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Effects of Number Card Games Approach and Teacher's Mastery on Early Years Children's Achievement in Numeracy

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Abstract: *The study investigated on effect of Number Card Game Approach and Teachers' Mastery on Early Years Children Achievement in Numeracy. A case of Ojo Local Government Area of Lagos State. A randomized control group pre-post test experimental research design was used in this study as such design allows for randomization and manipulation of results at any situation. This design is very suitable for this study because two groups were used in this study having an experimental group given treatment package and a control group given dummy talk. The population for this work was all Public Primary Pupils in basic 4 in Lagos state. A sample of 40 early years children from fourearly years schools was used as samples for this study. Numeracy Achievement Test (NAT) with 20 items was used as instrument alongside a treatment package that can manage materials on the four basic operations. A pilot test was conducted on 10 pupils distinct from the main samples of the study and a test re-test method of reliability was employed and a reliability co-efficient value of 0.83 was determined. The use of Analysis of Co-Variance (ANCOVA) statistical analysis was used to test the hypothesis at 0.05 level of significance. The findings revealed that significant mean score and in the mastery level and significant differences in the mean score of the groups were all established. The study concluded that Use of Number Card Game Approach if well administered, adapted or adopted by teachers of numeracy in schools would bring about a significant improvement in children achievement in Numeracy related subjects both within and outside the classroom situation. It recommended that in other to allow for validation of existing packages, scholars should engage in the "Evaluation of Numeracy Treatment Packages in early years Schools".*

Keywords: Number Card Game Approach, Numeracy, Solomon IV Pre-Post Test Design, Achievement.

Introduction

Mathematics(Numeracy) without any doubt remains very important to all discipline and field of human work and study (Odili, 2006). It has continued to play significant role in the development of both the individual and nation. Hence for any nation to survive and develop it has to improve on its teaching and learning of mathematics which is the foundation of science, technology and modern development (Muhammed, 2014). The importance of mathematics can also be seen by the status confirmed on the subject as one of the core subjects in school curricular from pre primary, primary up to senior secondary school by National Policy on Education (FRN, 2004). Despite the awareness of its importance by the government and educators, it is the subject that students show negative attitude most towards learning and complain that it is difficult to learn and understand (Muhammed, 2014) that is ascertained by the level of poor performance recorded in external examinations by our students especially in WAEC, NECO, NABTEB among others.Studies carried out by Galadima and Okogbenin (2012) in the field of mathematics education reported some difficulties students goes through in the course of acquiring mathematical concepts. It was revealed that students dislike mathematics and sometimes absent themselves in mathematics lesson due to the complex and numeric's associated with the subject (Galadima and Okogbenin, 2012). One begins to ask what might be responsible for such negative attitude towards mathematics, is it the nature of the subject? Lack of good instructional resources to teach the subject effectively or poor method of teaching mathematics? Whatever factor(s) may be the cause of such complain and negative attitude there is need to find a lasting solution (ultimate solution) to improve teaching of mathematics at all level of Nigeria Educational System.

Instructional Designs

According to Fatokun, Egya and Uzoechi (2016), games are integral parts of all cultures and one of the oldest forms of human social interaction. A game is any form of play, amusement and activity involving competition. Game contains what can engage students and help them enter a state of flow (Csikszentmihalye, 1990) where they are fully immersed in the learning environment and energized to focus on the activity they are involved in. Games in numeracy are activities which are designed particularly for the learning or reinforcement of some concepts/skills as well as for cultivating some important attitudes, including the appreciations of numeracy. The use of games in teaching and learning chemistry is based mainly on the psychology of play itself and on their relationship to real life situation in certain aspect. An important aspect ofeducational games is enjoyment, without which games may turn out to be tedious, resembling workbook activities rather than play.

The quality of teaching and learning in mathematics is a major challenge for educators. Since 20 years ago, there has been a noticeable increase in public anxiety regarding arithmetic achievement. What students should learn to succeed in mathematics is currently a topic of discussion among academics. The focus of the debate is on innovative approaches to instructional design that will enable

people to comprehend and use basic mathematical ideas. How to provide learning environments, situations, strategies, and approaches for students with various skill and ability levels is a crucial and ongoing problem. To ensure that students become successful learners, creative teaching approaches and strategies should be developed.

To obtain higher math achievement rates, it is crucial for educators to utilize instructional design strategies. (Obanya, 2012; Taiwo, 2008; Olaogun, 2009). Instructional design is a structured method and framework for thoughtfully organizing, creating, and modifying mathematics instruction while taking into account students' requirements and levels of mathematical understanding (Taiwo, 2008). "Instructional design is a powerful tool for solving many urgent issues in education. In order to maximize desired instructional outcomes, such as achievement and effect, instructional design is a science that connects several fields of study (Mill, 2007). Better learning and achievement cannot be achieved just through instructional design. Therefore, to create a link between objectives and student performance, instructional designers must be aware of key aspects that influence students' learning. Finding these elements will make it easier to make better use of time and money, which are both scarce resources (Harner, 2004). Mathematics challenges are just as prevalent as reading difficulties. About half of all children who struggle with learning in other areas like reading, writing, and oral language also struggle with math (Carr, 2006). Despite these facts, research on the causes of some children's math learning challenges is less developed than comparable research on the causes of reading issues. Additionally, there is little study on the efficiency of mathematics instruction systems and efficient math interventions (Darling 2007).

Teacher's Mastery of the Subject

Numerous studies show a connection between instructors' beliefs and knowledge of mathematics and the methods and choices they make for instruction (Mathematics Association of Nigeria, 2009; Thompson, 2002; Wilson, 2000). In addition, according to Geliert (1999), "it seems unquestionable in mathematics education research that the teacher's philosophy of mathematics has a major impact on the structure of mathematics classes." The effectiveness of a teacher's lessons and topic expertise are influenced by their teaching philosophy and choices. The roles and skills of teachers are one aspect of education that is changing in the twenty-first century. According to studies on teacher competency, teachers will need significantly more knowledge and fundamentally different skills than those they currently possess if they are to prepare an increasingly diverse group of students for work that is much more challenging in terms of framing problems, finding, integrating, and synthesizing information, creating new solutions, learning on their own, and working cooperatively (Darling, 2007).

Teachers must possess pedagogical expertise as well as knowledge about their students in addition to subject-matter expertise (Bransford et al., 2000). The way in which students think, comprehend, and learn arithmetic is intimately related to the skill of the teacher in these areas. There is little doubt that teachers must possess a thorough understanding of the subject area, the epistemology that underpins math education, as well as a similarly thorough awareness of the many instructional practices that foster student accomplishment, in order for students to achieve in arithmetic. An structured grasp of mathematical topics, reflective learning, critical thinking, and ultimately mathematical performance are all mapped out for students by competent math teachers.

Korau (2006) observed that over population makes it impossible to operate an ideal classroom size for effective chemistry teaching. National Policy on Education (FGN, 2004) stated that for effective participation of pupils in practical work, the teacher-pupil ratio should be kept at 1:20 but unfortunately this was never possible and most numeracy teachers use teacher-centered approaches instead. Also due to bulky nature of the numeracy curriculum which must be covered within a stipulated period before the school examination, Etsey (2005) reported that most teachers end up not completing the syllabus and not involving pupils in meaningful hand-on-activities. Consequently, both teachers and learners are not able to cope with the teaching and learning of the subject respectively (Achor, 2003; Derek, 2007; Ogbeba, 2009). Studies (Nwosu, 2004; Johnson, 2004) have shown that most science teachers do not possess the prerequisite knowledge needed for activity based learning. Numeracy teachers are expected to have a good level of competence and mastery of the subject in order to enhance students' interest.

Numeracy has often times proven to be a difficult subject for many pupils (Johnstone and Otis, 2006), containing many abstract concepts which are central to further learning in all number related sciences (Taber, 2002). These abstract concepts are important because further numeracy concept or theories cannot be easily understood if these underpinning concepts are not sufficiently grasped by students. The root of many difficulties that pupils have in learning numeracy is traceable to inadequate understanding of these underlying topics such as the basic operations. In a similar study, the statistics obtained on the performance of candidates in Senior Secondary Certificate Examination (SSCE) for the whole nation from 2001 – 2014 attested to students' poor achievement in chemistry at external examinations. Njoku (2004), Asikhai (2010) and Eze and Egbo (2007) have attributed the observed students' poor achievement in the subject to the use of inappropriate or ineffective teaching method by chemistry and numeracy teachers alike. Mari (2002) maintained that teaching strategies is a variable that can easily be manipulated by teachers to increase student's retention rate and performance as well as reduce or eliminate sex-related difference in science and mathematics performance. Osuala and Ogomaka (2005) reported that 60% of Nigeria secondary school teachers use the conventional method with occasional teacher dominated experiments which make for passive learning. Conventional method does not encourage meaningful pupil/student-teacher, pupil/students and pupil/student-material interaction. It also hinders activities for developing scientific reasoning and skill processes.

Ghassan (2007) observed that one of the reasons for the poor performance in chemistry is inability to recall previous knowledge easily. Therefore, learning and teaching chemistry with game could; motivate students, improve their learning interest, make students

utilize the knowledge learnt in an active manner, increase students' critical thinking and decision making ability, help students relate information to everyday situation and thus see the relevance of learning specific information, enhance students' retention of what they have learnt, lead to person growth e.g. communication, cooperation, personal judgment and problem solving. The brain has been found to reject the processing of some information presented to it if such information came from or will likely lead to stress, unhappiness or threat (Gwany, 2005). Game often remove stress and encourage relaxation and fun. Chemistry games get students to interact and have fun while learning chemistry. Using games to teach help students practice essential formulas and facts reduce anxiety thereby making learning permanent.

In many Nigerian schools, female students are presumed to evade the study of mathematics due to several factors like psychological, motivation and interest. Women Scientists are very few in Nigeria though the National Population Census clearly showed that the population of females' outnumbered that of males. The issue of how male or female students learn and retain concepts is still a concern. Therefore, teaching method that would benefit both sexes should be adopted by the numeracy teachers. Ogunleye&Babajide (2011) observed that science subjects such as chemistry are given masculine outlook by many educationists which imply that women and girls grapple with a lot of difficulties (Okeke, 2007). The females' non-involvement in scientific studies has created males dominance in technological advancement in Nigeria.

Agomuoh, (2010) and Ukozor, (2011) reported that males students performs better than females in chemistry, physics and biology generally while Olom, (2010) and Aniodoh & Egbo, (2013) revealed significant differences in favour of females. However, Udosoro, (2011) showed that gender has no significant effects on science achievement. Although boys and girls differ in their physical, emotional and intellectual development, efforts to link gender difference to intellectual capabilities have however proved untenable (Inyang and Hannal, 2000; Orimogunje, 2006). Ezeudu (2014) stated that gender was not a significant factor on student's achievement and retention in organic chemistry. The male and female students showed the same level of achievement and retention. In their study, Udo and Udofia (2014) reported that gender has a significant influence on students performance in the area of symbols, formulae and equations in chemistry, with the male outperforming there female counterpart. Although, research has generally supported the conclusion that there are no biological, neurological or genetic factors at work in creation of scientific gender disparity. Thus, research findings in chemistry education have been inconclusive as to who achieve higher whether male or female?

The use of games in the teaching and learning of numeracy is supported by Vygotsky theory. Vygotsky zone of proximal development talks about a point in the learning process where a special type of intervention is provided for the learning to help a student build knowledge or make sense of his/her world. The assistance used by the learner needs to be intentionally provided by the teacher. Vygotsky (1978) emphasized on social interaction as the best way of learning. To him a child learns better in collaborative activities than when he/she learns alone. According to Iroegbu, Nkwocha and Onyemerekya (2002), one of the educational implication of Vygotsky theory is for teachers to provide learners with motivations and clues on how to solve their problems.

Piaget (1962) pointed out that, informal games played by young children are critical component in their social and intellectual development. Therefore, teaching periodicity with games could help students learn the basic fundamentals of chemistry without engaging in memorization of complex information about elements and substances. Game can help teachers facilitate the transfer of skills through the pre-and post-game discussion which connect the game with other things student are learning in class (Ash, 2011). Close ties exist between games and learning; theories that focus on the integration of experience, learning and development of skills are associated with games and plays (Brett, Tom and Tom, 2011). Games and simulations have been used in pre schools, K – 12, the University, Military, Business and by older Adult (Dempsey et al 1997).

Bahrami et al (2012) in Fatokun, et al (2016) carried out a study on a comparison of the effectiveness of game- based and traditional teaching on learning and retention of first grade math concepts in Iran. The population of the study consisted of all the female student of khorramabad province. Experimental group were taught using game-based teaching while the control group were taught using the traditional teaching. Data description was done using mean standard deviation and data comparison was done using independent T-test and Effect Size (ES). The results showed that the experimental group had higher score in learning and retention; this revealed that using educational games in teaching of first grade math can be remarkably helpful and efficient. Hassan and Poopak (2012) in their study in Iran investigated the effect of teacher-made instructional card games and computer games for learning chemistry concepts on high school students majoring in math and science. The sample consisted of three groups of 35 students. The results indicated that there was a significant difference between teacher – made card games and computer games.

To achieve effective teaching of mathematics, teachers must put in place some strategies and activities that would arouse and sustain the interest of students in Mathematics. Thus this study investigated theUse of Number card Game Approach and Teacher's Mastery on Pupils Achievement in Numeracy especially at the primary school level.

The chief examiner's report of the West Africa Examination Council (WAEC 2014 - 2021) shows that most mathematics candidates displayed inability to accurately write down technical formula and balance simple equations. This is because they were not properly grounded on how to derive formulars. With the use of the conventional teaching method by teachers in the teaching of numeracy in early year schools, children's performance keeps taking a down ward trend as more learners keep developing negative attitude towards the subject. Other identified factors like lack of good instructional and relevant teaching materials to teach the subject effectively, poor methodology by teachers, poor mastery of subject by teachers, gender differential with respect to numeracy acquisition, psychological state of the learners (interest) among others are some of the identified problems responsible for the

continuous drop in pupils' performance in numeracy. The study seeks to establish the use of number card games approach and teacher's mastery as it would improve the performance of early year children in Numeracy.

Research Hypotheses

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

Ho1: There is no significant difference in the mean achievement scores of children taught using number games approach and those taught with conventional method.

Ho2: There is no significant difference in the mean retention score of children' exposed to Periodicity with games and those exposed to the conventional method.

Ho_3: There is no significant interaction effect of treatment and teachers mastery on children' Achievement in Numeracy (NAT).

Methodology

This study adopted a randomized pretest, posttest, control group, qausi experimental research design. Two groups are involved in this study as both groups are treated nearly alike as possible except for the treatment variable exposed to the experimental group. The essence of this design seeks to establish the effect of treatment administered to the experimental group on the control group. The population for the study comprise of all primary four (4) pupils in public primary schools in Ojo local government area of Lagos State**.** Sample size for this study was forty pupils drawn from two primary schools randomly selected on the criteria of availability of power supply, class size and availability of learning infrastructures. Two intact classes of experimental groups and another two intact classes of control groups were generated using a simple balloting method. In the course of selecting 4 intact classes for our samples, Purposive sampling techniques was employed to select schools that have access to the internet facilities and those who don't have access to this facility within the same environment. However gender was another condition considered in the course of sampling as (20 male and 20 female from each of the schools) ten pupils were selected using stratified sampling technique from each of the four Primary schools in OJO L.G.A of Lagos State. The instrument used for this study was Numeracy Achievement Test (NAT) which consisted of twenty (20) items on the 4-basic Operations: Addition, Subtraction, Multiplication and Division. The Achievement test was divided into two sections, where Section A took an unstructured format with 10 items as pupils are expected to solve the questions themselves and Section B has 10 items in form of multiple choice objective formats with 5-options respectively. The instrument was designed by the researchers and validated by experts in the field of test and measurement and numeracy teachers as well. It was adjured to meet both content and face validity. The reliability of the instrument was then determined on 5-pupils distinct from samples of the main study. With the use of test re-test method of reliability a co-efficient valued of 0.83 was obtained which shows that the instrument is very reliable and suitable for this study. The data generated from the study were analysed using Analysis of Co-Variance (ANCOVA) and Student t-test analysis to test the hypothesis at 0.05 level of significant. A Scheffe Post-Hoc analysis was further used to determine the effect of treatment package on the experimental group to control groups respectively.

Results

The following research hypotheses were tested in the course of this study:

Ho_1: There is no significant difference in the mean of achievement scores of children taught using number games approach and those taught with conventional method.

Table 1: One way ANCOVA result of pupils' achievement scores in POSTNAT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5251.841[a]	1	350.123	40.542	0.005
Intercept	211.808	1	211.808	24.526	0.000
Pretest	223.041	1	223.041	25.827	0.005
Group	650.000	2	325.000	61.26	0.000
Main Effect	954.876	3	318.292	55.304	0.001
Error	898.150	38	3.872		
Total	77274.000	40			
Corrected Total	2565.519	39			

From table 1 above, it shows the summary of the one way ANCOVA on children's achievement in Numeracy Achievement Test (NAT). The result revealed that the noted difference in the mean achievement scores in the experimental group and control group is significant at 0.05 alpha levels. Therefore, the null hypothesis (Ho1) was rejected showing that there is a significant difference in mean achievement scores of children taught using number card games approach and those taught using conventional method.

Discussion of Findings

This hypothesis was rejected as the result in Table 1 reveals thatthere is asignificant difference between the experimental group and control group on the usage of number card game approach is upheld. The results reveal that the participants in the experimental group display an increase in their performance rate as against those in the control group. This implies that treatment package

administered to the students was very effective because it brought about a positive change in their achievement in Numeracy. The outcome of this work is in conformity with that of Darling (2007) who maintained that effective teaching and any form of training exercise have the potential of bringing about a relatively positive change in behaviour over time. The performance of students in Numeracy is dependent on the relevance of effective teaching activity usually administered on pupils. He opined that if any teaching activity is well directed at changing the thought pattern of entities, it would go a long way in correcting the various abnormalities associated with the learning of numeracy.

Ho_2: There is no significant difference in the mean score of teacher's mastery on experimental and conventional group.

Table 2: One - Way ANCOVA results of mean score of teachers' mastery on experimental and convention group.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4254.333[a]	15	283.622	65.586	0.005
Intercept	326.802	1	32.802	34.632	0.005
Pretest	432.324	1	432.324	29.47	0.005
Teacher' Mastery	764.451	1	764.451	31.75	0.005
Error	898.150	38	3.872		
Total	94726.321	40			
Corrected Total	5637.657	39			

From Table 2 above, it shows the summary of the one way ANCOVA on children' mean score on teachers' mastery on experimental and convention group. The result revealed that the noted difference in the mean scores of teachers' mastery in the experimental group and control group is significant at 0.05 alpha levels. Therefore, the null hypothesis (Ho2) was rejected showing that there is a significant difference in mean score of teachers' mastery in the experimental and control group.

Discussion of Findings

The result in Table 2 is in consonance with that of Ball, (2003) who stated that teachers' mastery is very important in a classroom situation as it aids the effective fronting of other teaching and learning activity. He (Ball, 2003), was of the view that teacher's mastery reveals the extent of content mastery, coverage and ability to improvise materials when they are not within the reach temporarily. In addition to having subject-specific expertise, teachers also need pedagogical knowledge and knowledge about their students (Bransford et al., 2000).

The way that children think, understand, and learn math is intimately related to the expertise of the teacher in these areas. There is no question that teachers must possess a thorough understanding of the subject area, the epistemology that underpins math education, as well as a similarly thorough understanding of the various types of instructional activities that foster student achievement, in order for students to achieve in math. An structured grasp of mathematical topics, reflective learning, critical thinking, and ultimately mathematical performance are all mapped out for students by competent math teachers.

Ho_3: There is no significant interaction effect of treatment and teachers mastery on pupils' Achievement in Numeracy (NAT).

Table 3: Summary of Analysis of Covariance (ANCOVA) showing interaction effect of treatment and teachers mastery on children' achievement in numeracy.

Tests of Between-Subjects Effects

Dependent Variable: Performance in Numeracy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	896.314[a]	12	74.693	8.922	.000	.295
Intercept	2856.822	1	2856.822	341.254	.000	.571
Pre-Post Test	280.335	2	140.1675	70.083	.000	.116
Treatment	.364	1	.364	.043	.835	.000
Teachers' mastery	49.258	1	49.258	5.884	.016	.022
2-Way Interaction Effects						
Teachers mastery * treatment	24.226	2	12.113	1.447	.237	.011
Error	2143.114	38	56.3977			
Total	49310.000	40				
Corrected Total	3039.428	39				

a. R Squared = .725 (Adjusted R Squared = .262)

The result presented on Table 3 above showed that the extent of treatment package, main effect and also 2 way interaction effects. The tested hypothesis have it that there is no significant interaction effect of treatment administered on teacher's mastery on pupils

achievement in numeracy as a result the null hypothesis was rejected while the alternative hypothesis was upheld due to the interpretation that $F_{(2,40)} = 0.029$ where $P < 0.05$ statistically.

Discussion of Findings

Studies carried out by Darlington (2007), Ishola a revealed that effective treatment package should best be administered by a teacher who has good mastery of the subject area. They revealed that mastery of the subject by the teacher goes a long way in improving children performance in numeracy as all component parts that are needed for effective drilling and teaching are touched. Effective teaching brings about a lifelong change in the life span of the learners. Learning becomes permanent when effective teaching takes place. Ishola (2017) identified the teaching of basic operations as one activity in mathematics that is well internalized when treatment package is designed to accommodate all arithmetic and numeric in a teaching and learning situation.

Table 4: Scheffe Post-Hoc statistical analysis showing effect of treatment package on experimental and control towards achievement in Numeracy

Group	No	Mean	SD	Addition	Subtraction	Multiplication	Division
Experimental (Post- test)	20	72.14	4.62	*****	*****	*****	****
Control (Post-test)	20	27.88	1.81	***	**	**	*
Total	40						

From table 4 above, it showed that children' demographic factors made no significant contribution to the experimental group but the effect of treatment was observed through teacher's mastery of the subject as it contributed significantly to the change in the achievement pattern of the children in Numeracy likewise the mode of instructional design contributed significantly to the experimental group as this was best seen in the score obtained in the mean scores of the pupils where the experimental group recorded a higher value of 69.18 as against the control group that recorded a lower mean value of 32.59 respectively.

Conclusion

Numeracy remains one important subject that is taught at all levels of education. The derivative associated from the understanding of numeracy comes with numerous benefits both to the teacher and learners alike. Findings from this study revealed that:

- There exists a significant difference in the mean score of early year children in the experimental and control groups as children's who are exposed to the instructional games approach established a significant difference due to the effect of the treatment package administered.
- Teachers' mastery of the subject contributed significantly to the performance of the pupils in the groups. A teacher who is guided with the content and mastery of the subject would be able to effectively disseminate the content to learners through the use of the instructional game approach.
- The interaction effect of treatment on gender and effect of Teachers' mastery on numeracy a core subject has a significant impact on the quality of package designed for any study.

Recommendations

This study have validated this work by coming up with its findings able for this work, although this study came up with the assertion that similar work should be replicated to higher learners in other to see if the same result can be achieved. However, the work recommends among others the following for further studies:

1. Effect of instructional designs and teacher's mastery as determinants of student's achievement in Economics.
2. Demographic factors and teacher's mastery as correlates of children's Performance in Numeration.
3. Evaluation of Early year Education Treatment Packages in Early year Schools. **References**

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