Effects of Graphic Advance Organizers on Senior Secondary School Students' Performance and Retention of Physics Concepts

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ABSTRACT

The study was designed to examine the effect of Graphic Advance Organizers on the academic performance and retention of physics concepts among secondary schools in Etinan Educational Zone. The study adopted pretest, post-test and post-post-test quasi-experimental design. The study was conducted using a total of Sixty (60) Senior Secondary II Physics Students. Purposive and random sampling was employed to select the schools. The topic: concept of wave motion was taught for four weeks using Graphic Advance Organizers and lecture method for Experimental group and lecture method only for the control group. The instrument used for pre-test and post-test was physics performance Test (PPT) with reliability of 0.79 while that of post-post test was Physics Retention Test (PRT). Two null hypothesis were tested, t-test statistics was used to determine the level of significance of the two groups at $p<0.05$. The major finding of the study shows that there is a significant difference in the mean academic performance scores of the experimental and control groups. Also there is a significant difference in the retention level of students taught using Graphic Advance Organizers compared to those taught lecture method only. This study concluded that Graphic Advance Organizer enhances academic performance and aids in retention of physics concepts. It was recommended that physics teachers should be encouraged to adopt Graphic Advance Organizers in conjunction with appropriate teaching methods in teaching physics concepts in our secondary school.

KEYWORDS: Graphic Advance Organizer, Academic performance, Retention, Physics concept,

Introduction

Physics occupies a very crucial position in scientific and technological growth of a nation. Therefore, its knowledge and meaningful understanding are critical for the successful

study of many important professionals such as medicine, engineering, technologies and agriculture for national, socio-economic and technological development and sustainability. In spite of efforts made toward encouraging students to study physics, studies such as Orji (2000) and Abiam (1997) showed that physics has the least popularity index among school science subjects in Nigeria. Physics is generally perceived by students to be difficult and abstract in nature, hence most students in secondary schools have negative attitude towards learning it (Ubom, 2003). It is therefore pertinent to look for an innovative strategy that could be adopted to improve student's achievements and retention in the subject. One of the instructional strategy which has the potential to offer opportunity to address the problems of teaching and learning physics concepts is the Advance Organizer (AO) learning theory advocated by Ausubel in the 1960s.

According to Rene (1998), an Advance Organizer is a cognitive strategy proposed by Ausubel in his subsumption theory, which allows the learner to recall and transfer prior knowledge to the new information being presented. If connection can be made between the new information and previous knowledge, the learning experience will become more meaningful to the learner. Hence Advance Organizer is not a strategy used by the learner but rather an instructional strategy used by the teacher. Meyer, (2003) described Advance organizer as a cognitive instructional strategy used to promote the learning and retention of new information. It is information that is presented of new information. It is information that is presented prior to learning and that can be used by the learner to recognize and interpret new incoming information.

Advance Organizer is described by Daniel (2005) as a cognitive instructional strategy or mental learning aid to help-learners integrate new information with existing knowledge, leading to meaningful learning as opposed to role memorization. Keraro (2009) submitted that Advance Organizers are frameworks that enable students learn new ideas or information and meaningfully link these ideas to the existing cognitive structure. Advance Organizer may be presented in written text, as Graphic Organizer or may utilize audio-visual supports or may be presented orally (Akinbobola, 2004).

Graphic Organizer is a two-dimensional representation of cognitive structures showing the interconnections of concepts involved in a discipline or sub-discipline. According to Hall and Stragman (2002), Graphic Advance Organizer is a pre-instructional strategy in the form of visual or graphic display that depicts the relationship between facts, terms and ideas within their subject matter as being interrelated ideas.

Retention is the term used to describe the remembering of fact or idea after a passage of time. Meaningful learning is deemed to have taken place if after a passage of time the student can recall and apply information which he/she has been taught previously. According to Nwachukwu (2002), there is a growing realization that poor learning and retention of science concepts may be related to the inability of students to links previous learning with present one.

Earlier research reports have demonstrated the effectiveness of using Advance Organizes in teaching scientific concepts. For instance, Robinson (1998) and Shihasu and Keraro (2009) showed that Advance Organizers facilitated meaningful leaning and enhanced students performance. Hendron (2014) reported that students who use graphic representation performed better in tests that require cognitive skills. Boujaoude and Atteh (2008) showed that students

exposed to Advance Organizers performed better than those that did not use Advance Organizers at knowledge, comprehension and application levels respectively.

It seems therefore that Teachers' continued reliance on traditional method only in teaching of difficult and abstract concepts in science does not promote higher cognitive skills in the students and has not yielded expected results. Therefore, it is pertinent to search for appropriate strategy to apply alongside suitable teaching methods in teaching physics concepts to enhance performance and retention in cognitive structure of the learner. This is why this study considers the use of Graphic Advance Organizer in the teaching of physics to prove its worth or otherwise on the achievement and retention of physics concepts.

Statement of Problem

Physics being a fundamental science course has found numerous application in all other sciences and hence its principles constitute the bedrock of development in the service and technology of nation. Achieving proficiency in physics is therefore a national concern. However, developing countries like Nigeria suffer persistent power failure, insufficient food, inadequate medical care and portable water supply as well as unconducive living and working environment that indicate the low level of scientific and technological development.

The major aim of physics teaching is to promote the understanding of the concepts being taught with the view to applying knowledge of such understanding to real life situations. Hence it is expedient to investigate an effective teaching strategy that will enhance the transfer of knowledge of students in what they have learned in one content to new context in physics.

Purpose of the Study

The main objective of this study is to:

1. Investigate the effects of Graphic Advance Organizer (GAO) on Academic Performance of Student in Physics concepts ar senior secondary schools.
2. Determine if the use of Graphic Advance Organizers (GAO) enhace retention ability of senior secondary students in physics concepts.

Research Hypothesis

The following null hypothesis was formulated by the researcher.

HO_1: There is no significant difference between the mean performance scores of students taught physics concepts with Graphics Advance Organizers and lecture method and those taught with lecture method only.

HO_2: There is no significant difference in mean retention scores of students taught with Graphics Advance Organizers and lecture method and those taught with lecture method only.

Scope of the Study

The scope of this study is limited to Etinan Educational Zone of Akwa Ibom State and to all senior secondary II students offering physics in public schools. The topic taught was on concept of wave motion in accordance with the SS physics syllabus. The Graphic Advance Organizer

was developed in form of a flow chart to include production of waves, types, properties, light waves, sound waves, application of light and sound waves and electromagnetic waves.

Research Design

The research design employed in this study is the pre-test, post-test and post-post test quasi experimental design. The samples was grouped into two: the experimental group (EG) and the control group (CG). EG were taught with GAO and lecture method while CG were taught with lecture method only. Physics performance test (PPT) and Physics Retention Test (PPT) was constructed. A total of 50 multiple choice items were constructed on the concept of waves motion as PAT. Also PRT contain the same set of 50 multiple choice items but arranged in different orders. The instruments were faced and content validated by physics experts.

Area of Study

Etinan education Zone of Akwa Ibom State is made up of three Local Government Areas with a total of 25 public senior secondary schools.

Population of the Study

The target population of this study is the entire public senior secondary II (SS II) students in Etinan Educational Zone who are offering physics.

Sample and Sampling Techniques

Purposive sampling technique was used to select schools from the target population. The criteria was

- Schools that have graduate teachers for physics with at least 3 years of teaching experience.
- Schools with well-equipped laboratories.
- Schools in which concept of waves motion has not been taught yet.

Eight (8) schools met the criteria and random sampling technique through use of balloting was carried out to select two (2) schools among those that met the criteria. Sixty (60) students made up the sample size for the study. On the whole, 30 students were in Experimental Group while 30 students were in control group.

Instrumentation of Data Collection

The instrument that was used for this study to generate data was physics performance test (PPT) and physics retention test (PRT) which consisted of 50 multiple choice questions. Pre-test, post-test and post-post test are reshuffled forms of each other.

Validity of Instrument

In order to ensure content relevance and appropriateness of items of the test draft copies were distributed to two experts in physics for vetting.

Reliability of the Instrument

To test for reliability, a test-retest method was employed. First test was given to students of a school that did nor form part of the sample used. After 2 weeks the second test was administered

to the same students. Pearson product moment correlation coefficient statistic was used and correlation coefficient of r=0.79 was obtained, proving the test instrument reliable.

Data Collection

The teaching was carried out by research assistants who are regular physics teachers in the respective schools. The research assistant were trained and provided with well-structured lesson packages on the concept of wave motion. Pre-test was administered to both experimental and control group before the treatment.

Graphic Advance Organizer teaching Strategy were administered to EG for one week after which the treatment was given to both EG and CG for 4 weeks. Post-test was administered to the groups after the treatment.

Two weeks after the completion of the treatment, the post-post test (PPT) was administered to both groups. The mean scores of the PPT and PRT collected were analyzed using t-test statistics. All hypothesis were tested at 0.05 level of significance.

Data Analysis

The data collected from mean scores were used to test the stated hypothesis using t-test statistics. The results are presented in the table below.

Table 1: t-test comparison of pre-test mean scores of EG and CG.

Group	N	$\overline{X}$	SD	DF	t-cal	t-crit	Decision
EG	30	6.87	6.70				
				58	1.75	2.00	NS
CG	30	4.40	4.21				

NS = not significant at <0.05

From the result, the calculated t-value 1.75 is less than the critical t-value 2.0 indicating that there is no significant difference between the performances of the two groups in the pretest. This means that the two groups are not significantly difference in their depth of knowledge on the concept of waves.

HO_1: There is no significant difference in academic performance between the mean scores of students taught using GAO strategy and lecture method and those taught using lecture method only.

Table 2: t-test comparison of the post-test mean scores on performance of students taught with GAO and lecture method and those taught with lecture method only.

Group	N	$\overline{X}$	SD	DF	t-cal	t-crit	Decision
EG	30	65.57	8.27				
				58	3.67	2.00	S

CG	30	58.13	7.47

S = significant at <0.05

Analysis table shows that calculated t-value 3.67 is greater than critical t-value 2.00. It implies that there is a significant difference in the performance of students taught using GAO and lecture method and those taught with lecture method only. That means that GAO produce a positive significant effect in the learning of physics concepts.

HO_2: There is no significant difference in the mean scores of students taught physics concepts with GAO and lecture method and those taught with lecture method only.

Table 3: t-test comparison of retention mean scores on performance of students taught with GAO and lecture method and those taught with lecture method only.

Group	N	$\overline{X}$	SD	DF	t-cal	t-crit	Decision
EG	30	60.70	7.25				
				58	3.35	2.00	S
CG	30	30.40	4.21				

S = significant at <0.05

The calculated t-value 3.35 is greater than critical t- value 2.00. It implies that physics students taught with GAO and lecture method differ significantly in their ability to retain the concepts taught than those taught with lecture method only.

Table 4: Comparison of retention abilities of EG and CG

Group	Posttest Mean score	Retention test Mean scores	Retention ability loss	%
EG	65.57	60.70	4.87	93%
CG	58.13	30.40	19.73	66%

The result from table 4 shows that students in experimental group had high retention ability of 93% while those in control group has 66%. It could therefore be deduced that employing Graphic Advance Organizer strategy in teaching physics greatly enhances retention and recall abilities in students.

Discussion of the Results

The results of this study revealed that there exist a significant difference between achievement of physics students exposed to GAO and those without GAO. Student taught with GAO strategy perform better than those taught without GAO. GAO strategy enabled the student to be meta-cognitively active bringing abstract and difficult concepts into visual format that encouraged meaningful learning and hence remarkable cognitive achievement. These findings are consistent with findings of Shihasu and Keraro (2009), Hendron (2014), Heron (2001) and Kang (1999) that Graphic Advance Organizer strategies facilitate meaningful learning and enhanced students' achievement.

The result also revealed that there exist a significant difference between the retention abilities of students taught physics concept with GAO and those taught Advance Organizer. This could be attributed to anchoring ability of the Graphic Organizer that enables the experimental group to understand and retain the learnt concept better than those of the control group. The result is in line with the findings of Adejumo (2002) and Coffey and Canas (2001) which indicated that Advance Organizers facilitated meaningful learning and retention abilities.

Implications of the Study

The findings of this study have implications for the improvement of science and technology in Nigeria.

1. The use of GAO strategy is found to be more of physics in physics concepts. Therefore, sustenance of students' interest in science and technology can encourage and motivate the students to practice and apply scientific knowledge gained to new situation by making use of the process skills in science. This could lead to the acquisition and development of technology in the country.
2. Retention of concepts learnt would help in reflective thinking and the use of retain concepts used in creative way to solve novel problems in our society.

Conclusion

The results of this revealed that Graphic Advance Organizer strategy is more effective in the learning of physics concepts in our secondary schools. Learners performed better when taught with GAO in conjunction with traditional methods as compared to those taught by traditional methods only. GAO helped the students to overcome the difficulties in learning physics concept perceived as abstract and difficult by both teachers and students. GAO is useful to improve retention ability of the students.

Recommendation

Teachers of physics should be encouraged to adopt appropriate Advance Organizers together with other appropriate teaching methods in teaching difficult physics concepts.

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