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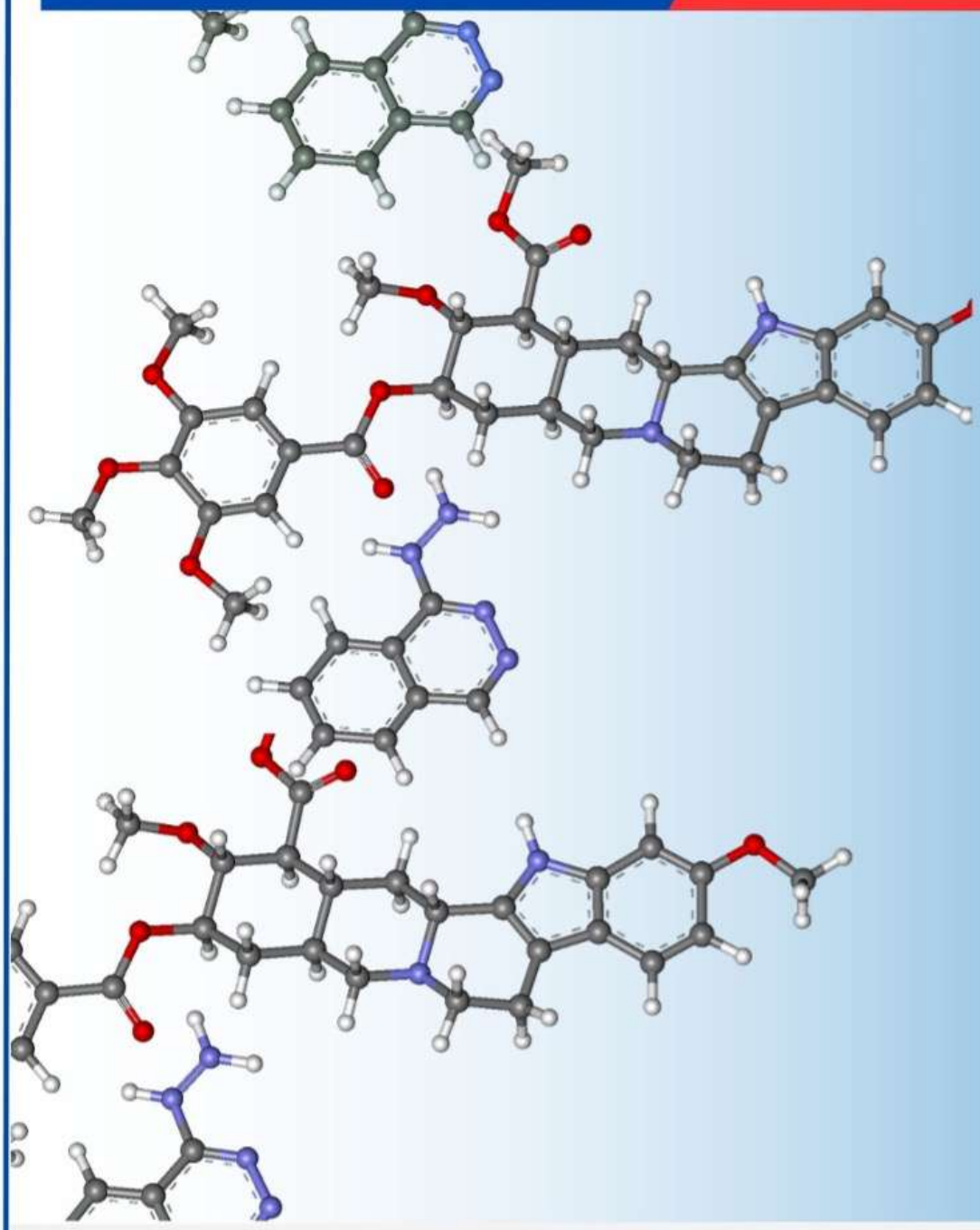

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EDITORIAL

STEM Journal of Anambra STAN (STEMJAS) is a publication of **Science Teachers Association of Nigeria, Anambra State Chapter.** STEMJAS is developed to disseminate information on Science, Technology, Engineering and Mathematics (STEM) to teachers, teacher-trainers, researchers and other interested persons. Articles that are of relevance to STEM education are published in this journal.

We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

Prof. Ebele C. Okigbo
Editor-in-Chief

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EFFECT OF NUMBER MULTIPLES GAME ON MIDDLE BASIC SCHOOL PUPILS' ACHIEVEMENT AND RETENTION IN MATHEMATICS IN ENUGU SOUTH LOCAL GOVERNMENT AREA

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Abstract

This study sought to determine the effect of Number Multiples Game on Middle Basic School Pupils' achievement and retention in mathematics. Two research questions and two hypotheses guided the study. Pretest-posttest non randomized control group design was adopted for the study. The study was conducted in Enugu South Local Government Area of Enugu State. Population for the study was 12,901 Middle Basic II pupils in Enugu South Local Government Area from which a sample of 414 Middle Basic II pupils was drawn from 12 intact classes across 6 purposively sampled schools. Technique adopted for sampling was multistage sampling technique. Instrument used for data collection was Algebra Achievement Test (ALAT). The instrument was constructed by the researcher and validated by three research experts. ALAT was subjected to internal consistency test and it yielded a reliability coefficient of .65 obtained by Kudar-Richardson 20 formula. Since ALAT was used for retention test, there was need for stability test. Hence, ALAT yielded a stability coefficient of .81 obtained through test –retest approach. Research questions were answered using mean and standard deviation. Hypotheses were tested using Analysis of Covariance (ANCOVA). Major findings of the study showed that the experimental group achieved higher and retained more algebra than their counterparts in the control group. It was recommended, among other things, that Number Multiples Game Strategy be used in teaching middle basic school mathematics.

Keywords: Game, Achievement, Retention, Mathematics.

Introduction

In Nigeria, basic education refers to the education given to learners in the first nine (9) years. Basic education is categorized into three, namely; Lower Basic (Primary 1-3), Middle Basic (Primary 5-6) and Upper Basic (Junior Middle basic1-3). Since the rest of the educational system is built upon the basic level, basic education is the key to the success or failure of the whole educational system. According to Federal Republic of Nigeria, FRN (2013), the goals of lower and

middle basic education (Primary 1-6) are to; inculcate permanent literacy and numeracy and ability to communicate effectively; lay a sound basis for scientific and reflective thinking; give citizenship education as a basis for effective participation in and contribution to the life of the society; mold the character and development of sound attitude and morals in the child; develop in the child the ability to adapt to the child's changing environment; give the child opportunities for developing manipulative skills that will enable the child function effectively in the society within the limits of the child's capacity and provide the child with basic tools for further educational advancement, including preparation for trades and crafts of the locality.

Unarguably, these goals of lower and Middle Basic Education are laudable. Baraje (2015) stated that the goals of Basic Education cannot be attained without effective communication skills. Communication skills according to Baraje are instruments of thought which binds human society together in communities and linguistic groups. Official communication in Nigeria is hinged on English Language. Mathematics as a science subjects does not only deal with manipulation of numbers, but it goes further to explain relationships between the numbers, attributes of the number and application of the numbers to solving day to day practical life problems. Thus, giving her learners a fuller understanding of the world around them. According to Hooke and Charles (2012) hinted that mathematics could be said to be as old as mankind, in every culture, there has always been the need for mathematics for counting and record keeping which varied from tribe to tribe and country to country. All societies have developed mathematical concepts and practices to serve their needs and interests. Ngoma (2013) added that proficiency in basic numeracy is essential for every day functioning and it is a foundation for other aspects of human endeavour. In the Nigerian formal educational system, mathematics is studied at all levels; primary, secondary and tertiary.

In recognition of its importance, mathematics is made compulsory at the primary and middle basic school levels in Nigeria. At least a credit pass in mathematics is also a sine qua non for gaining admission to study most courses in the nation's various tertiary institutions. Ohanusi (2011) observed that this is to help Nigeria achieve her five main national goals. These goals are to build; 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 full of bright opportunities for all citizens (Federal Republic of Nigeria (FRN), 2009). Consequently, Nigeria's philosophy of education is based on; the development of the individual into a sound and effective citizen; the full integration of the individual into the community; and the provision of equal access to educational opportunities for all citizens of the country at the primary, secondary and tertiary levels both inside and outside the formal school system (FRN, 2013).

Also on the basis of National Policy on Education (2013) and with particular reference to aims and objectives of middle basic education, the general objectives for teaching and learning of mathematics in Nigeria are: to generate interest in mathematics and to provide a solid foundation for everyday living; to develop computational skills; to foster the desire and ability to be accurate

to a degree relevant to the problem at hand; to develop precise, logical and abstract thinking; to develop the ability to recognize problems and to solve them with related mathematical knowledge; to provide necessary mathematical background for further education; and to stimulate and encourage creativity.

Unfortunately, research evidences such as Ohanusi (2011), Derbuck and Kpakor (2012), Oluremi and Ajao (2012) as well as Kuntu and Pedro (2013) submitted that this all important subject is dreaded, hated, feared and massively failed by pupils especially at middle basic school level. Middle basic school mathematics curriculum covers so many topics such as geometry, trigonometry, algebra, statistics and commercial arithmetic. Ajom and Agbenyi (2013) hinted that Algebra consists over 46 percent of middle basic school mathematics curriculum content in Nigeria. Algebra is one of the main branches of pure mathematics. It is concerned with the study of the rules of operations and relations, and the constructions and concepts arising from them, including terms, polynomials and equations. Middle basic education algebra mainly introduces the concepts of variables representing numbers. Statements based on these variables are manipulated using the rules of operations that apply to numbers.

Algebra do not only deal with properties of numbers but also reveals how those properties can be applied in solving day to day practical life problems. Hence, good skills and competences in algebra is a great asset to any middle basic school student because it is a tool for developing critical and logical thinking that can facilitate the learning of other branches of mathematics and even other science subjects. This consequently affects the pupils' achievement and retention in algebra negatively. Pupils' achievement and retention are very vital to ensure progress in their academic endeavours.

More worrisome to well meaning researchers is also the no definitive stance on the academic achievement and retention of pupils especially when taught with innovative strategies such as Number Multiples Game. Mbunda (2012) and Bell and Thompson (20212) found that Number Multiples Game promoted higher achievement and more retention than expository method among middle basic school pupils. Ohanusi (2011) and Kofi (2012) found that expository method promoted higher achievement and more retention than Number Multiples Game among middle basic school pupils. While Kuntu and Pedro (2013) found no significant difference between the academic achievement and retention of middle basic school pupils taught mathematics with Number Multiples Game and their counterparts taught same topics with expository method. This calls for more investigations. This study therefore aimed at determining the effects of Number Multiples Game on the achievement and retention of middle basic school pupils in algebra. This is with a view to finding out ways to help pupils achieve higher and retain more in this vital branch of mathematics.

Statement of the Problem

The role of mathematics in achieving the functional education required for the attainment of the Nigerian national objectives cannot be over-emphasized. In realization of this fact, the federal government of Nigeria made mathematics a compulsory subject at primary and middle basic school levels. Also, mathematics is a prerequisite for admission to study most science courses in our tertiary institutions. It is worrisome that middle basic school pupils tend to avoid algebra which incidentally consists over 46 percent of middle basic school mathematics curriculum (Ohanusi, 22011). Research evidences have consistently implicated teaching method as a major factor in pupils' achievement and retention in mathematics. Of all the innovative instructional strategies, computer aided instruction such as Number Multiples Game Strategy has been widely recommended, yet there is still no definitive conclusion as on its effect on pupils' achievement and retention in mathematics. This study is a deliberate attempt to bridge the gap highlighted above. The problem of this study can therefore be reduced to the following question; what are the effects of Number Multiples Game on middle basic school pupils' achievement and retention in algebra?

Purpose of the Study

The purpose of this study was to investigate the effects of Number Multiples Game on Middle Basic School Pupils' achievement and retention in mathematic in Enugu south Local Government Area of Enugu state. Specifically, the study aimed at investigating the:

i. effect of Number Multiples Game on Middle basic school pupils' achievement in Algebra

ii. effect of Number Multiples Game on Middle basic school pupils' retention in Algebra

Research Questions

The following research questions guided the study

1. What is the difference in the mean algebra achievement scores of Middle basic school pupils taught using Number Multiples Game and their counterparts taught using expository strategy?

2. What is the difference in the mean algebra retention scores of Middle basic school pupils taught using Number Multiples Game and their counterparts taught using expository strategy?

Hypotheses

The following research hypotheses were tested at .05 level of significance

1. There is no significant difference between the mean algebra achievement score of Middle basic school pupils taught using Number Multiples Game and that of their counterparts taught using expository strategy.
2. There is no significant difference between the mean algebra retention score of Middle basic school pupils taught using Number Multiples Game and that of their counterparts taught using expository strategy.

Method

The research design adopted in the conduct of this investigation was quasi-experimental design. Specifically, the design was a pretest –posttest, non-equivalent control group design. The area covered in this study was Enugu South Local Government Area of Enugu state Nigeria. Population for the study was 12,901 Middle Basic II pupils in Enugu South Local Government Area from which a sample of 414 Middle Basic II pupils was drawn from 12 intact classes across 6 purposively sampled schools. Technique adopted for sampling was multistage sampling technique. The sample was made up of 210 pupils in the experimental group and 204 pupils in the control group. Algebra Achievement Test (ALAT) was used to collect achievement scores, (pretest and posttest). A re-arranged version of ALAT was also used to collect retention scores two weeks after the posttest. ALAT was developed by the researchers. It was made up of forty (40) multiple choice questions with four options each. The items were drawn using a table of specification to ensure adequate coverage of the content area covered in the study as well as maintain even spread across the different levels of the cognitive domain tested. ALAT was validated by three research experts. After necessary corrections as directed by the experts, ALAT was confirmed to have face and content validity. ALAT was subjected to internal consistency test and it yielded a reliability coefficient of .65 obtained by Kudar-Richardson 20 formula. Since ALAT was used for retention test, there was need for stability test. Hence, ALAT yielded a stability coefficient of .81 obtained through test –retest approach.

Experimental Procedures

The researcher trained the six regular mathematics teachers in the six middle basic schools used for the study for a period of two weeks on the use of the Number Multiples Game used in this study. Fore-most, the ALAT was administered to all the subjects of the study as pretest. Thereafter, the treatment was administered for a period of six weeks. The experimental group in each school was taught the selected algebraic topics using Number Multiples Game while the control group in each school was taught the same topics using expository method. All topics were drawn from Middle Basic II mathematics scheme of work. After the treatment period, the ALAT was re-arranged and administered to all the subjects as posttest. After two weeks of posttest, ALAT was re-arranged again and administered to all the subjects as retention test. Research Questions were answered using mean statistic and standard deviation. Tests of hypotheses were done with Analysis of Covariance (ANCOVA) at .05 level of significance. ANCOVA was deemed most suitable for hypotheses' testing so as to correct possible errors arising from initial differences among subjects of the study.

Results:

Research Question 1: What is the difference in the mean algebra achievement scores of Middle basic school pupils taught using Number Multiples Game and their counterparts taught using expository strategy?

Table 1: Mean Achievement scores of experimental and control groups in pretest and posttest.

Group	N	Pretest		Posttest		Mean Difference
		Mean	SD	Mean	SD	
Experimental	210	22.31	11.0413	71.25	5.0019	48.94
Control	204	21.84	10.5201	52.80	8.4522	30.96

From table one above the pretest mean score of experimental group was 22.31 while that of control group was 21.84. These suggest that both groups were almost of equal ability at the beginning of the experiment. However, in the posttest, experimental group had a mean of 71.25 (mean difference of 48.94) while the control group had a mean of 52.80 (mean difference of 30.96). Apparently, the two groups achieved higher in the posttest than the pretest indicating that learning took place. Evidently, the posttest mean score of the experimental was higher than that of the control group. Moreso, a lower standard deviation value of 5.0019 in the posttest for experimental group indicates that there were fewer extreme scores in the experimental group than the control.

Research Question 2: What is the difference in the mean algebra retention scores of Middle basic school pupils taught using Number Multiples Game and their counterparts taught using expository strategy?

Table 2: Mean Retention scores of Experimental and control groups.

Group	N		
		Mean	SD
Experimental	210	66.03	6.5224
Control	204	48.72	8.1831

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The mean retention score and standard deviation of the experimental group were 66.03 and 6.5224 respectively. While those of the control group were 48.72 and 8.1831 for mean and standard

deviation respectively. This result indicates that the experimental group retained more than the control group.

Hypothesis 1: There is no significant difference between the mean algebra achievement score of Middle basic school pupils taught using Number Multiples Game and that of their counterparts taught using expository strategy.

Table 3: ANCOVA analyses of the pupils' Achievement scores.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Decision
Method	921.400	1	921.400	1.536	0.000	S
Ownership	98.212	1	89.212	0.149	0.340	NS
Method * Ownership	56.371	1	56.371	0.094	0.251	NS
Error	246600.000	411	600.000			
Total	247666.983	414				

From table 3 above, method gave an f value of 1.536 and this is significant at .000. Since .000 is less than 1.536 this mean that at .05 level of significance, the f value of 1.536 is significant. Therefore, hypothesis 1 is not accepted as stated. This indicates that there is a significant difference between the mean achievement scores of the experimental and control groups. Similarly, the sum of squares arising from methods (921.400) when compared with the sum of squares arising from error (246600.000) indicates that the observed difference in the achievement of the experimental and control groups is due to the treatment administered in the experiment.

Hypothesis 2: There is no significant difference between the mean algebra retention score of Middle basic school pupils taught using Number Multiples Game and that of their counterparts taught using expository strategy.

Table 4: ANCOVA analyses of the pupils' Retention scores

Source	Sum of Squares	DF	Mean Square	F	Sig.	Decision
Method	1457.298	1	1457.298	2.067	0.009	S
Ownership	99.051	1	99.051	0.141	0.310	NS
Method * Ownership	78.892	1	78.892	0.112	0.281	NS
Error	289800.210	411	705.110			

Total	291435.451	414

The ANCOVA analyses of retentions scores show that, method gave an f value of 2.067 and this is significant at 0.009. Since 0.009 is less than 2.067 this means that at .05 level of significance, the f value of 2.067 is significant. Therefore, hypothesis 2 is not accepted as stated. Because there is a significant difference between the mean retention scores of the experimental and control groups. Similarly, the sum of squares arising from methods (1457.298) when compared with the sum of squares arising from error (289800.210) indicates that the observed difference in the retention of the experimental and control groups is due to the treatment administered in the experiment.

Summary of Findings

The results presented above can be summarized thus:

1. The pupils taught Algebra with Number Multiples Game achieved higher than those taught with expository method.
2. The pupils taught Algebra with Number Multiples Game retained more than those taught with expository method.

Discussion

Research question one sought to ascertain the mean achievement scores of the pupils in both experimental and control groups in both pretest and posttest as to determine the difference. Note worthy is the fact that the mean pretest scores of both groups did not differ significantly. This suggests that both groups had similar entry behavior and achievement ability. Also, the wide gap between the mean pretest scores and the mean posttest scores showed that learning took place in both groups. However, the result indicates that there was significant difference between the achievement of the groups. Hence, the experimental group achieved higher than the control group.

Tenty and Awe (2011) defined academic achievement as the gain in knowledge of pupils as a result of taking part in a learning activity or program. Going by this definition, we can say, with certainty, that the achievement of the pupils was as a result of the treatment administered to them. Moreso, extraneous variables were properly controlled. This implies therefore, that Number Multiples Game promoted higher achievement in algebra than the expository method. This finding supports those of Mbunda (2012) and Bell and Thompson (20212) found that Number Multiples Game promoted higher achievement and more retention than expository method among middle basic school pupils. Ohanusi (2011) and Kofi (2012) found that expository method promoted higher achievement and more retention than Number Multiples Game among middle basic school pupils. While Kuntu and Pedro (2013) found no significant difference between the academic

achievement and retention of middle basic school pupils taught mathematics with Number Multiples Game and their counterparts taught same topics with expository method.

Also important is experimenters' Ingenuity in designing the various Number Multiples Game to suit possible peculiarities in their studies. Results from retention scores indicated that Number Multiples Game Strategy promoted higher retention in algebra than expository method. Retention is indispensable in the teaching and learning process. People who retain poorly are usually judged as poor learners. Learning as defined by Mbunda (2012) is a relatively permanent change in potential behavior which is acquired through practice or experience. Mbunda argue that "relatively permanent" in the definition connotes something stored or locked up somewhere, in other words, something retained. Furthermore, "potential behavior" in the definition implies something for a later use and this is the retrieval of something retained.

Conclusions

Based on the findings of this study, the following conclusions were made;

1. Use of Number Multiples Game elicits higher achievement in algebra than the expository method.
2. Use of Number Multiples Game elicits more retention in algebra than the expository method.

Recommendations

From the finding of this study, the following recommendations are deemed necessary:

1. Use of Number Multiples Game for teaching middle basic school mathematics should be adopted by teachers in all middle basic schools in Enugu South Local Government in particular and Enugu State in general.
2. Nigerian teacher education curriculum should emphasize use of Number Multiples Game in microteaching and teaching practice exercises to avail teachers more practical knowledge during their training.
3. Periodic practical oriented workshops and seminars should be organized for mathematics teachers on use of Number Multiples Game for teaching Middle basic mathematics.

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