

Effects of Advance Organizer teaching approach on Students' Academic Performance in Physics in Senior Secondary School in Ekiti State, Nigeria

AWODUN, Adebisi Omotade (Ph. D.)

Department of Physics,

College of Education, Ikere-Ekiti. Ekiti State,

Nigeria.

Received May 28, 2016

Accepted June 14, 2016

ABSTRACT

The study investigated the effects of Advance Organizer teaching approach on students' academic performance in Physics in Senior Secondary School in Ekiti State, Nigeria. The study was a pretest, posttest, control group quasi-experimental design. Purposive and stratified random sampling techniques was used to select a total sample of 50 SS II Physics students (this sample was divided into experimental and control groups in ration 1:1 i.e 25 in each group) from two Senior Secondary Schools in Ekiti West Local Government Area, Ekiti State. Three null hypotheses were formulated and tested at 0.05 level of significance. The instrument for this study was Physics Achievement Test (PAT) and the treatment package used for the study was tagged: Advance Organizer Instructional Package (AOIP). The data collected were analysed using t-test and ANCOVA statistical analysis packages. The results of the analyses showed that no significant difference existed between the performance of students in experimental and control groups involved in the study at pretest (this indicated initial academic homogeneity of the groups). However, students' achievement in the experimental group at post-test level was found to be significantly better than that of the control group. This showed that Advance Organizer teaching approach significantly influenced students' academic performance in Physics in senior secondary school. Based on the findings of the study, it was recommended that non-conventional teaching approaches such as using Advance Organizer teaching approach, should be introduced into the teaching of Physics in the nation's secondary schools to reinforce the hitherto adopted conventional teaching method and Physics teachers should be encouraged to make use of these new teaching approaches.

Key Words: Physics, Physics students, Advance Organizer, Advance Organizer instructional package.

1. Introduction

Science has become such an indispensable tool that no nation, developed or developing, wishing to progress in the socio-economic sphere can afford to relegate its learning in schools. The role of science in this modern era of technology is wide and profound. In line with this reasoning, Ogunleye and Babajide (2011) emphasized the importance of scientific knowledge in boosting national prestige, military might, national income and international rating of the country. Physics is among the three major pillars of science (i.e. Physics, Chemistry and Biology).

As opined by Olarinmoye (2000), Physics is the most utilized basic science subject in most technology and technology-related profession. This merely indicates that the enormous role that Physics plays in the technological growth of any

nation must not be undermined. Physics is the study of matter and natural events, based mostly on empirical observations and quantitative measurements (Guzel, 2004). Physics dealt with the study of laws that determine the structure of the universe with reference to the matter (Ike, 2002). Many technical or basic tools and equipment surrounding us, work according to the laws of Physics. According to Adenike (2012), almost all aspects of life science (both living and non-living) have something to do with Physics, ranging from engineering to Mathematics, Biology and Chemistry. Physics is one of the pre-requisite subjects for the study of engineering, technology, medical and other applied science courses in the university. She stressed that Physics is at the heart of almost every face of modern life. Physics

provides training for a vast range of careers, where it is either employed directly, or where the skills developed can be applied in innovative ways in other fields.

In Nigeria, in spite of the enormous role that Physics plays in national development and the efforts of government in the provision of necessary science equipments in schools with good teachers and parents/guardians in providing for their children/wards educational needs at improving science education, Physics results in the examination conducted by most

certified examination bodies like the West African Examinations Council (WAEC) and National Examinations Council (NECO) have not been satisfactory. In particular, reports on WAEC results of Senior School Certificate Examination in Ekiti State over the years often revealed low performance of students in Physics. A fluctuation trend was observed in the performance of students in Physics in the past six years (between 2008-2013) in May/June WASSCE (Table 1 below).

Table 1: Summary of trends of performance in Physics in the West Africa Senior Secondary School Certificate Examination, Ekiti State (between 2008-2013)

YEAR	No EXAMINED			CREDIT A1- C6	PASSES D7- E8	FAILURE F9
	M	F	TOTAL			
2008	1,786	1,599	3,385	1,274 (37.6%)	797 (23.5%)	1,314 (38.9%)
2009	2,439	1,850	4,289	2,296 (53.5%)	1,036 (28.7%)	937 (17.8%)
2010	2,949	2,510	5,459	2,569 (49.8%)	1,825 (31.6%)	1,065 (18.6%)
2011	3,815	3,044	6,859	4,020 (58.6%)	1,124 (16.4%)	1,715 (25.0%)
2012	2,872	2,209	5,081	2,514 (49.5%)	1,379 (27.1%)	1,188 (23.4%)
2013	2,843	2,640	5,483	1,857 (33.9%)	1,685 (30.7%)	1,939 (35.4%)

Source: Ekiti state Ministry of Education, Science and Technology (2014)

A cursory look at the table 1 revealed that not very many of the candidates had credit pass in Physics over the period of observation. In addition, Very many of the candidates that were examined over the period of observation scored below passes level (i.e. A1 to C6) grade required for admission purpose to read science based courses in the tertiary institutions. This situation is disturbing and not in the best interest of the technological growth and development of the country.

The general desire to improve teaching performance and students' academic performance in sciences (particularly, Physics) should be a concern of all stakeholders in education in Nigeria. Emphasis should be among others on the use of innovative teaching approach such as the use of Advance Organizers. Therefore, this study intends to ascertain whether the use of Advance Organizer teaching approach would facilitate students' academic performance in Physics.

According to Ausubel (1960), an advance organizer is a material that is introduced before an unfamiliar content so as to facilitate its assimilation. They, therefore, act as an anchor for the reception of new content (Ausubel, 1963). Ausubel further points out that cognitive restructuring process that is as a result of advance organizers leads to some positive learning outcome.

Similarly, Curzon (1990) opined that an advance organizer is a relatively short arrangement of material introduced to the learner before the lesson. It is designed to cue the relevant prior knowledge of a learner and it is usually presented at a higher level of abstraction, generality and inclusiveness than that of the planned lesson.

Furthermore, Hudson and Fred (2009) cited in Novak (1980) opined that an advance organizer is a kind of cognitive bridge, which teachers use to help learners make a link between what they know and what is to be learnt. Advance organizers

are therefore frameworks that enable students learn new ideas or information and meaningfully link these ideas to the existing cognitive structure.

There are two broad categories of advance organizers. One of them is Expository organizers' which are used whenever the new material is totally unfamiliar; they emphasize context and link the essence of the new material with some relevant previously acquired concepts. The other one is "Comparative organizers" which are used when the material to be learnt is not entirely new. They are intended to point out ways in which that material resembles and differs from that which is already known (Curzon, 1990). All the advance organizers were presented to learners before actual classroom instruction took place.

Effects of the use of advance organizers on learning research into the use of advance organizers suggests that they are of considerable value where the learner may not be able to recognize his or her prior knowledge as relevant and where the teacher wishes to focus students' attention on relationships among linked parts of an idea and on connections between parts and the whole (Curzon, 1990). Curzon further points out that Ausubel's own research suggests that the use of advance organizers can enhance the relationship between cognitive structure and new material, thus facilitating teaching and learning. A study by Nyabwa (2005) has demonstrated the effectiveness of using advance organizers in the teaching of mathematics in secondary schools. Their merit in facilitating meaningful learning of expository materials has been recorded by Allen (1970); Lawton & Wasnaka (1977).

White and Tisher (1986) presented evidence suggesting that students who lack relevant prior knowledge are most likely to benefit from the use of advance organizers and that this may explain the contradictions among studies. Weil and Murphy (1982), assert that use of an advance organizer is a highly effective instructional strategy for all subject areas where the objective is to achieve meaningful assimilation of concepts. According to Mayer (1979), advance organizers have positive but conditional effects on learning. Mayer further suggests that the most effective advance organizers are those that: allow the

students to generate all or most of the logical relationships in the material to be learnt; point out relationships between familiar and less familiar material; are relatively simple to learn; and are used in situations in which the learner would not spontaneously use them. As a result of this view, it can be perceived that advance organizers have a positive influence on learning outcomes.

Gender inequality in education has remained a perennial problem of global scope (Bordo, 2001; UNESCO, 2003; and Reid, 2003). In general, there has been inequality in the opportunities for boys and girls in later life translated into unequal access to education, health and employment (Esan, 2002). Esan (2002) in the study of gender differences in mathematical problem-solving amongst Nigerian students observed that the level of participation of girls in science, technology and Mathematics activities is low. Also, Onah and Ugwu (2010) in their study to determine the factors which predict performance in secondary school Physics asserted that sex is a very good predictor of performance in Physics at secondary school level. Similarly, the findings of Ariyo (2006) revealed significant in the aspect of gender difference in favour of boys in Physics achievement. Also, Ogunleye and Adepoju (2011) observed that there is gender inequality in science, technology and mathematics.

Conversely, Igboke (2004) in a study of comparative analysis of SSCE and NECO results in Ohaukwu local government area of Ebonyin State reported that there is no significant effect of gender. Similarly, Ma (2007) in a study of gender differences in learning outcomes also reported that there is no significant effect of gender on the achievement of students. Also, Coley (2010) in a study of differences in gender gap comparisons across racial/ethnic groups in education and work reported that there is no significant effect of gender on the achievement of students in Physics. In the same way, Kolawole and Popoola (2011) in their study maintained that academic achievement is free of gender influence.

2. Research Hypotheses

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

1. There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.
2. There is no significant difference in the achievement mean scores of students in experimental and control groups after treatment.
3. There is no significant difference in the achievement mean scores of male and female students in each of the experimental and control groups.

3. Methodology

The study was a pretest, posttest, control group quasi-experimental design. The sample for the study was 50 Senior Secondary Two (SSII) Physics students (this sample was divided into the experimental and control groups in ratio 1:1 i.e. 25 in each group), selected through purposive and stratified random sampling techniques from two Senior Secondary Schools in Ekiti West Local Government Area, Ekiti State.

The instrument used to collect relevant data from the subjects was Physics Achievement Test (PAT). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.78.

The administration of the instrument was in three stages: the pre-treatment stage (two weeks), the treatment stage (four weeks) and the post-treatment stage (two weeks). Eight weeks altogether were used for the whole study. The experimental group was treated with Advance Organizers instructional package (i.e. the students were taught using Advance Organizers package) while, the control group were taught with the same concepts but through the conventional teaching approach.

Three null hypotheses were tested at 0.05 level of significance. The data collected were analysed using inferential statistics of t-test and Analysis of Covariance (ANCOVA).

4. Results and Discussion

Hypothesis 1

There is no significant difference in the achievement mean scores of students in experimental and control groups before treatment.

Table 2: t-test analysis of achievement mean scores of students in experimental and control groups before treatment

GROUP	N	X	SD	df	t _{cal}	t _{tab}	Result
Experimental	25	6.28	5.81	48	0.018	1.68	NS
Control	25	6.31	5.77				

P > 0.05 (Result Not significant at 0.05 level), NS = Not Significant.

As shown in table 2, when the mean score of students in the experimental and control groups before the treatments (pre-test) were statistically compared, a *t-value* ($t_{cal} = 0.018$) with $p > 0.05$ alpha level was obtained, which was not significant at 0.05 level. This implies that there is no significant difference between experimental and control groups in pretest achievement mean score. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in experimental and control groups before treatment was accepted.

Hypothesis 2

There is no significant difference in the achievement mean scores of students in experimental and control groups after treatment.

Table 3 : t-test analysis of achievement mean scores of students in experimental and control groups after treatment

GROUP	N	X	SD	df	t _{cal}	t _{tab}	Result
Experimental	25	22.12	8.76	48	3.950	1.68	*
Control	25	13.63	6.24				

P < 0.05 (Result Significant at 0.05 level). * = Significant.

As shown in table 3, when the mean score of students in the control and experimental groups after the treatments (posttest) were statistically compared, a *t-value* ($t_{cal} = 3.950$) with $P < 0.05$ alpha level was obtained, which was significant at 0.05 level. This implies that there exists significant difference between the control and experimental groups achievement mean scores after the treatment in favour of experimental group. Consequently, the null hypothesis which states that there is no significant difference in the achievement mean scores of students in experimental and control groups after treatment was rejected. As such, the conventional method of instruction used for control group can be said to be less effective compared with Advance Organizers instructional approach to teach the experimental group.

Hypothesis 3

There is no significant difference in the achievement mean scores of male and female students in each of the experimental and control groups.

Table 4: Summary of ANCOVA analysis on the achievement mean scores of male and female students in each of the experimental and control groups

Source of variation	SS	df	Ms	F _{cal}	F _{tab}	P	Result
Corrected model	765.246 ^a	3	261.326	42.34	2.42	0.000	
Covariate (pretest)	54.613	1	54.613	1.93	3.20	0.201	
Gender	.654	1	.654	0.21	3.20	0.676	NS
Group	551.216	1	557.216	82.92	3.20	0.000	*
Gender *Group	22.314	1	22.314	0.10	3.20	0.262	NS
Error	284.821	44	7.228				
Corrected Total	912.964	49					
Total	19769.00	50					

P > 0.05 (Result Not significant at 0.05 level), NS = Not Significant, and * = Significant

Table 4 showed that the computed *F-value* ($F_{cal} = 0.21 < F_{tab} = 3.20$) with a *P-value* ($P > 0.05$ alpha level) obtained from the analysis of the students' gender was not significant. Hence, the mean achievement scores of male and female students were not significantly different. The table also revealed that the compared *F-value* ($F_{cal} = 0.10 < F_{tab} = 3.20$) with a *P-value* ($P > 0.05$ alpha level) obtained for the interaction of gender and group was not significant as well. The null hypothesis was thus not rejected. It, therefore, implies that there is no significant interaction between gender of students and Advance Organizers teaching approach applied. In other words, gender of students has no significant influence on either the effectiveness (or otherwise) of the method of instruction applied.

5. Discussion

The first finding of this study revealed that the performance of students in both experimental and control groups in pretest were low and do not differ statistically. This finding established the homogeneity of the two groups involved in the study prior to the experiment. In other words, it could be said that the knowledge baseline for the two groups involved in the study are equal. Consequently, any significant difference recorded afterwards would not be ascribed to chance, but to the specific treatments applied. It also revealed that the mean scores was very low for the two groups (experimental and control), this may probably be due to the possible ineffectiveness of the conventional method of instruction generally adopted by Physics teachers in the nation, which

might not have been potent enough to help students in solving their learning problem in Physics. This assertion is supported by Ojo (2001), Akanbi (2003), Akinola (2006), Gonon and Basaran (2008), Adodo and Gbore (2012), and several other researchers, who were of the opinion that the use of the conventional method to teach Physics students in school diminishes their interest and ability to grasp relevant underlying concepts because this approach to teaching Physics encourages Physics students to be passive, more direction followers and without personal initiative.

Another major finding of this study was that the achievement means scores of students in

experimental and control groups were statistically different after the treatment. By implication, therefore, the advance organizers teaching approach was more effective in improving students' performance in Physics than the conventional mode of teaching. This finding is consistent with that of Nyabwa (2005); Hudson and Fred (2009) and others, who reported that teaching with advance organizers can give both the teacher and students a new outlook and improve the academic performance of the students.

The findings of this study also revealed that there was no significant difference in the academic achievement of male and female students in Physics in each of the experimental and control groups before and after the treatment. In other words, academic performance of male and female students exposed to advance organizer teaching approach did not differ significantly as female students were found to have similar academic performance in Physics as their male counterparts in the two groups involved in the study. The implication of this result is that gender was not a significant predictor of students' academic performance in Physics. The finding agrees with the findings of Igboke (2004), Ma (2007), Koley (2010), Kolawole and Popoola (2011) and others who also found that there is no significant effect of gender on academic achievement of students in Physics and concluded that how effective a teaching method would be is not determined by the gender of the students. The finding, however, was at variance with the findings of Esan (2002), Ariyo (2006), Onah & Ugwu (2010) and Ogunleye & Adepoju (2011), who in their separate studies reported that gender is a major factor that influenced students' academic performance in science (particularly, Physics).

6. Conclusion

Based on the findings of this study, it can be concluded that Advance Organizers teaching approach is more potent in improving students' academic achievement in Physics in secondary schools than the conventional method in vogue in the nation. It can also be concluded that the effect of teaching approach on secondary school Physics

was also found not to vary with gender of students. This simply implies that performance of students taught using different teaching approaches is not in any manner affected by their gender.

7. Recommendations

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

1. Since the hitherto commonly used conventional method of instruction in formal schools had been empirically discovered in this study to be less potent and less effective than Advance Organizers mode of teaching in improving secondary school students' academic achievement in Physics, the conventional method presently in use by Physics teachers should either be improved upon, modified or replaced with an activity-based teaching approach (as appropriate).
2. Physics teacher should be encouraged to adopt Advance Organizers teaching approach in order to: demystify Physics in its entirety; simplify the perceived abstract nature of Physics'-concepts for improved students' academic achievement in Physics for improved academic performance and subsequently create an environment where people would realize that Physics is neither an 'abstract' nor 'esoteric' subject that cannot be understood by diligent learners as many currently erroneously presume.

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Accept challenges, so that you may feel the exhilaration of victory.

~ George S. Patton