

Influence of Study Questions as Advance Organizers on Students' Academic Achievement and Retention in Physics in Plateau State, Nigeria

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Abstract: This study investigated the influence of Study Questions as Advance Organizers on Students' Academic Achievement and Retention in Secondary School Physics in Mangu L. G. A., Plateau State. The research design is quasi experimental pretest, posttest and non-equivalent group of independent variables. The total population of students is 1,094 with male population of 787 and female population of 307 drawn from 11 secondary schools. The sample consisted of 97 students with 76 in the experimental and 21 in the control group while the instruments used for data collection was Physics Achievement Test (PAT) for both students' achievement and retention in physics with a reliability coefficient of $r=0.796$. The tools used for the analysis and testing of hypotheses were descriptive statistics of mean and standard deviation and the t-test for paired samples variables. The findings showed that students in the experimental group had higher achievement mean scores; students in the experimental group showed high retention ability and that there is a significant difference in the mean achievement score of students in the control and experimental group; there is a significant difference in the retention of students in the experimental group and after the entire treatment period of exposure to study questions. The study recommends among others, that; the ministry of education through the education resource center in plateau state, school administrators and the government provide adequate training and retraining of teachers to enhance their competence and mastery of how to use study question for effective teaching and learning process.

Keywords: Study Questions, Advance Organizers, Academic Achievement, Retention

1. Introduction

Secondary school education is the second stage of formal education in Nigeria which gives the learners the basic introduction to science education through the developing of technologically literate citizens who understand how science, technology and society influence one another and are able to use the knowledge in their everyday activities. Science subjects have become a critical component and enhancer of economic and social technological development as a result of the emphasis placed by the national policy on science and technology FRN [8]. The applicability of these policy has led to the transformation of different raw materials and societal

waste into finished goods and services for better quality of lives therefore, the efficient use of the policy has over time resulted to underdeveloped, developed and developing countries of the world at large Mandung [12].

Over the years, the situation of mass failure in science subject have been a thing of concern and can be attributed to different factors which include; inappropriate method of teaching resulting to poor students' academic achievement and retention, gender amidst others have affected the tendency to builds the manifestation of an advance technological society through inventions and innovation in any society James & Awe [10]. Despite the importance of physics which forms the bedrock to national development and its contribution to

science, technology and the society, the present situation in our secondary schools remain worrying therefore the need to improve students' academic achievement and retention in physics at all levels of educational system in Nigeria to cushion the effects student's failure.

The major cause of poor academic achievement of students in our schools today is largely rooted in the lack of effective teaching and learning study technique. Therefore, the need to use study questions which are given to learners in advance or before the actual study period relating to the concept of consideration. Raich and Skelly [18], believes that study questions reflect an uncertainty that you want to try to resolve, perhaps an uncertainty about the effectiveness of an intervention or how well an intervention works in a specific sampled population which is the basis for a research study and presents the idea(s) that are to be examined in the study. Lawrence [11] opined that everything included in the study must relate to the study question(s) and study objective(s) which gives information about the interest of the sampled population that is to be studied, interventions to be compared, and primary outcomes to focus on. He maintained that, the most important step in conducting a high-quality research study is to create a study question that will provide the guidance for the planning, analysis, and reporting of your study even though the process of generating a novel, answerable study questions seems like it should be simple at first blush.

Retention is the ability of a learner to remember facts and figures in memory. It is the ability of an individual to hold factual knowledge, skills, processes, images and figures in memory and at the same time, retrieve same when needed Woolfolk [20]. The retention and subsequent application of scientific knowledge and skills by students in their life endeavors is a key expected outcome of science education programme Igboko & Ibeneme [9]. Students who successfully complete science education programme are expected to retain such knowledge and skills acquired from the classroom to the extent that they can apply the same competence gained in the workplace and in their future academic endeavor hence, science education curriculum is designed in a way as to expose learners to knowledge and skills that will enhance their economic self-reliance on completion of the basic level of education.

Students' academic achievement in science subjects has been generally poor and for optional science subjects the dropout ratio was found to be extraordinarily high; in some of the years over two third of the students dropped optional science subjects Siwel & Kizito [19]. Morrison [13] stated that the academic achievement of a student is the yardstick for testing the educational quality of a nation therefore the need to maintain a high performance in internal and mostly external examinations. However, Akpan [2] opined that, the continued lamentation by employers of labour about the unemployability of school leavers due to school leavers' lack of requisite skills may be due to the low motivated interest and none retention of knowledge by the school leavers. Therefore, the needs to enhance students' academic achievement which will lead to proper retention of knowledge long enough to

provide adequate and correct responses to achievement test questions. In similar research, Ajai and Imoko [1] stated that students tend to easily forget materials taught them within relatively short periods. Their study revealed that students mean retention scores obtained via delayed tests were lower than the scores from achievement tests which were earlier taken by students. However, the need to address the low academic achievement and retention of students becomes imperative, more so that this challenge of students' continuous failure constitutes a clog in the wheel of progress in Nigeria's quest to address the current unemployment challenge which has continued to affect both individuals and national development.

2. Theoretical Framework

This work was anchored on the Ausubel's theory of advance organizers [6]. Ausubel theory of advance organizers are tool or mental learning that aid and enhance students learning by integrating the new information's with their existing knowledge leading to meaning learning as opposes to rote memorization. This can also be seen as a mean of preparing the learners cognitive structures for the learning experience about to take place. He advocates the use of advance organizers as a mechanism to help to link new learning materials with existing related ideas. An advance organizer is information presented by an instructor that helps the student organize new incoming information. This is achieved by directing attention to what is important in the coming material, highlighting relationships, and providing a reminder about relevant prior knowledge thus they're are helpful in the process of learning when difficult and complex or materials are introduced. This is satisfied through two conditions: The student must process and understand the information presented in the organizer, this increases the effectiveness of the organizer itself and the organizer must indicate the relations among the basic concepts and terms that will be used. Ausubel's theory of advance organizers fall into two categories: comparative and expository organizers. The main goal of comparative organizers is to activate existing schemas or knowledge and is used as a reminder to bring into the working memory of what you may not realize is relevant. A comparative organizer is also used both to integrate as well as discriminate. It "integrates new ideas with basically similar concepts in cognitive structure, as well as increase discriminability between new and existing ideas which are essentially different but confusedly similar". "In contrast, expository organizers provide new knowledge that students will need to understand the upcoming information". Expository organizers are often used when the new learning material is unfamiliar to the learner. They often relate what the learner already knows with the new and unfamiliar material, this in turn is aimed to make the unfamiliar material more plausible to the learner. Therefore, the aforementioned theory provide the basis for this research. Ausubel's theory address retention, academic achievement and students' learning interest because learners' involvement boast the

level and extent for which they comprehend and learn.

2.1. Research Questions

Two research questions were formulated to guide the study:

- 1) What is the mean achievement score of physics students in the control and experimental groups?
- 2) To what extent do study questions as advance organizers affect students' retention in physics in the experimental group?

2.2. Hypotheses

In order to guide the study, the following null hypothesis were formulated and tested at 0.05 level of significance to guide the study

- 1) There is no significant difference between the mean achievement scores of physics students before and after exposure to study questions.
- 2) There is no significant difference between students' academic retention during treatment and after treatment with study questions in the experimental group.

3. Methodology

This study adopted the use of quasi-experimental design of pretest, posttest and non-equivalent control group design which permits the use of intact classes and does not allow for randomization. The purpose of the study was to find out the academic achievement and retention of students in secondary school physics using study questions as advance organizers. The population for this study consisted of all the secondary schools in Panyam-Mangu, Plateau State, Nigeria with 11 senior secondary schools offering physics as a subject. The total population of students is 1,094 with Male population of 787 and Female population of 307 students. According to Peter [17], if the population of a study is a few thousand, a 10% sample or more will do. Therefore, 11% of the population was sampled through stratify random sampling for the study. Two schools were used for this study; the schools were sampled based on their characteristic which includes: free from disturbance, the availability of qualified and well train teachers and both schools are co-educational among others. The sample of the study consisted of 97 students out of which the experimental consisted of 76 students with 50 Male and 26 Female while the control group consisted of 21 students with 9 Male students and 14 Female students. The topics used in this study are all in the SS II syllabus which is: elastic property of solid, motion under gravity and the concept of wave. The Physics Achievement Test (PAT) is a 40 items multiple choice texts. The 40 questions were used for the pretest and re-numbered for the posttest and same was used for the retention test in the post-posttest and each question had four options A, B, C and D. The multiple-choice items were drawn from the SS II syllabus using table of specification under the selected topics. The questions were developed by WAEC and NECO from 2008-2015 senior secondary certificate Examination for Physics and were adopted by the researcher. The PAT was

validated by three experts; one from Physics Education, department of Science and Technology Education, Faculty of Education, University of Jos; one from the department of Physics, Faculty of Natural Science, University of Jos and the third from the department of Physics, College of Education Gindiri, Plateau State. The face validity was conducted by an expert from Physics education, department of Science and Technology Education, Faculty of education, University of Jos while the content validity was conducted by an expert from Test and Measurement at College of Education, Gindiri. The pilot study of the Physics Achievement Test (PAT) had a sample size of 42 students of Glorious Hope High Bukuru, Jos South L. G. A Plateau State. The reliability of the instrument was being determined using the Pearson's product moment correlation coefficient (r) which determines the suitability of the instrument for the study and it yielded a reliability coefficient value $r = 0.76$

4. Results

Research Question 1

What is the mean achievement score of physics students in the experimental and control group?

Table 1. Mean and Standard Deviation for Treatment and Control Group.

Group	N	Pretest		Posttest		Main Gain
		Mean	SD	Mean	SD	
Experimental	76	14.75	3.84	22.68	4.76	7.93
Control	21	12.95	3.60	17.19	4.61	7.41
Mean Diff.		1.80		5.49		

Table 1 shows the treatment group pretest and posttest mean scores of 14.75 and 22.68 with a standard deviation of 3.84 and 4.76 respectively. However, the control group has a pretest and posttest mean score of 12.95 and 17.19 with a standard deviation of 3.60 and 4.51 respectively. The result shows a mean achievement gain score for both treatment and control group as 7.93 and 7.41 respectively. Therefore, students taught using study questions had a higher achievement mean score compared to the control group.

Hypotheses 1

There is no significant difference between the mean achievement scores of physics students before and after exposure to study questions.

Table 2. T-Test Analysis for Paired Two Sample Means of Students' Achievement Scores Taught with Study Questions.

	Variable 1	Variable 2
Mean	14.75	22.68421
Variance	13.52333	30.13895
Observations	76	76
Df	75	
t-Statistics	9.89788	
t Critical two-tail	1.992102	

$P < 0.05$ significant level

The analysis in Table 2 shows that, t-statistics (9.89788) is greater than t-critical two-tail (1.992102), the null hypothesis is

rejected and the alternative hypothesis is accepted. Thus, there is a significant difference between the mean achievement scores of physics students before and after exposure to study questions.

Research Question 2

To what extent do advance organizers affect students' retention in physics in the experimental group?

Table 3. Mean and Standard Deviation Scores of Student Retention in the Experimental Group.

Retention Group	N	Posttest Scores		Retention Scores		Main Gain
		Mean	SD	Mean	SD	
Treatment	76	22.68	4.76	41.98	8.69	18.30
Control	21	17.19	4.51	28.89	6.28	11.70

Table 3 shows the mean retention score of students in the experimental group. The posttest and mean retention score revealed a mean score of 22.68 and 41.98 with a standard deviation of 4.76 and 8.69 from a total population of 97 students. It was observed that the students had a significant increase in the mean retention score with a gain of 18.30. In conclusion, advance organizers affect students' retention ability in physics.

Hypothesis 2

There is no significant difference between students' academic retention in the posttest and post-posttest retention score in the experimental group.

Table 4. T-Test Analysis for Paired Two Sample Means of Students' posttest and post-posttest retention score in the experimental group.

	Variable 1 posttest	Variable 2 Post-posttest
Mean	22.68421	24.0286
Variance	30.13895	33.9317
Observations	76	76
Df	75	
t-Statistics	4.8239	
t Critical two-tail	0.96421	

P<0.05 significant level

The analysis in Table 4 shows that, t-statistics (4.8239) is greater than t-critical two-tail (0.96421), the null hypothesis is rejected and the alternative hypothesis is accepted. Thus, there is a significant difference in students' academic retention when exposed to study questions as advance organizers.

5. Discussion of Findings

The study revealed that students' academic achievement increased significantly with the use of study questions as advance organizers in table 1 and equally revealed that there is a significant difference between the mean achievement scores of physics students when exposed to study questions as reveal in table 3. Students taught using study questions had a higher achievement mean score compared to the control group. The findings agree with earlier findings of Okeke [16]; Peter [17]; Morrison [13] and Ameh & Dantani, [4] who found out there's no significant difference between the mean achievement scores of students when exposed to other forms of treatment ranging from cooperative, active learning and case study compared to the conventional lecture method. More so, Peter [17] found out

that students exposed to the use of active learning as in computer assisted packages have better mean achievement than those expose to conventional method. Therefore, the use of study questions as advance organizers enhances students' academic achievement in physics.

The place of increase in the learners' retention abilities are also very crucial since the aim of teaching process is that the learners are able to retain what they have learnt Ausubel [6]. The findings from the research revealed that students exposed to study question in the experimental group showed significant retention ability as showed in table 3. More still, the null hypotheses was rejected as indicated in table 4 which states that there is no significant difference between students' academic retention in the posttest and post-posttest retention score in the experimental group. The findings was in agreement with the Studies conducted by (Atomatofa [5]; Amber [3]; Efe [7]; Ogbeba & Agernor [15] all supported the notion that learners retention ability is improved and sustained in teaching and learning much more when they are actively involved in the process of learning and make ease for them to retain what they have learnt. Nden and Ubana [14] observed that, physics have a very low popularity index among other subject including the sciences hence it affects even the retention ability of physics students. The researcher concludes that students' retention ability improves significantly if they are actively involved in the learning process.

6. Conclusion and Recommendations

The paper examined the influence of study questions as advance organizers on students' academic achievement and retention in physics and it revealed that students in the experimental group have statistically significant mean achievement score and retention ability in secondary school physics. Based on the findings and conclusions of the research work, the following recommendations were made:

- 1) Study questions should be encouraged in our schools as a way of improving students' academic achievement through providing the requisite friendly atmosphere for students to be actively and not passively involved in the teaching and learning process which can be a catalyst to students' retention of what they learn.
- 2) The ministry of education through the education resource center in plateau state, school administrators and the government should provide adequate training and retraining of teachers to enhance their competence and mastery of how to use study question for effective teaching and learning process.

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