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EFFECT OF GRAPHIC ADVANCE ORGANIZER ON SENIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT AND RETENTION IN ALGEBRAIC PROCESSES IN ABUJA, NIGERIA

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Abstract

The study investigated the Effect of Graphic Advance Organizer on Senior Secondary School Students' Achievement and Retention in Algebraic Processes in Abuja, Nigeria. The target population of the study comprised 2,443 Senior Secondary (SS) I Students in Abuja. The Sample of the study consists of 97 SS I students. Quasi-experimental design of pre-test and post-test, non-equivalent control Group was used. Two intact classes were used, one of which was randomly assigned to experimental and the other control group. Two research questions were answered and two hypotheses were tested. Algebraic Achievement Test (AAT) which comprised of 50 choice multiple question was face, logical and content validated using table of specification by three experts in Mathematics Education and in Measurement and Evaluation from Nasarawa State University, Keffi, a logical validity index of the instrument was found to be 0.72 was used for data collection. The reliability coefficient of internal consistency (r) of 0.84 was obtained using Spearman's Rank Order Correlation Coefficient. Mean and standard deviation were used to answer the research questions while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The results revealed that Graphic Advance Organizer Strategy enhanced achievement in Algebra and student taught algebra using graphic organizer retain better. The study recommended among others that with improvement of students' achievement and retention on Graphic Advance Organizers strategy, practicing teachers of secondary schools mathematics should be sensitized by way of organizing seminars and workshops on the use of Graphic Advance Organizer strategy for onward application in the classroom instruction.

Keywords: Achievement, Teaching Strategies, Retention, Advance organizer.

Introduction

Science, Technology and Mathematics Education (STME) have been proven to be indispensable subjects in the economic development of any country, Nigeria inclusive. Today, it is a reality that the creation, mastery and utilization of modern science and technology basically distinguish the developing nations from the developed nations of the world. That is to say that the standard of living of any nation is dependent on the level of science and technology of such nation. Science is the bedrock that provides the spring board for the growth of technology while mathematics is the gate way and key to the sciences (Kolawale, 2007). In other words, it is the level of mathematics that determines the level of the science and technological component of any nation. The foundation of science and technology, which is the basic requirement for the development of a nation, is mathematics (Charles-Ogan, 2015). Therefore, mathematics plays a vital role in nation building. Mathematics is the major tool available for formulating theories in the sciences as well as in other fields (Lawrence & Kolawole, 2007). It is used in explaining observation and experiments in other fields of enquiry. There is hardly any area of science that does not make use of mathematical concepts to explain its own concepts, theories or models. Thus, anyone who neglects mathematics may not be able to go far in the study of sciences and in fact, other things of the world. In the present age of science and technology, the achievement of any meaningful development must be largely dependent on science and technology, which is also dependent on mathematics.

Today mathematics in its various forms has found applications in economics, science, chemical and energy development, engineering and technology that it has become a veritable and indispensable tool in national development, (Phebe & Samuel, 2016). The Federal Republic of Nigeria in the National Policy on Education (FRN, 2014) stressed the need for effective mathematics education and the recognition for its importance/relevance in the provision of the required manpower and technological development of a nation. The development of mathematics education has been of great concern all over the world, most especially in the developing countries like Nigeria. This is not far from the fact that a number of events in educational world have made people to realize the indispensable role that the knowledge of the subject can play in the life of every individual in today's world (Oyeniran, 2010). Competence in mathematics is critical to many career and job opportunities available to young people in today's increasing technological society. For any nation to produce qualitative and quantitative future scientists and technologists, the knowledge of mathematics is inevitable. It is a subject that liberates the mind and not only gives individual an assessment of their intellectual abilities but as a point of direction for improvement.

Many students have difficulty with the abstract concepts taught in algebra (Pramesti & Retnawati, 2019). It is important that teachers use strategies that provide students with ample

time to learn the concept and a sufficient number of opportunities to practice the concept. The uses of graphic advance organizer might help Students master prerequisite skills prior to learning algebra. These skills include but are not limited to basic facts, problem solving skills, and probability skills. It is imperative that algebra problems be related to real-life situations. Graphic advance organizer shows how Students relate algebra problem to real life situations (Gabriel, 2008). Relating it to real-life situations will encourage the connection between what the students already know and what they are about to teach (Gabriel, 2008).

In the case of poor achievement of students in mathematics, over the years, mathematics educators have not relented in searching for better ways of teaching the subject (Agbenyeku, 2014). There have consequently been a myriad of research studies that have sought to identify the numerous factors affecting the teaching and learning of mathematics and address the problem of poor achievement of students in the subject. However, despite their findings and recommendations, the problem of poor achievement of students in algebraic processes still persists. As a consequence, the situation in Nigeria is that, academic achievement in Mathematics education is still low, both in certificate and non- certificate examinations.

One problem with the teaching and learning of Mathematics is that most teachers continue to keep faith with the old system of using rote learning of teaching. Unfortunately, students' achievement in this all important subject has been consistently poor especially in the Senior Secondary Certificate Examination (SSCE) organized by the West African Examination Council (WAEC) and the National Examination Council (NECO), Kluwer and Agbenyeku, 2011. WAEC is the examination written by Nigerian students at the end of their secondary education and it is used to measure the extent of knowledge and skills the students have acquired at that level of education. The result of this examination is also used as prerequisite for admission into institutions of higher learning where students could go to pursue courses in their areas of interest. In most Nigerian institutions, a credit pass in mathematics and English language are required to study any course whatsoever. However, students' results released yearly by the examination bodies continue to show a steady trend of mass failure of the students in mathematics. Teaching strategy which is the method of how a teacher is to deliver a lesson to the students, concern most researchers today because effective teaching strategy would promote students achievement in mathematics and in algebraic processes. Since inappropriate teaching strategy is partly a factor that contributes to students' poor achievement in mathematics, there is a need to identify the teaching strategy to adopt in learning and teaching of mathematics with a view to improving students' achievement and retention in mathematics, (Adetunji, Bamidele, & Awodele, 2013).

Graphic Advance organizer is information the teacher presents, at the onset of a lesson, used by students to help them mentally organize new material. Advanced organizer is also used to

assist students in learning and retaining material that is subsequently read. Therefore, advance organizer functions as "ideational scaffolding," or a frame of reference for the assimilation of new textual material to be learned. Thus, advance organizer is intended to facilitate learning through helping students to create a new schema, by activating relevant prior knowledge and fashioning a new structure for the logical and hierarchically organized reception of new material. An important assumption of Ausubel's work is that the learner's cognitive structure is organized hierarchically in terms of highly inclusive broad concepts under which are subsumed less inclusive sub - concepts as well as specific pieces of information. With the advent of increasingly sophisticated and detailed research on information processing, this body of research continues to grow.

Baiyun (2007) observed that student taught mathematical concept using advance organizers demonstrated statistically significant effect among the treatment groups and the control group. However, in agreement with the previous research, this study shows a positive but inconclusive benefit of using advance organizers for students' short-term knowledge acquisition. The students using a concept map consistently obtained higher learning achievements than individuals using a text outline. More importantly, this study reiterated the proposition that students of lower-learning abilities benefit more from using organizers for online learning than those of higher-learning abilities. From the study of Ambard and Ambard, (2012), advance Organizer model is more effective than traditional method on achievement of students in mathematics teaching which was based on only one variable that is achievement while this present study will work with two variables which were achievement and retention.

Retention is a concept that is very vital in psychology of education. It refers to what is learned minus what is forgotten. Retention is the persistence of learned material over a period of time which can be reflected in the individual ability to recall or remember. Graphic Advance Organizer enhances the learning of students who receive the explanation on the concepts to be taught and also deepens the understanding of the teacher or student providing the explanation. Hence, consistent elaboration or explanation of a topic using Graphic Advance Organizer would surely bring forth complete retention of a topic being learnt for a longer period of time. Retention is defined by Kundu & Tutoo (2002) as a preservative factor of the mind.

Statement of the Problem

Despite the universal recognition of the importance of mathematics and the tremendous efforts being made by educationists, mathematicians, mathematics teachers and researchers towards improving the teaching and learning of mathematics in secondary schools, students still have low mathematics achievement and retention. This low mathematics achievement and retention is of great concern to teachers, educationists,

students, school administrators and the society in general.

Despite the importance of mathematics in the development of a nation, many students have a negative outlook toward mathematics because they feel that they are unable to succeed and cannot improve their mathematics skills. Many students turn out to be very miserable and inattentive in a mathematics class after being taught a topic and discover they could not memorize or recall such a concept with ease. The reason for this difficulty may vary but this could sometimes be related to the teaching method being used. There has also been an increasing awareness by those concerned with mathematics education that the rote learning of teaching mathematics has not been very successful. For effective teaching to take place, the skilful mathematics teacher needs to use many different methods and techniques at his disposal. A carefully designed teaching method can make teaching and learning effective.

All efforts made so far in Nigeria have not really solved the problems of teaching and learning of mathematics in schools. This makes it imperative to search for an approach for teaching of mathematics that aimed at understanding rather than memorizing and juggling of facts. This study is therefore, designed to find out the effect of graphic Advance Organizer on senior secondary school student's achievement and retention in Algebraic Processes in Abuja, Nigeria.

Objectives of the Study

The purpose of the study was to investigate the effect of graphic Advance Organizers on Senior Secondary School Students Achievement and Retention in Algebraic Processes in Abuja, Nigeria. Specifically, the study sought to:

1. Determine the effect of Graphic Advance Organizer of student's achievement in algebraic processes.
2. Determine the extent to which the use of Graphic Advance Organizer enhances the retention of students in algebraic processes.

Research Questions

To guide the study, the following research questions were posed:

1. What are the mean achievement scores of students taught Algebraic processes using Graphic Advance Organizer and those exposed to conventional method?
2. What are the mean retention scores of students taught algebraic processes with Graphic Advance Organizer and those exposed to conventional method?

Statement of the Hypotheses

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

$Ho_{1:}$ There is no significant difference in the mean achievement scores of students in algebraic process when exposed to Advance Organizer and those exposed to Conventional Method.

Ho_2: There is no significant difference in the mean retention scores of students taught

algebraic processes with Advance organizer and those taught with Conventional Method.

Methodology

The study adopted quasi-experimental design with non-equivalent control group in which pre-test, post-test and post post-test control group. The population of the study was made up of 28121students (14,162 male and 13,959 females) from 2017/2018 academic session. The sample for the study consists of 97 SS1 students. The sample consists of 49 students in the experimental group and 48 students in the control group. Random sampling technique was used to select schools. Two (2) secondary schools were randomly selected. Furthermore, in each of the two selected schools, one SS I intact classes was sampled randomly and assigned to experimental and control groups. Algebraic Achievement Test (AAT) which comprised of 50 multiple choice questions was face, logical and content validated using table of specification by three experts in Mathematics Education and in Measurement and Evaluation from Nasarawa State University, Keffi, a logical validity index of the instrument was found to be 0.72 was used for data collection. The reliability of the instrument was determined using Spearman Brown rank order correlation, and this yielded an index of 0.84.

Two different lesson plans were prepared and used for each instructional delivery approach. The analysis of pre-test scores and the emergence of two similar groups took one week. The real experimental teaching was carried out for four weeks duration after the pre-test. The post- test was administered as soon as the last class session was over, while the post-post- test came up two weeks after the post-test. Data collected were analysed using mean, standard deviation and ANCOVA statistics.

Results

Research Question 1: What are the means achievement scores of students taught Algebraic processes using Graphic Advance Organizer and those exposed to conventional method?

Table 1: Mean Scores and Standard Deviation of Students Taught Algebra Using Graphic Advance Organizers and Conventional Method

Teaching Method	Type of Test	No. of Students	Mean	SD
Graphic Advance Organizers	Pre-test	49	15.45	5.748
	Post-test	49	29.35	7.788
Conventional Approach	Pre-test	48	17.83	5.536
	Post-test	48	27.46	7.237

Table1 shows the mean scores and standard deviation of the students in the Experimental and Control groups. From Table1 it could be seen that the mean scores and the standard deviation of post-test of the students taught with Advance Organizers which is 29.35 and 7.788 respectively is more than the mean scores and standard deviation of the post-test and the standard deviation respectively and standard deviation of the students who were taught with conventional approach which is 27.46 and 7.237 respectively. The Graphic Advance organizer strategy is more efficacious than the conventional approach.

Research Question 2

What are the mean retention scores of students taught algebraic processes with Advance Organizer and those taught without Advance organizer?

Table 2: Mean Retention Scores and Standard Deviation of Students Taught Algebra Using Advance Organizers and Conventional Method

Teaching Method	Type of Test	No. of Students	Mean	SD
Advance Organizers	Post-test	49	29.35	7.78
	Retention	49	27.76	7.74
Conventional Approach	Post-test	48	27.46	7.24
	Retention	48	24.42	7.052

Table 2 shows that the mean retention scores of the students taught with Advance Organizers was 27.76, Standard deviation was 7.737, while that of Students taught with Control group was 24.42 with Standard deviation of 7.052. This implies that Graphic Advance Organizers is more effective than the conventional Approach in teaching and retention of Algebra.

Test of Hypothesis

Ho_1: There is no significant difference in the mean achievement scores of students exposed to Advance Organizer and those not exposed to Advance Organizer.

Table 3: One-way ANCOVA Result on Students' Achievement Scores in Algebra

Source	Type III Sum of Square	DF	Mean Square	F	Sig
Corrected model	4553.457	2	2276.729	236.204	0.000
Intercept	658.314	1	658.314	68.298	0.000
Pre-test	4466.971	1	4466.971	463.436	0.000
Group	531.033	1	531.033	55.093	0.000
Error	906.048	94	9.639		
Total	83764.000	97			
Corrected total	5459.505	96			

The result from Table 3 shows that the $F_{(1, 94)}$ = 55.093 and p=0.000 < α at the 0.05 level of significant. This shows that the noted difference among the group is significant at 0.05 alpha levels, therefore, the null hypothesis one was rejected. Thus there is significant difference in the mean achievement scores of students taught algebra using Advance organizer and those taught using the conventional method. This implies that Advance organizer Strategy is more efficacious than the conventional approach

Ho_2: There is no significant difference in the mean retention scores of students taught algebraic processes with Advance organizer and those not taught with Advance organizer.

Table 4.7: One-way ANCOVA Result on Students' Retention Scores in Algebra

Source	Type IIII Sum of the Square	Df	Mean	F	Sig
Corrected model	5172.027	2	2586.014	786.832	0.000
Intercept	6.776	1	6.776	2.062	0.154
Post-test	4901.786	1	4901.786	1491.44	0.000
Group	56.194	1	56.194	17.078	0.000
Error	308.942	91	3.287		
Total	71574.000	97			
Corrected Total	5480.969	96			

The result from Table 4, the $F_{(1, 91)} = 17.078$ and $p=0.000 < \alpha$ at the 0.05 level of significant. This shows that the noted difference among the group is significant at 0.05 alpha levels, therefore, the null hypothesis two was rejected. Thus there is significant difference in the mean retention scores of students taught algebra using Advance organizer and those taught using the conventional method. This implies that Advance organizer Strategy has an effect on students' retention on algebra.

Discussion of Findings

The findings of the research questions showed that Graphic Advance organizers strategy enhance students achievement in algebra than the student taught algebra using conventional approach. Hence, students who were taught using Graphic Advance Organizer strategy performed better than those taught using conventional approach. This finding tends to support previous researches (Baiyun, 2007; Ambard, P. D., & Ambard, L. K. 2012; Huifen, & Francis, Jeff 2015). The researchers had concluded from their investigations that teaching students with the use advance organizers strategy had a positive effect on the achievements of the experimental group. Adebola (2011) from the results of his investigations concluded that Advance organizer is an effective strategy for teaching and learning of mathematics.

Advance organizers were found to be facilitating in enhancing students retention in mathematics, this might be due to the fact that graphic advance organizer seemed to make students remember more conceptual ideas and were able to relate the test to prior knowledge. This was consistent with the findings of (Gabriel, 2008) that advance organizers facilitate meaningful learning and retention of mathematics concepts. On the effect of advance organizer on the retention of algebraic concepts between male and female students, the result of this study showed that there exists no significant difference between male and female Mathematics students taught with graphic advance organizer. Atomatofa (2013) had similar results. The non-significant difference among the sexes on student's retention of algebraic concepts with respect to those exposed to graphic advance organizer in this study is not unconnected with the fact that any good teaching strategy (like the graphic organizer) does not have disparity among the sexes in the retention of Mathematics concepts. This implies that the graphic advance organizer is a good teaching strategy for both sexes in the retention of Algebraic concept.

Conclusion

Based on this study, the following conclusions were made;

1. Academic achievement in Algebraic processes concepts in mathematics can be enhanced by the use of graphic advanced organizers.
2. Graphic Advanced organizers promote meaningful learning and retention of Algebraic concepts of students in secondary schools

Recommendation

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

1. Practicing teachers of secondary school mathematics should be sensitized by way of organizing seminars and workshops on the use of Advance organizers strategy for onward application in the classroom instruction.
2. Tertiary institutions like Colleges of Education and Universities training pre-service teachers of mathematics should incorporate the Graphic Advance organizers strategy into their existing teaching strategies for use when in practice.
3. Mathematics curriculum planners and developers should infuse the Graphic Advance organizers strategies into the curriculum of secondary school mathematics.
4. Authors and publishers should write and publish the secondary school mathematics textbooks from the point of Graphic Advance organizers strategy. This will make the contents of such books to be in the context of real life applications thereby upholding students' achievement and retention in mathematics.

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