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Effect of Advance Organizers on Upper Basic Two Students' Retention in Mathematics in Gboko Local Government Area, Benue State, Nigeria

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Abstract

The study investigates effect of advance organizers on upper basic two students' retention in mathematics. Two research questions and two hypotheses were formulated to guide the study. The quasi-experimental design of pre-test post-test control group type was adopted. A sample of 186 from a population of 672 upper basic two students in Gboko Local Government Area of Benue State was drawn for the study using simple random sampling. The instruments used for data collection was MAT and MRT each made of 25 multiple choice items. The reliability coefficient of 0.87 was obtained for MAT using Kuder-Richardson formula 21. Mean and standard deviation were used to answer research questions while hypotheses were tested at 0.05 level of significant using ANCOVA. Findings of the study revealed that students taught with advance organizers retained significantly higher than their counterpart taught without advance organizers. The study also revealed that there was no significant difference in the mean retention scores of male and female students taught mathematics with advance organizers. The study recommends that the mathematics curriculum should incorporate advance organizers as a teaching strategy in secondary schools. Also, mathematics teachers should be trained on how to integrate advance organizers in teaching through Seminars.

Keywords: Effect, Advance Organizers, Retention in Mathematics, Gender.

Introduction

Mathematics is a veritable tool for functional education in all nations of the world. Its usefulness is noticeable in the fields of humanities, technology and science. Every individual needs some knowledge of mathematics for his or her day to day activities. Meremikwu (2008) described mathematics as an essential science which serves as the underlying knowledge for science and technology. To Iyekekpolor (2007), mathematics is the key to the solution of human problems. The Federal Republic of Nigeria (FRN, 2008) recognized the importance of mathematics and made it compulsory at basic education and senior secondary education levels.

In spite of the importance accorded to mathematics as a school subject in Nigeria, students' achievement in the subject is consistently reported as low (Iwendi & Oyedum, 2012; Gimba, 2013). More so, analysis of annual results of the West African Examination Council (2002–2015) shows that less than 50% of registered candidates in Nigeria obtained credit pass in mathematics.

Research (Abakpa & Agbo-Egwu, 2007; Anyagh & O'kwu, 2010; Nneji, 2013) identified poor strategies used in teaching and learning of mathematics as one of the main causes of students' low achievement in mathematics. They observed that the inappropriate teaching strategies used by mathematics teachers are instrumental to learners' inability to understand the basic Mathematical principles, computations or logical facts involved, thereby resulting to rote learning which lead to low achievement and hence low retention.

According to Iji (2010), man has a limited capacity for memorization. Therefore, it is difficult to learn mathematics with rote learning method alone, since the learning of mathematics involves a

vast understanding of mathematics relationships and connections. Thus, the challenge faced by mathematics teachers is to develop teaching strategies capable of improving students' ability towards effective assimilation and retention of mathematical facts.

One of such instructional strategies which have the potential to address the problems of effective teaching and learning of mathematics concepts is the advance organizer strategy (Okey & Avwiri, 2014). According to Okigbo (2010), an advance organizer is a cognitive instructional strategy used to promote the learning and retention of new information. Anderson (2004) defined it as a method of bridging and linking old information with something new. Adebola (2011) described advance organizers as information that is presented prior to learning that can be use by the learner to organize and interpret new incoming information. Thus, advance organizers are the instructional tools or instructional procedure used by an instructional designer to help the learner recall and transfer prior knowledge to the new information being presented. This is achieved by directing attention to what is important in the incoming material, providing a reminder about relevant previous knowledge and highlighting relationships that exist between the incoming concept and the previous knowledge.

To Okigbo (2010), instructional strategies such as advance organizers have tremendous potentials in the teaching of abstract branches of mathematics such as algebra. Hence, the present study uses advance organizers in teaching algebraic processes (Algebraic Fractions and Simple Equations) so as to examine its effect on students' retention in mathematics. Specifically, mathematical games identified as one of the advance organizers Okigbo (2010) was used in this study.

Retention, which is the noun form of the verb retain, is defined as the act of absorbing, holding, or continuing to hold or have facts learned (Nneji, 2013). In the context of this work, retention refers to the act of absorbing, holding, or continuing to hold or have mathematical facts under the concept algebraic fraction and simple equation learned. Since retention involves absorbing and holding of concepts for a period of time it therefore means that students' achievement in any given test that is not taken immediately after a course or programme of study will

depend on the level at which the individual retains the concepts learnt. Students with sound retentive ability will achieve better than students with poor retentive ability in such a test. Thus, the low achievement of students in mathematics as aforementioned is a result of students' poor retentive ability in mathematics.

The effect of students' poor retention rate in mathematics has become worrisome as can be seen in the West Africa Examiners' Council *Chief Examiners' Report* (2006). The report expressed worries over the low achievement due to poor retention rate in mathematics by candidates. In response to this assertion, Obi, Agwagah, and Agah (2014) contended that for improvement of retention of learned materials in mathematics, activity-based learning is indispensable – hence the justification for the use of an activity-based strategy (advance organizers strategy) in the present study.

Review of empirical studies on advance organizers conducted by researchers such as Shihusa and Keraro (2009), Okigbo (2010), and Adebola (2011) shows that advance organizers significantly improve students' achievement in mathematics. But the trend cease to be laudable with studies conducted to explore the impact of advance organizers on students' retention in mathematics. Eze (2012), and Okey and Avwiri (2014), in their separate investigations on the effect of advance organizers strategy on students' retention in mathematics submitted that the advance organizers strategy show no significant difference in students' retention. This worrisome submission calls for the present research.

Also, gender differences in mathematics ability has remained a source of worry as mathematics educators and other stakeholders in education seek to address the under-representation of women at the highest levels of mathematics (Asante, 2010). But results of studies on gender still yield no definite conclusion. Nneji (2013), Obi, Agwagah, and Agah (2014), and Ajai and Imoko (2015) showed that there is no significant difference between the mean retention scores of male and female students in mathematics. Carr and Jessup (2006) opined that there is a significant gender difference in mathematics adding that boys have higher aspirations for Mathematics inclined careers then girls.

Anyamene and Anyachebelu (2009) on their part reported that male students show a significantly higher achievement and retention in mathematics than female students. Against this backdrop, the present study examines the efficacy of the advance organizers strategy in bridging gender gaps.

Statement of the Problem

Due to the applicability of mathematics to every aspect of human activities it is made a compulsory subject. This is so because all individuals need some mathematical skills in order to contribute meaningfully to the society they live. This notable objective appears like a fantasy in Nigeria because of the persistent annual reports of low achievement in external examinations. Research evidence has it that the inappropriate teaching strategies used in delivering mathematics lessons are to blame for the low achievement. Thus, the present study examines the effect of advance organizers on students' retention in mathematics in a desperate bid to improve on the unacceptable state of mathematics in Nigeria. Specifically, will advance organizers, when used in mathematics, improve students' retention? Will advance organizers as an instructional strategy bridge the gap between male and female students in mathematics retention tests?

Purpose of the Study

The purpose of the study is to find out the effect of advance organizers on upper basic two students' retention in mathematics. Specifically, the study aims to:

i. determine students' retention of mathematics concepts when taught with advance organizers.

ii. find out if there is difference in male and female students' retention of mathematics concepts when taught with advance organizers.

Research Questions

The following research questions served as guide to the study.

i. What are the mean retention scores of students taught mathematics with advance organizers and those taught without advance organizers?
ii. What are the mean retention scores of male and female students when taught mathematics with advance organizers?

Research Hypotheses

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

i. There is no significant difference between the mean retention scores of students taught with advance organizers and those taught without advance organizers.
ii. There is no significant difference between the mean retention scores of male and female students taught with advance organizers.

Methodology

The design adopted for this study was the quasi-experimental design of pre-test, post-test non-randomized control group type. This design was used because it is not possible to subject human beings to some treatments as obtainable in true experiments. In order not to disrupt school organization, intact classes were used.

The population of the study is 672. The population is made up of all Upper Basic Two students in eight schools within the area of the study (Gboko Local Government Area) that meet the criteria used for selection. The sample for the study is made up of 186 students (107 boys and 79 girls) out of the 672 Upper Basic Two students in Gboko Local Government Area (Gboko Area Education office, 2015). The treatment group comprised 97 Upper Basic Two students (56 boys and 41 girls) while the control group was made up of 79 Upper Basic Two students (51 boys and 38 girls). The study employed a multi-stage sampling technique. Purposive sampling was used to select co-

educational secondary schools for the study as gender is a co-factor considered for the study and only schools with qualified (upper basic two) mathematics teachers were used for the study. The simple random sampling technique (hat and draw method) was used to select two co-educational schools out of the eight co-educational schools that met the criteria. Furthermore, the selected schools were randomly assigned to the treatment group and the control group by flip of a coin.

The instruments for data collection was a researcher made Mathematics Achievement Test (MAT) and Mathematics Retention Test (MRT), each comprised of twenty-five (25) multiple- choice items based on the topic considered for the study. The instrument was validated by three validates: one expert in measurement and evaluation, and two lecturers in mathematics education from the University of Agriculture, Makurdi, Nigeria. The recommendations of the validates were considered in the final production of MAT. Using Kuder-Richardson formula 21 ($K - R_{21}$), a reliability value of 0.87 was calculated for the MAT items. This shows that the instrument is reliable. $K - R_{21}$ was used because the reliability of the test was estimated from a single administration of the test and the items were dichotomously scored.

Procedure for the Experiment

A pre-test was given to the control and the treatment group to determine the homogeneity of the two groups in the topics to be taught during the experiment (simple algebraic fractions and equations). Both the treatment group and the control group were taught by their regular class teachers (research assistants). The research assistants in the experimental group were given training on Mathematical games such as Equation Whot, LCM Whot and Magic Instruction Game as advance organizers. Lesson plans for both treatment and control groups were prepared by researchers for the research assistants

Students in the treatment group were taught how to play the chosen games at least one week before the start of lessons. This was done so as to allow the subjects in the treatment group play the games and refresh the needed advance organizers for the study of the new concepts. Thereafter, both the treatment and control groups were taught the same

topic (simple algebraic fractions and equations) for two weeks. The items in the pre-test instrument were then rearranged (by shuffling the serial number of each item as well as the options of the items of the pretest) and re-administered to both groups as post-test to measure the learning that had taken place. The MAT items were further re-arranged and re-administered after two weeks as MRT to measure the retention of the subject.

The means and standard deviations were used to answer research questions while analysis of co-variance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. ANCOVA statistic was to help eliminate the difference in the entry abilities of the groups that may exist (due to the use of intact classes).

Results

Research Question 1

What are the mean retention scores of students taught mathematics with advance organizers and those taught without advance organizers?

Table 1: Mean retention scores and standard deviations of students taught mathematics with advance organizers and those taught without advance organizers

Groups	**N**	**Post-test**		**Retention Test**	
		Mean	**SD**	**Mean**	**SD**
With Organizers	97	58.80	15.55	54.27	17.08
Without Organizers	89	50.61	15.30	44.81	14.41
Mean Difference				**9.46**	
Total	**186**				

N = Number of Students, SD = Standard Deviation

Table 1 shows that in the retention test, students taught mathematics with advance organizers had a mean of 54.27 with a standard deviation of 17.08, while those taught without advance organizers had a mean of 44.81 with a standard deviation of 14.41. This indicates that the

difference in the mean retention scores between the two groups (9.46) is in favour of the group taught with advance organizers.

Research Hypothesis 1

There is no significant difference between the mean retention scores of students taught with advance organizers and those taught without advance organizers.

Table 2: summary of one-way analysis of covariance of mathematics retention scores of the group taught with advance organizers and those taught without advance organizers

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	4339.29[a]	2	2169.65	8.62	.00
Intercept	28699.54	1	28699.54	113.96	.00
Pretest	186.47	1	186.47	.74	.39
Group Retention	3451.23	1	3451.23	13.70	.00
Error	46088.32	183	251.85		
Total	510640.00	186			
Corrected Total	50427.61	185			

Table 2 shows that P (1,183) = 0.00, P<0.05. Thus, the hypothesis of no significant difference between the mean retention scores of students taught with advance organizers and those taught without advance organizers is rejected. The implication is that there was a statistical significant improvement in the mean retention scores of students taught with advanced organizers.

Research Question 2

What are the mean retention scores of male and female students taught mathematics with advance organizers?

Table 3: Mean retention scores and standard deviations of male and female students taught mathematics with advance organizers

Gender	**N**	**Post-test**		**Retention Test**	
		Mean	**SD**	**Mean**	**SD**
Male	56	59.92	16.35	55.43	16.65
Female	41	57.23	14.46	52.68	17.73
Mean Difference				**2.75**	
Total	**97**				

N = Number of Students, SD = Standard Deviation

Table 3 shows that the mean retention scores of male and female students taught with advance organizers were 55.43 and 52.68 respectively with corresponding standard deviations of 16.55 and 16.93. The difference in the mean retention scores of male and female students (2.75) is in favour of males.

Research Hypothesis 2

There is no significant difference between the mean achievement scores of male and female students taught mathematics with advance organizers.

Table 4: Summary of one-way analysis of covariance of mathematics retention scores of male and female students taught with advance organizers

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	1046.18[a]	2	523.09	1.82	.17
Intercept	11433.30	1	11433.30	39.88	.00
Pretest	867.74	1	867.74	3.03	.09
Gender Retention	116.83	1	116.83	.41	.53
Error	26950.86	94	286.71		
Total	313664.00	97			
Corrected Total	27997.03	96			

Table 4 shows that P(1, 94) = 0.53, P>0.05. Thus, the hypothesis of no significant difference between the mean retention scores of male and female students taught with advance organizers is retained. The implication is that the difference between the mean retention scores of male and female students taught with advance organizers is statistically not significant.

Discussion of Findings

Table 1 shows that the mean retention scores of students taught mathematics with advance organizers and those taught without advance organizers were 54.27 and 44.81 respectively. The result indicates that the mean retention scores of students in the group taught with advance organizers is higher than the mean retention scores of the group taught without advance organizers. The test of hypothesis 1 as shown in Table 2 confirmed this. Table 2 shows that P(1, 183) = 0.00, P< 0.05. Hence, the difference in the mean retention scores of the two groups is significant. This means that students taught mathematics with advance organizers retained significantly higher than those taught without advance organizers.

The finding is in agreement with Shihusa and Keraro (2009), Okigbo (2010), and Adebola (2011) who found that use of advance organizers enhance students' achievement and hence retention of learned materials. The finding however contradicts with Eze (2012), and Okey and Avwiri (2014) who found that the use of advance organizers had no significant effect on students' retention.

Table 3 shows that the mean retention scores of male and female students taught mathematics with advance organizers were 55.43 and 52.68 respectively. The result indicates that the mean retention scores of male students taught with advance organizers is higher than the mean retention scores of female students in the same group. The mean obtained was 2.75. The test of hypothesis 2 in Table 4 was done to confirm the significance or insignificance of the findings. The result shows that P(1, 183) = 0.53, P>0.05. Hence, hypothesis 2 is retained. This means that there is no statistical significant difference in the mean retention scores of male and female students taught mathematics with

advance organizers. The implication is that advance organizers strategy helped to minimize the gap in male and female students' retention in mathematics.

The finding agrees with earlier studies of Nneji (2013), Obi and Agwagah and Agah (2014) and, Ajai and Imoko (2015) who found that there is no significant difference in the retention of male and female students. However, the result disagrees with Carr and Jessup (2006) and, Anyamene and Anyachebelu (2009) who reported that male students showed a significantly higher achievement and retention in mathematics than female students.

Conclusions

Based on the finding of the study it is concluded that the use of advance organizers improves students' retention of mathematics concepts compared with conventional method. Also, it is concluded that gender does not influence students' retention in mathematics.

Recommendations

Based on the findings of the study the following recommendations are made.

1. Mathematics curriculum planners should review the mathematics curriculum incorporating the advance organizers strategy.
2. Mathematics teachers in secondary schools should always incorporate advance organizers in their lessons in order to improve students' retention in mathematics.
3. Relevant professional bodies like the Mathematics Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) should organize seminars to train teachers on the use of advance organizers.

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