

EFFECT OF ADVANCE ORGANIZER ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT AND RETENTION IN ALGEBRAIC PROCESSES IN VANDEIKYA LOCAL GOVERNMENT AREA, BENUE STATE, NIGERIA

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Abstract

The purpose of the study was to investigate the Effect of Advance Organizers on Senior Secondary School Students' Achievement and Retention in Algebraic Processes in Vandeikya local Government Area. The population of the study comprise 2,443 Senior Secondary (SS) II 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 one to control group. Two research questions and two hypotheses guided the study. Instrument used for data collection was Algebra Achievement Test (AAT). The AAT was developed by the researchers. The instrument was validated by three research experts, two specialists in measurement and evaluation and the other one specialist in mathematics education. The instrument was also trial – tested and the result obtained was used to calculate the reliability coefficient of internal consistence (r) using Spearman's Rank Order Correlation Coefficient which yielded 0.84. Mean and standard deviation were used to answer the research questions. The hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The results revealed that advance organizers strategy enhanced students' achievement in Algebra and is independent of gender. The study recommended among others that with improvement of students' achievement and retention using advance organizers strategy, practising teachers of secondary schools mathematics should be sensitized by way of organizing seminars and workshops on the use of Advance Organizer strategy for onward application in the classroom instruction.

Keywords: Advance Organizer, Achievement, Retention and Conventional.

Introduction

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 (Tyoor 2019). 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 development of a nation, is mathematics. Therefore, mathematics plays a vital role in nation building.

Mathematics today is having an enormous impact on science and society. The influence may be silent and appear hidden but has shaped our world in many ways. Mathematical ideas have helped make possible the revolution of electronics which has transformed the way we think and live today. The information technology of today has transformed the world into a global village. These advances in science and technology are made possible by the numerous developments in pure mathematics.

Despite the importance of mathematics in the development of a nation like Nigeria students' low achievement in mathematics at both internal and national examinations have been of great concern. WAEC (2017) reports the trends in achievement of Nigeria students in SSCE mathematics as published by West African Examination Council. The causes were partly attributed to inappropriate use of teaching strategy and how mathematics is learnt by the students (Obioma, 2011). Many students have a negative outlook toward mathematics because they feel that they are unable to succeed and cannot improve their mathematics skills.

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. 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 mathematics still persists. As a consequence, the situation in Nigeria is that, academic achievement in Mathematics education is still deplorably low, both in certificate and non-certificate examinations. This poor Mathematics performance of students is further worsened by gender imbalance leading to the problem which now constitutes a major research focus across the globe (UNESCO, 2011).

One problem with Mathematics teaching and learning is that most teachers continue to keep faith with the old system. Unfortunately, students' performance in this 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 Examinations Council (NECO). SSCE 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 is required to read 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 teaching and 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. Since inappropriate teaching strategy is partly a factor that contributes to student's poor achievement in mathematics, there is a need to identify the appropriate teaching strategy to adopt in learning and teaching of mathematics so as to improve students' achievement and retention in mathematics. One instructional device use in bridging the known to the unknown is the advance organizer.

Advance organizers are information the teacher presents at the onset of a lesson, used by students to help them mentally organize new material. Advanced organizers are also thought to assist students in learning and retaining material that is subsequently read. According to Ausubel (1968), students often have to learn the details of an unfamiliar discipline before having available a sufficient number of key anchoring ideas. Therefore, advance organizers function as "ideational scaffolding," or a frame of reference for the assimilation of new textual material to be learned. Thus, advance organizers are 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. Stated differently, the purpose of the organizer, according to Ausubel (1963, p. 23), is to "relate the potentially meaningful materials to be learned to the already existing cognitive structure of the learner". 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. Thus, this researcher will try the effectiveness of advance organizers in enhancing students' achievement and retention in mathematics. There are three basic purposes of advance organizers. First, it directs students' attention to what is important in the upcoming lesson. Second, they highlight relationships among ideas that will be presented. Thirdly, they remind students of relevant information that they already have.

Retention is a concept that is very vital in psychology of education. It refers to what is learned minus what is forgotten. According to Archie (2000), retention is the persistence of learned material over a period of time which can be reflected in the individual ability to recall or remember. Theories of forgetting made it clear that forgetting takes place as a result of the passage of time. This has an implication of making sure on the part of mathematics teacher that what is taught is related to life and students experience in order to ensure constant practice on the part of the students. Teachers should also place emphasis on revision in order to consolidate learning and to achieve this; they should use learning strategies that enhance retention which is what this study tends to find out by using advance organizers as teaching strategy.

The concept that will be used in this study is the 'Algebraic processes'. It is used in the study because some students find it difficult to understand them (Gabriel, 2008). The areas of Algebraic processes used are: sets, factorization, simplification and solving an equation.

Based on the importance placed on mathematics, and bearing in mind, that effective teaching strategies increase achievement and retention of students in mathematics, this study is set to find the effect of Advance Organizer on senior secondary school student's achievement and retention in algebraic processes in Vandeikya Local Government Area, Benue State.

Despite the universal recognition of the importance of Mathematics and the tremendous efforts being made by educationist, mathematicians, mathematics teachers and researchers towards improving the teaching and learning of mathematics in secondary school, students still have low mathematics achievement and retention. This low mathematics achievement and retention is of great concern to teachers, educationist, students, school administrators and the society in general. A study by (Helen, 2013) which was motivated by the need to find out factors responsible for the observed continued poor performance in mathematics public examinations in spite of efforts for its improvement have shown that students consider factors to do with teachers and resource materials for teaching very crucial in determining their achievement in mathematics. All these factors determine the effectiveness of teaching and learning which subsequently affect achievement in examinations.

Despite the efforts being made towards ensuring that citizens have equal educational opportunities as well as making other training facilities readily accessible to the users so as to improve students' academic performance in both internal and external examinations, it has been observed by Adepoju (2012), and Oluchukwu (2011) that all is not well with the system as a result of the poor achievement of students recorded in public examinations in recent years.

The persistent poor achievement of secondary school students in public examinations such as the Senior School Certificate Examinations (SSCE) in Nigeria in the recent times has made the development of secondary education in the country a difficult task. Parents, guardians and other stakeholders in education industry have variously commented on the achievement of secondary school students particularly in Mathematics (Adepoju, 2012).

All efforts made so far in Nigeria have not really solved the problems of teaching and learning of mathematics in schools. The low achievement has been partly attributed to lack of good and adequate teaching strategies. 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 Advance Organizer on senior secondary school student's achievement and retention in Algebraic Processes.

Objectives of the Study

The purpose of the study was to investigate the effect of advance organizers on Senior Secondary School Students achievement and retention in algebraic processes in Vandeikya Local Government Area, Benue State. Specifically, the study sought to:

1. determine the mean achievement scores of students taught using advance organizer.
2. determine the extent to which the use of advance organizer enhances the retention of algebraic concepts in students.

Research Question

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

1. What are the mean achievement scores of students taught using advance organizer and those taught with conventional method?

2. What are the mean retention scores of students taught algebraic processes with advance organizer and those not taught with advance organizer?

Hypotheses

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Ho₁: There is no significant difference in the mean achievement scores of students taught using advance organizer and those taught with conventional method?

Ho₂: There is no significant difference in the mean retention scores of students taught algebraic processes with advance organizer and those taught with conventional method

Research Method

The research design adopted for this study was quasi-experimental of the non-equivalent Control group pretest post-test type. The sample for the study was made up 110 senior Secondary II (SS II) students in Benue State public secondary schools. The sample was made up of 55 males and 57 females. The sample consists of 56 students in the experimental group and 54 students in the control group. Random sampling technique was used to select schools. Two secondary schools were randomly selected. Furthermore, in each of the schools, one SS II intact classes was sampled randomly and assign to experimental and control groups. This was because there were more than one arm of SS II in each of the two selected schools.

The instrument used for data collection in this study was Algebraic Achievement Test (AAT). The AAT was constructed by the researcher and administered to SS I1 secondary school students from the selected schools in the study area to point out their ability and difficulties in solving and simplifying algebraic processes. The instrument was used to measure student's achievement in algebraic concept in mathematics. This test consists of items that were covered in Algebraic processes for six weeks. The content involved factorization; simplification, set, and algebraic equation. The test contained 50 items having a total score of 50 marks. The test items covered all the units that will be taught by the researcher. The distribution of the test items over the concepts was done by the use of table of specification. Table of specification were prepared. In this study, all the six levels of cognitive processes of knowledge, comprehension application, Analytic, synthesis and evaluation was prepared using the six levels of bloom's taxonomy. Lesson plans were prepared for the experimental group which was graphic advance organizer model and the control group. To ascertain Retention, the Algebraic Achievement Test (AAT) was reshuffled and given to the students after six weeks of post-test.

The instrument was subjected to face validity, logical validity, and contents validation by three experts in mathematics education and in measurement and evaluation. This was done by sending copies of the title of the study, purpose of the study, research questions, hypotheses, table of specification, and the achievement test (AAT). Their comments and suggestions on the suitability, clarity scope of the contents were taken into consideration in producing the final instrument that will be used for the study. The logical validity index of the instrument was found to be 0.72.

The Algebraic Achievement Test (AAT) was trial tested to determine its reliability. The pilot testing of the instrument was conducted to ascertain that the instrument was

effective to capture the necessary information. An intact class of SS I1 in one school which was not part of the main study was used for pilot testing. 56 students were used for the test. The SS I1 students from the school selected were made of both boys and girls that participated in the pilot testing. This was done using Split half reliability method to establish the internal consistency of the instrument. . Item analyses were carryout to determine the discriminating index and item difficulty. The AAT for the pilot testing consisted of 50 questions. The test items were split into two equal parts (Odd and Even numbers). The scores were correlated using spearman's Rank order correlation. The average difficulty index and discriminating power were 0.43 and 0.43 respectively. The instruments were trial-tested and their reliability coefficient was 0.84.

Descriptive statistics (mean scores and standard deviation) was used to answer all the research questions and Analysis of covariance (ANCOVA) was used to test the two hypotheses at 0.05 level of significance.

Results

Research Question One:

What are the mean achievement scores of students taught using Advance Organizer and those taught with Conventional Method?

Table 1: The mean scores and standard deviation in AAT of students in Advance Organizer Strategy and conventional Method.

Teaching strategy	No of Students	Type of Test	Mean	Standard Deviation
Problem Solving	56	Pre-test	48.79	11.79
		Post-test	63.86	14.37
Conventional	54	pre-test	48.22	15.50
		Post-test	50.93	15.70

Table 1 shows the mean scores and standard deviations of the students in the experimental and control groups. The mean scores of students taught using Advance Organizer Strategy had mean scores of 48.79 and 63.86 in pre-test and post-test respectively, with standard deviation of 11.79 in pre-test and 14.37 in post-test. For students, who were taught using Conventional method, their mean scores were 48.22 and 50.93 and standard deviation of 15.50 and 15.70 in pre-test and post-test respectively. Students taught with Advance Organizer had highest mean score while those taught with Conventional method had lowest mean score. The standard deviation scores for the pretest and posttest were not at much variance implying that the efficacy of the treatment is sustainable.

Hypothesis one: There is no significant difference between the mean achievement scores of students taught algebra using Advance Organizer Strategy and conventional Method.

Table 2: One way ANCOVA results in AAT of students in Advance Organizer Strategy and Conventional method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remarks
Corrected Model	43334.982 ^a	2	14444.994	381.420	.000	S
Intercept	435.191	1	435.191	11.491	.001	S
Pretest	38633.517	1	38633.517	1020.117	.000	S
Group	4240.325	2	2120.163	55.983	.000	S
Error	6286.694	107	37.872			
Total	623243.000	110				

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Table 2 shows the summary of the one-way Analysis of Covariance (ANCOVA) result on students' achievement scores in AAT. The result indicated that the noted difference between mean achievement scores of the two groups is significant at 0.05 alpha levels. This is from the fact that F-ratio = 55.983 and $P = 0.000 < \alpha = 0.05$. The null hypothesis that there is no significant difference in the mean achievement scores of students taught algebra using Advance Organizer and Conventional method was therefore rejected showing that difference exist.

Research question 2: What are the mean retention scores of students taught algebra using Advance Organizer Strategy and Conventional method?

Table 3: - The mean retention scores and standard deviation in AAT retention of students in Advance Organizer Strategy and Conventional method.

Teaching strategy	No of Students	Type of Test	Mean	Standard Deviation
Problem solving	56	Post-test	63.86	14.365
		Retention	63.21	14.859
Conventional method	54	Post-test	50.93	15.701
		Retention	51.24	16.026

Table 3 shows that students taught with Advance Organizer strategy had mean retention scores of 63.86 in posttest and 63.21 in post posttest with standard deviation of 14.365 and 14.859 in posttest and post posttest respectively. The students taught with Conventional method had mean retention score of 50.93 and 51.24 with standard deviation of 15.701 and 16.026 in posttest and post posttest respectively. The students taught with advance organizer strategy had highest mean retention score while students taught using Conventional method had lowest mean retention score. The pre retention and post retention scores were not at much variance. This means that the ability to produce a desired result is sustainable.

Hypothesis Two: There is no significant difference between mean retention scores of students taught algebra using Advance Organizer Strategy and Conventional method.

Table 4 ANCOVA result in AAT retention scores of students in Advance Organizer Strategy and Conventional method.

Source	Type III sum of squares	DF	Mean square	F	Sig	Remark
Corrected Model	18072.948 ^a	2	6024.316	123.255	0.000	S
Intercept	4282.250	1	4282.250	87.6130.000		S
Group	3779.858	2	1889.929	38.667	0.000	S
Posttest	6007.755	1	6007.755	122.916	0.000	S
Error	11241.668	107	48.877			
Total Corrected	551876.000	110				
Total	29214.615	109				

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Table 4 reveals that the noted difference in retention of students taught using Advance Organizer Strategy and Conventional method is significant at 0.05 alpha level. This is from the fact that F-ratio 38.667 and $P = 0.000 < \alpha = 0.05$. The null hypothesis was therefore rejected indicating that there is significant difference in the mean retention score of students taught using Advance Organizer Strategy and Conventional method.

Discussion of findings

The discussion of the result was made based on the research questions asked and the corresponding hypotheses that were tested

The result from Table 1 showed that the mean achievement scores of students taught using Advance Organizer strategy was higher than the mean achievement scores of students taught using conventional approach. This was further confirmed by the result in Table 2 which revealed that the teaching strategies were a significant factor on the students' achievement in advance organizer strategy. Hence, students who were taught using advance organizer strategy performed better than those taught using conventional approach. This finding tends to support previous researches ((Narendra 2012; Baiyun 2007; Huifen, Francis & Jeff, 2009, Tanveer, Farkhunda & Arshad 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) reported that advance organizer is an effective strategy for teaching and learning of mathematics.

In respect of result from Table 3, the mean retention scores of student taught using Advance organizer is higher than that of their counterpart who were taught with Conventional method. Advance organizer was found to be facilitating in enhancing students' retention in mathematics, this might be due to the fact that 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 (Mayer 2010; Demide 2010) that advance organizer facilitates meaningful learning and retention of mathematics concepts.

Conclusion

The findings of this study have shown that Advance organizers strategy has significant effect on students' achievement and retention more than conventional. However, these results imply that the learning approach which is mainly conventional employed by

mathematics teachers in teaching might have been partly responsible for the persistence under-achievement and low retention of students in mathematics. The implications of this study hinges on the development of better teaching strategies for teaching of mathematics.

Recommendations

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

1. Teachers should adopt the use of advance organizer strategy in order to enhance students' achievement and retention in algebra aspect of mathematics.
2. Curriculum planners should include advance organizer Strategy as a major method for teaching algebra topics when planning mathematics curriculum.
3. Teachers should be educated through workshops and seminars on how to use advance organizer strategy in schools at all levels

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