam-Kayode & Salman, 2015).

Mastery learning strategy is an instructional strategy that is based on the principle that all students can learn a set of reasonable objectives when provided with appropriate instruction and sufficient time. It is a strategy in which students are given unlimited opportunities to demonstrate mastery of content taught. It involves breaking down the subject matter to be learnt into units of learning each with its own objectives. It gives students the opportunity to study a material unit after unit until they master it (Oluwatosin & Bello, 2015). Mastery learning strategy uses differentiated and individualized instruction, progress monitoring, formative assessment, feedback, corrective procedures, and instructional alignment to minimize performance gaps (Bloom, 1971) and focuses on how to improve the process of mastering content rather than changing it. Following a previous instruction, the teacher administers a brief formative assessment based on a unit learning goals. The assessment as a feedback informs the teacher about the student, which helps to identify what have been learnt and what needs to be learnt better. Students who have learnt the specified concepts continue their learning experiences while others who have not properly learnt the concept receive feedback paired with corrective activities

different from the initial instruction and offer guidance and direction and how to remedy their learning challenges. These correctives can include varying activates, individualized instruction, and additional time to complete assignments. The challenge therefore becomes providing enough time and employing appropriate instructional strategies so that all students can attain the same level of learning. Obih and Ekomaru (2011) stated that mastery learning is the mastery of a task, topic, or subject by every learner is given the time required to learn the task, topic or subject and at the same time given the optimum quality of instruction.

Therefore, when used as part of instructional strategy is potent at increasing students' performance, knowledge and retention (Adodo, 2013; Uman,2017) and also has the potentials to enable students engage in reflective thinking (Madu & Metu, 2012). These two strategies recognize individual differences in learners and encourage them to create their own knowledge at their own pace, this study compares the effect of the two teaching strategies in order to determine students' performance and retention in mathematics.

Statement of the Problem

Despite the importance of Mathematics education as a pre-requisite to enhance nation's growth and development; students' learning outcomes in the subject had been so disappointing. This is manifested in students' negative values such as poor academic performance, lukewarm attitude to work, disrespect to constituted authority and absence of a sense of patriotism among others. This has been a concern to various authorities particularly the mathematics specialist, over the years new strategies that could improve the teaching of the subject to enhance students' performance and retention were ignore. The different instructional strategies employed in teaching the subject has yielded little improvement. However, gamification and mastery learning strategies have been used to improve learning outcomes in other subjects with relative success. It is on this note that this study aims at investigating the effect of gamification and mastery learning strategies on students' performance and retention in mathematics

Purpose of the Study

The purpose of this study is to investigate the effects of gamification and mastery learning strategies on students' performance and retention in mathematics. Specifically, the study is design to achieve the following objectives;

1. Examine the effects of gamification, mastery learning and conventional strategies on students performance in mathematics
2. Examine the effects of gamification, mastery learning and conventional strategies on students retention in mathematics.

Research Questions

The study is guided with the following research questions:

1. What are the effects of gamification, mastery learning and conventional strategies on students' mean performance scores in mathematics?

2. What are the effects of gamification, mastery learning and conventional strategies on students' mean retention scores in mathematics?

Hypotheses

1. There is no significant difference in the mean performance scores of students in mathematics taught using gamification, mastery learning and conventional strategies
2. There is no significant difference in the students' mean retention scores in mathematics taught using gamification, mastery learning and conventional strategies

METHODOLOGY

The research used the non-equivalent pre-test, post-test, control group design. They was no randomization of subject so as to disrupt school programme. The intact classes was randomly assigned to control and experiment group. The population on for the study consists of the Upper Basic II students in Oju Local Government Area of Benue state, a sample of 74 students from six classes in three selected schools was purposively sampled.

The instrument used for data collection was mathematics achievement and retention test (MART) which consist of twenty structured multiple choice questions that was evaluated by experts in mathematics education and measurement and evaluation to established the validity. The test retest method was used to determine the reliability of the instrument. The reliability coefficient of the instrument was form to be 0.85 treatment were introduced to the experimental groups through GLS, and MLS while the control group were though using conventional strategy. Three topic (Algebra expression, expansion and substitution) were taught in all the six classes concurrently within a period of four weeks. Instrument was reconstruction and administered to the group in the fourth week of post-test to serve as retention test. The research questions were answered using mean and standard deviation while analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. This method helps to remove the initial differences among research respondents and to control the extraneous variables.

RESULT

Data were presented, analyzed and interpreted based on the research questions and hypotheses, in all cases; the decision rule is that null hypotheses are not accepted if the p-value is less than 0.05. On the other hand, hypotheses are accepted if the p-value is greater than 0.05.

Research Question 1
What are the effects of gamification, mastery learning and conventional strategies on students' mean performance score in mathematics?

Table 1. mean and standard deviation of students' mean performance score in mathematics taught using gamification, mastery learning and conventional strategies.

Groups		Pretest	Posttest	Mean Gain
Gamification	Mean	64.16	73.04	8.88
Strategy	N	25	25	
	Std. Deviation	9.07230	6.7450	
Mastery Strategy	Mean	62.22	71.63	9.41
	N	27	27	
	Std. Deviation	6.64098	7.62157	
Conventional	Mean	63.81	63.43	0.38
Strategy	N	21	21	
	Std. Deviation	7.91286	5.78421	

Table 1 show that the mean and standard deviation performance using GLS, MLS and conventional strategies are 64.16, 62.22, 63.81 with the corresponding standard deviation of 9.07, 6.64 and 7.91 respectively during pretest. While during the posttest the mean performance for GLS, MLS and conventional strategies are 73.04, 71.63 63.43 with the corresponding standard deviation of 6.75, 7.75 and 5.78 respectively.

The Table further reveals the mean gain of GLS as 8.88, MLS 9.41 and conventional strategies 0.38. Thus, the experimental group achieved higher than the control group, meaning the use of gamification and mastery learning strategies enhance maximum performance than the conventional strategy.

Research Question 2

What are the effects of gamification, mastery learning and conventional strategies on students' mean retention scores in mathematics?

Table2. Mean and standard deviation of students' mean retention scores in mathematics taught using gamification, mastery and conventional strategies.

Groups		Pretest	Posttest	Mean Gain
Gamification	Mean	64.16	72.64	8.48
Strategy	N	25	25	
	Std. Deviation	9.07	6.95	
Mastery Strategy	Mean	62.22	72.59	10.37
	N	27	27	
	Std. Deviation	6.64	5.69	
Conventional	Mean	56.81	60.33	3.52
Strategy	N	21	21	
	Std. Deviation	5.91	6.97	

Table 2 shows that the mean and standard deviation performance using GLS, MLS and conventional strategies 64.16, 62.22, 56.81 with the corresponding standard deviation of 9.07, 6.64 and 5.91 respectively during pretest, while the retention mean performance for GLS, MLS and conventional strategies is 72.64, 72.59, 60.33 with the corresponding standard deviation of 6.95, 5.69 and 6.97 respectively.

The Table further reveals the mean gain of GLS 8.48, MLS 10.37 and conventional strategy 3.52. Thus, the experimental group retains higher than the control group, meaning the use of gamification and mastery learning strategies enhance higher retention than the conventional strategy.

Hypothesis 1
There is no significant difference in the mean performance scores of students in mathematics taught using gamification, mastery learning and conventional strategies.

Table 3 ANCOVA test of students' mean performance scores in mathematics taught using gamification, mastery learning and conventional strategies

Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	2171.655[a]	3	723.885	21.642	.000
Intercept	'1509.910	1	1509.910	45.142	.000
Achievement Pretest	966.493	1	966.493	28.895	.000
Groups	**418.671**	**2**	**209.335**	**6.259**	**.003**
Error	2307.906	69	33.448		
Total	359664.000	73			
Corrected Total	4479.562	72			

R Square =.485 (Adjusted R Squared = .462)
Table 3 shows that F=6.269; df=2,72; p=.003. Since P-value of 0.003 is less than 0.05 the null hypothesis is rejected. This means there is significant difference in the mean performance scores of students in Mathematics taught using gamification, mastery learning and conventional strategies.

Hypothesis 2
There is no significant difference in the students' means retention scores in mathematics taught using gamification, mastery learning and conventional strategies.

Table4 ANCOVA test of students' mean retention scores in mathematics taught using gamification, mastery learning and conventional strategies

Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	2739.322[a]	3	913.107	25.321	.000
Intercept	2214.804	1	2214.804	61.419	.000
Achievement Pretest	482.760	1	482.760	13.387	.000
Groups	**1313.650**	**2**	**656.825**	**18.214**	**.000**
Error	2488.185	69	36.061		
Total	353609.000	73			
Corrected Total	5227.507	72			

a. R Square =.524 (Adjusted R Squared = .503)

Table 4 shows that F=18.21; df=2; p=.00. Since P-value of (.00) is less than 0.05 the null hypothesis is rejected. This means that there is significant difference in the students' mean retention scores in Mathematics taught using gamification, mastery learning and conventional strategies

DISCUSSION

The findings of the study revealed that there was no significant difference in the mean performance of Mathematics students before they were taught mathematics using GLS and MLS and the conventional strategies. This suggests that the three groups were quite homogenous at the start of the study. It implies that students used for the study have relatively equal background knowledge of mathematics. The result of hypothesis one which states that there is no significant difference in the effect of GLS, MLS and the conventional strategies of teaching on students' academic performance in mathematics showed that the three teaching strategy used have effect on the academic performance of the students in their groups as the post-test mean scores in each group are higher than the respective pre-test mean scores. This is an indication that the treatments given improved the performance of the students.

The result also showed that the students in the MLS group performed better than those in the GLS group and then the control group. This is in agreement with Olubodun (2016) who opined that MLS improved the performance of Mathematics student, and Oluwatosin and Bello (2015) that MLS is an effective tools for improving the performance of student in Physics, it has been argued that conventional teaching method is content centered in which teachers remain more active, more cognitive and less effective (Singh, 2004). According to Mezieobi, Fubara and Mezieobi (2015), the strategy is concerned with the recall of factual knowledge and largely ignores higher levels of cognitive outcomes, the teacher seeks to transfer thought, and meanings to the learners leaving little room for student-initiated questions, independent thought or

interaction between students' learning process. The use of interactive techniques and strategies help the student to become more engaged in learning and retain more information, thus giving them satisfaction. It is therefore necessary to provide interesting classes for students so that teachers can have positive feedback from them.

Furthermore, the result of hypothesis two shows that student that were taught using gamification and mastery learning strategies retain more than those in the conventional class. This finding agrees with Olubodun (2016) who discovered that teaching with mastery learning strategies enhanced students to retain more. Also, Adodo, (2013) found out that mastery learning strategy is a potent strategy which increases students' performance, knowledge. This is because the method gives room for learners to participate, which enables them to understand and retain higher when situation demands. This method is in line with the Chinese adage which says when I hear, I forget, when I see I remember but when I do I understand.

CONCLUSION AND RECOMMENDATIONS

The study had been able to show that MLS is more effective in improving the academic achievement of students in mathematics when compared with GLS and conventional teaching strategies, though the difference is not something to worry about. This implies that GLS and MLS has the capacity to help students associate ideas, think creatively, and make connections that might not be achievable in the conventional note taking strategy. Again, the two approaches used in this study do not differ in the ways they enhance the retention ability of Mathematics concepts by learns. This implies that the two could improve on the learners' retention ability in the same proportion. It therefore entails that MLS would be one of the most effective learning strategies that could be employed by teachers to overcome many of the problems encountered in teaching and learning of Mathematics. In similar manner, GLS could also be used to effectively teach and learn Mathematics but where the facilities needed for MLS are available; it should be utilized to be able to obtain maximum output by learners. Based on the findings of this study and the conclusion reached, the following recommendations are made.

1. Following the findings of this study that MLS significantly improves learning, it is recommended that mathematics teachers should adopt the strategy and other participatory strategies during instruction so that learners could be guided to learn meaningfully.
2. Mathematics educators and researchers should gear their effort towards understanding the characteristics, strength and weaknesses of the individual learners so as to help in designing the appropriate instructional programmes to meet their needs.
3. Seminars, workshops and conferences should be organized by the ministry of education for mathematics teachers to educate them on how to implement gamification and mastery learning strategies in school.

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