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Effects of advance organizer teaching strategy on students' academic performance in biology in senior secondary school in Ekiti state, Nigeria

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Abstract
The study investigated the effects of Advance Organizer teaching strategy on students' academic performance in Biology 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 80 SS II Biology students (this sample was divided into experimental and control groups in ration 1:1 i.e 40 in each group) from two Senior Secondary Schools in Ikole Local Government Area, Ekiti State. Three null hypotheses were formulated and tested at 0.05 level of significance. The instrument for this study was Biology Achievement Test (BAT) 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 performances of students in experimental and control groups involved in the study at pretest. 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 strategy significantly influenced students' academic performance in Biology in senior secondary school. The implications of the results on students' academic performance in Biology are discussed. Based on the findings of the study, conclusion and recommendations were made.

Keywords: Biology, Biology students, Advance Organizer, Advance Organizer instructional package

1. Introduction

The teaching- learning process is as old as human being on the earth. It has been carried out by human beings and even by animals, to teach their young ones for successful adjustment to existing conditions in their environments.

Biology is a natural science subject consisting of contents from microscopic organisms to the biosphere general, encompassing the earth's surface and all living things (Okwo, 2004) [19]. Considering its characteristics and importance, Biology is a standard subject of instruction at all levels of our educational system, from primary to tertiary levels. It is one of the core subjects at Secondary School Certificate Examination (SSCE) whose study is very relevant to man's successful living (Akindele, 2009) [1].

Araoye (2009) [2] opined that, exposure to Biology education offers the learners a wide range of relevance to all aspects of life. Most of the students in the senior secondary schools in Nigeria opt for Biology in their senior secondary schools. Biology is quite popular at all levels of Nigerian education. It also has a large students' enrolment than any other science subject especially at the tertiary levels of the Nigerian education (Ofoegbu, 2003) [18]. In spite of the importance of Biology, it is pertinent to note that most students still see and learn Biology as an abstract subject. In particular, reports on WAEC results of Senior School Certificate Examination in Ekiti State over the years often revealed low performance of students in biology. A fluctuation trend was recorded in the performance of students in biology in the past six years (Between 2008, 2013) in May/June WASSCE (Table 1).

Table 1: Summary of trends of performance in Biology in the West African Senior Secondary School Certificate Examination, Ekiti State (Between 2008, 2013)

Year	No. Registered			A1 To C6				D7 To E8				Failure			
	M	F	Total	M	F	Total	%	M	F	Total	%	M	F	Total	%
2008	6627	6217	12844	1376	1395	2771	21.57	2065	1956	4021	31.30	3186	2866	6052	47.10
2009	6490	5855	12345	2430	1421	3851	31.20	1829	1788	4144	33.60	2210	1934	4350	35.20
2010	7726	6862	14588	4280	3412	7692	52.70	3520	3241	3762	25.80	2042	1720	3134	21.50
2011	8883	8249	17132	3889	3564	7453	42.50	3327	3417	6126	35.80	3264	2862	3553	20.70
2012	3358	3317	11527	919	1542	2461	21.35	1664	1691	4175	36.20	1459	1432	4891	42.40
2013	3647	3692	7339	175	210	385	5.25	2272	2364	4636	63.17	1145	1173	2318	31.60

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

A look at table 1 revealed that: in 2008, out of 12,844 candidates examined for Biology in MAY/JUNE WASSCE, only 2,771 (21.57%) scored A1 to C6 grade, 4,021 (31.30%) got pass and 6,052 (47.10%) candidates failed. In 2009, 12,345 candidates were examined for Biology, only 3,851(31.20%) recorded A1 to C6 grade, 4,144 (33.60%) scored pass and 4350 (35.20%) failed. Also, in 2010, out of 14,588 candidates that were examined for Biology, only 7,692 (52.70%) had A1 to C6 grade, 3,762 (25.80%) scored pass and 3,134 (21.50%) failed. In 2011, out of 17,132 candidates that were examined for

Biology, only 7453 (42.50%) had A1 to C6 grade, 6,126 (35.80%) scored pass and 3553 (20.70%) failed. In 2012, 11,527candidates were examined, 2461 (21.35%) recorded A1 to C6 grade, 4,175 (36.20%) scored pass and 4891 (42.40%) failed. Finally, in 2013, 7,339candidates were examined, 385 (5.25%) recorded A1 to C6 grade, 4,636 (63.17%) scored pass and 2318 (31.60%) failed.

The analysis further revealed that not very many of the candidates had credit pass in Biology over the period of observation. In addition, over 40% 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 Biology based courses in the tertiary institutions. This situation is disturbing and not in the best interest of the science and technological growth and development of the country.

This poor result calls for serious concern and this concern has been expressed by parents, teachers, employers of labour and the entire society. Several researchers have also pointed out different reasons for students' poor performance, some of which are due to the abstractness of certain aspects of Biology, lack of understanding on the students' part of certain biological concepts such as ecology (Nzelum, 2010).

According to Ausubel (1960) [3] 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) [5]. 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) [7] 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.

In the same way, Hudson and Fred (2009) [13] cited Novak (1980) 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) [7]. All the advance organizers were presented to learners before actual classroom instruction took place.

According to Mayer (1979) [17], 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, Reid, 2003) [9, 23, 22]. 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) [12]. Esan (2002) [12] 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) [21] 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) [20] observed that there is gender inequality in science, technology and mathematics.

Conversely, Igboke (2004) [14] 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) [10] 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) [15] in their study maintained that academic achievement is free of gender influence.

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

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 academic performance mean scores of students in experimental and control groups before treatment.
2. There is no significant difference in the academic performance mean scores of students in experimental and control groups after treatment.
3. There is no significant difference in the academic performance 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 80 Senior Secondary Two (SSII) Biology students (this sample was divided into the experimental and control groups in ratio 1:1 i.e. 40 in each group), selected through purposive and stratified random sampling techniques from two Senior Secondary

Schools in Ikole Local Government Area, Ekiti State.
The instrument used to collect relevant data from the subjects was Biology Achievement Test (BAT). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.81.
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 academic performance mean scores of students in experimental and control groups before treatment.

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

Group	N	$\overline{X}$	SD	df	t_{cal}	t_{tab}	Result
Experimental	40	5.19	6.93	78	0.165	1.68	NS
Control	40	5.45	7.32				

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} = 0.165) 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 academic performance mean scores of students in experimental and control groups before treatment was accepted.

Hypothesis 2

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

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

Group	N	$\overline{X}$	SD	df	t_{cal}	t_{tab}	Result
Experimental	40	12.34	7.89	78	2.708	1.68	*
Control	40	8.54	4.76				

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} = 2.708) 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 group's 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 academic performance 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 strategy to teach the experimental group.

Hypothesis 3

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

Table 4: Summary of ANCOVA analysis on the academic performance 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	843.237[a]	3	261.326				
Covariate (pretest)	65.522	1	65.522	38.42	2.42	0.000	
Gender	.734	1	.734	2.84	3.20	0.201	NS
Group	582.322	1	582.322	0 .42	3.20	0.732	*
Gender *Group	36.423	1	36.423	76.64	3.20	0.000	NS
Error	366.776	44	7.228	0.40	3.20	0.320	
Corrected Total	8462.842	79					
Total	28669.000	80					

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} = 0.42 < 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} = 0.40 < 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 strategy applied. In other words, gender of students has no significant influence on either the effectiveness (or otherwise) of the method of instruction applied.

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 Biology teachers in the nation, which might not have been potent enough to help students in solving their learning problem in Biology.

Another major finding of this study was that the academic performance means scores of students in experimental and control groups were statistically different after the treatment. By implication, therefore, the Advance Organizers teaching strategy was more effective in improving students' performance in Biology than the conventional mode of teaching. This finding is consistent with that of Hudson and Fred (2009) [13] 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 Biology 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 Biology 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 Biology. The finding agrees with the findings of Igboke (2004) [14], Ma (2007), Coley (2010) [10], Kolawole and Popoola (2011) [15] and others who also found that there is no significant effect of gender on academic achievement of students in Biology 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) [12], Ariyo (2006), Onah & Ugwu (2010) [21] and Ogunleye & Adepoju (2011) [20], who in their separate studies reported that gender is a major factor that influenced students' academic performance in science (particularly, Biology).

Conclusion

Based on the findings of this study, it can be concluded that Advance Organizers teaching strategy is more potent in improving students' academic performance in Biology in secondary schools than the conventional method in vogue in the nation. It can also be concluded that the effect of teaching strategy on secondary school Biology was also found not to vary with gender of students. This simply implies that performance of students taught using different teaching strategy is not in any manner affected by their gender.

Recommendations

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

- 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 Biology, the conventional method presently in use by Biology teachers should ether be improved upon, modified or replaced with an activity- based teaching strategy (as appropriate).
- Biology teacher should be encouraged to adopt Advance Organizers teaching strategy in the teaching of Biology to encourage and stimulate the students' interest in Biology.

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