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Efficacy of Advance Organizer Strategy on Students' Achievement and Retention in Secondary School Physics in Kafanchan, Jema'a Local Government Area, Kaduna State, Nigeria

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Abstract

The paper focused on the efficacy of advance organizer strategy on students' achievement and retention in secondary school physics in Kafanchan, Jema'a local government area, Kaduna state, Nigeria. Quasi-experimental design was employed to guide the study. The population consisted of 1720 senior secondary two students who offered physics in all public secondary schools in the study area. A total of 40 students in two intact classes, one class from each of the two sampled schools were used as sample. Four research questions with corresponding hypotheses were raised and formulated. The Physics Achievement Test was used to gather data. Mean and standard deviation were used to answer the research questions while Analysis of Covariance was used to test the hypotheses. One of the findings revealed that advance organizer strategy significantly affects students' achievement and retention. One recommendation proffered is that secondary school teachers should adopt the use of advance organizer strategy in teaching Physics to foster students' achievement and retention.

Keywords: *Advance organizer strategy, Students' Achievement, Students' Gender, Students' Retention, Physics*

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Background to the Study

Physics is a tool for the scientific, technological, economical and industrial development and growth of all nations. Physics generate the fundamental knowledge needed for any technological advancement of any nation. Physics is the study of matter in relation to energy playing the important role of development of science and technology and paramount to the achievement of career choice (Abot, 2017). The importance of Physics to national development cannot be relegated to the background. Josiah (2025) opined that "a decline in the comprehension of Physics concepts which underpins the understanding of other fields will result to a gradual decline in the understanding of such fields as agriculture, engineering, medicine, telecommunication and pharmacy."

Physics generates fundamental knowledge that drives the economic engines of the world. Most of the raw material used in industries and almost all the energy resources are derived directly or indirectly from the knowledge of Physics. From this knowledge therefore, all electronic digital computers, the transistors, the lasers, and even the World Wide Web were invented. In medicine, X-rays, radio isotopes, nuclear magnet resonance imaging, among many others gadgets or equipment were made available in this field. Ryder (2019) defined achievement as the accomplishment of a desired goal. It is the success by students attributed to mastery of a subject matter or concepts learned.

Achievement is a quantitative indication we have of the positive result behavior accruing from the study of science. It is also the extent to which a person has achieved something or acquired certain information or training. Previous studies such as those by Ibe (2014), Achor and Gbadamosi (2020), Josiah and Pwol (2020) have shown that there is a relationship between teaching method/strategy and students' achievement. Some of the low achievement in Physics among students is due to factors such as inexperienced teachers and teachers' use of inappropriate teaching strategies such as the conventional lecture method in teaching Physics. Lecture method entails one-way flow of communication from the teacher to the students. This strategy is teacher-centered where by most of the talking is carried out by the teacher while the students remain passive listeners, mostly taking notes; thereby denying the students the opportunity to develop the required manipulative skills needed in learning Physics.

Students' retention is the ability to remember values, attitudes, skills, knowledge amongst others, acquired by students in the process of learning. Ojobola and Ogunjobi (2021) opined that retention is the persistence to perform learned behaviours and is the preservative factor of the mind. Studies such as those of Achor and Gbadamosi (2020), Josiah and Pwol (2020) showed that student-centred methods of teaching enhance their retention. Appropriate choice of teaching strategy is a factor that enhances students' achievement and retention. These variables are related in a way that when students have good retentive memory, they can achieve significantly; conversely, when students achieve, it means that they have retained what they have learned. Advance organizer refers to as information that is presented prior to learning that is used by learners to organize and interpret new incoming information (Mayer, 2013). An advance organizer is a type of teaching strategy that is utilized to better ensure that information presented to students is understood. Ushie and Akpan (2019)) viewed an

advance organizer as a way of activating and building schema in students before such students learn new concepts. A teacher using the advance organizer strategy introduces the concept to be taught and illustrates the relationship between that concept and the prior knowledge of the students. An effective advance organizer links the unknown to the known. Students' gender may influence achievement and retention in Physics.

Gender is a social and cultural construct that describes roles assigned to male and female individuals. In education, male students may sometimes be considered as better achievers than their female counterparts, especially in science subjects. Josiah and Pwol (2020) in their study, however, found no significant difference between the achievement of male and female students in Physics. On retention based on gender, the studies of Achor and Gbadamosi (2020), Josiah and Pwol (2020) found out no significant difference between the retention of Physics concepts by both male and female students when exposed to student-centred instructional strategies. There is, therefore, the need to investigate whether advance organizer strategy has effect on SS II students' achievement and retention in Physics in Kafanchan, Jema'a local government area, Kaduna State, Nigeria and whether such students' achievement and retention depends on gender.

Statement of the Problem

The problem of this study is the poor achievement of students in physics in Kafanchan, Jema'a local government area, Kaduna State, Nigeria over the past years. Table 1 attests to the aforementioned problem.

Table 1: Analysis of Results of WASSCE and NECO SSCE from 2019-2023 for Schools in Kafanchan, Jema'a Local Government Area, Kaduna State, Nigeria

YEAR		WAEC	NECO
2019	No of students registered	1780	1040
	No of students failed	870	521
	% failure	48.8	50.1
2020	No of students registered	2010	1573
	No of students failed	1093	530
	% failure	54.4	33.7
2021	No of students registered	1942	1410
	No of students failed	1023	621
	% failure	52.7	44.1
2022	No of students registered	1814	1327
	No of students failed	880	641
	% failure	48.5	48.3
2023	No of students registered	1911	1092
	No of students failed	870	422
	% failure	45.5	38.7

Source: National Resource Center, Kaduna State (2020).

Many factors could be attributed to the manifestation of this problem, which include lack of frequent practice by students, poor background in mathematics, poor classroom management, and teaching methods used in physics as posited by Josiah and Larina (2015), Josiah and Okonkwo (2020), Sule and Mankilik (2015). If this problem persists, many students may not be able to gain admission into tertiary institutions to study physics or Physics-related courses. This study, therefore, sought to investigate the effect of advance organizer strategy on senior secondary two students' achievement and retention in Physics in Kafanchan, Kaduna State, Nigeria; whether the strategy would enhance students' achievement and their retention in Physics or not.

Purpose of the Study

The following objectives guided the study:

1. Determine senior secondary two students' achievement in secondary school Physics before and after exposure to advance organizer strategy (AOS).
2. Find out the achievement of male and female students in secondary school Physics before and after exposure to AOS.
3. Determine the effect of AOS on students' retention in secondary school Physics when exposed to AOS.
4. Find out the effect of AOS on male and female students' retention in secondary school Physics when exposed to AOS.

Research Questions

Four research questions were raised from the specific objectives and answered. These were:

1. What is the pre-test and post-test mean achievement scores of senior secondary two (SS II) students in Physics when exposed to advance organizer strategy (AOS) and conventional lecture method (CLM)?
2. What is the pre-test and post-test mean achievement scores of SS II male and female students in Physics when exposed to AOS?
3. What are the mean retention scores of SS II students in Physics when exposed to AOS and CLM?
4. What are the mean retention scores of SS II male and female students in Physics when exposed to AOS?

Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 level of significance:

1. There is no significant difference between the achievement of senior secondary two (SS II) students in Physics when exposed to advance organizer strategy (AOS) and conventional lecture method (CLM).
2. There is no significant difference between the achievement of SS II male and female students in Physics when exposed to AOS.
3. There is no significance difference between SS II students' retention in Physics when exposed to AOS and CLM.
4. There is no significant difference in the retention of SS II male and female students in Physics when exposed to AOS.

Methodology

The design for the study was quasi-experimental. Specifically, the study applied pre-test, post-test non-equivalent control group design. The population of the study included all public senior secondary schools in Kafanchan, Jema'a local government area, Kaduna State, Nigeria offering Physics with a total of 1720 students. A total of 40 SS II students in two intact classes, one class each from the two sampled co-educational senior secondary schools were used as sample for the study. Twenty students each were in the experimental and control groups. The instrument used to gather data for the study was the Physics Achievement Test (PAT) which consisted of 50 multiple-choice items developed by the researchers based on the topics 'Heat' and 'Light energy' in Physics. The PAT was validated by three experts, two from the University of Jos and one from Government Secondary School, Kafanchan, Jema'a local government area, Kaduna State, Nigeria.

Pre-test was administered to both the experimental and control groups the week before the treatment. This was done to find out the cognitive entry behaviour of the students. Therafter, treatment was meted out to the experimental group for four weeks. The Physics teachers in sampled schools, who were employed as research assistants, assisted in teaching the topics heat and light energy, which are Physics topics in the SS II curriculum. The students in the experimental group were taught using the advance organizer strategy. During the treatment, the students in the control group were merely taught the same topics but with a placebo (conventional lecture method). A week after the treatment, post-test was administered to both the experimental and control groups. This was done to ascertain the effect of the advance organizer strategy on the achievement of students in Physics. Three weeks after the administration of the post-test by the researchers, a post post-test was administered to the students in the two groups so as to determine their retention in Physics. The descriptive statistics (mean and standard deviation) were used to answer all the research questions while Analysis of covariance (ANCOVA), an inferential statistic, was used to test all hypotheses at 0.05 level of significance.

Results

Research Question One

What are the pre-test and post-test mean achievement scores of senior secondary two (SS II) students in Physics when exposed to advance organizer strategy (AOS) and conventional lecture method (CLM)?

Table 2: Summary of Pre-test and Post-test Mean Achievement Scores of SS II Students in Physics when exposed to Advance Organizer Strategy and Conventional Lecture Method

Group		Pre-test		Post-test			
	N	Mean	SD	Mean	SD	Mean Gain	Mean Gain Difference
Experimental	20	54.10	8.93	83.00	6.82	28.90	19.35
Control	20	34.11	11.74	43.60	19.43	9.55	

The result on table 2 shows that the achievement mean scores before the treatment in the experimental group was found to have a mean score of 54.10 and standard deviation of 8.93 while after the treatment, the mean score was found to be 83.00 and standard deviation of 6.82 with mean score difference of 28.90. the achievement mean score and standard deviation before the treatment in the control group was found to be 34.11 and 11.74 respectively while after the treatment, the mean score and standard deviation in the control group was found to be 43.60 and 19.43 respectively with mean score difference of 9.55. The mean gain difference between the experimental and control group is 19.35 in favour of the experimental group. This implies that the advance organizer strategy had a positive effect on students' achievement in Physics.

Research Question Two

What is the pre-test and post-test mean achievement scores of SS II male and female students in Physics when exposed to AOS?

Table 3: Summary of Pre-test and Post-test Mean Achievement Scores of SS II Male and Female Students in Physics when exposed to Advance Organizer Strategy

Group		Pre-test		Post-test			
	N	Mean	SD	Mean	SD	Mean Gain	Mean Gain Difference
Male	12	55.17	4.78	86.17	4.78	31.00	5.27
Female	8	52.50	6.66	78.23	6.88	25.73	

The result in table 3 shows that for post-test, male students obtained a higher mean score of 86.17 and standard deviation of 4.78 while the female students had a lower mean score of 78.23 and standard deviation of 6.88. This gives a mean gain difference of 5.27in favour of the male students. Comparing the mean gain of male and female students, the male students had a high mean gain of 31.00 and the female students had a lower score mean gain of 25.73. This shows that the male students had a higher achievement mean than the female students after exposure to advance organizer strategy.

Research Question Three

What are the mean retention scores of SS II students in Physics when exposed to AOS and CLM?

Table 4: Summary of Mean Retention Scores of SS II Students in Physics when exposed to Advance Organizer Strategy and Conventional Lecture Method

Group		Post-test		Post Post-test			
	N	Mean	SD	Mean	SD	Mean Gain	Mean Gain Difference
Experimental	20	83.00	6.82	78.00	5.63	-5.00	14.43
Control	20	43.60	19.43	24.46	19.43	-19.14	

Table 4 shows that students in the experimental group obtained retention mean gain of -5.00 while that of the control group was -19.14. The mean gain difference of 14.43 indicates that the students who were exposed to advance organizer strategy retained higher than those not exposed to treatment.

Research Question Four

What are the mean retention scores of SS II male and female students in Physics when exposed to AOS?

Table 5: Summary of Post-test and Post Post-test Mean Retention Scores of SS II Male and Female Students in Physics when exposed to Advance Organizer Strategy

Group		Post-test		Post Post-test			
	N	Mean	SD	Mean	SD	Mean Gain	Mean Gain Difference
Male	12	86.17	4.78	83.33	6.89	-2.84	-0.36
Female	8	78.23	6.88	75.75	11.53	-2.48	

The result in table 5 shows the mean scores of male and female students' retentions in Physics after treatment with the advance organizer strategy. The male students had mean score of 83.33 and standard deviation of 6.89 while the female students had a score of 75.75 and a standard deviation of 11.53. The mean gain difference was -0.36. This shows that the male students retained more than their female counterparts after exposure to advance organizer strategy.

Hypotheses One

There is no significant difference between the achievement of senior secondary two (SS II) students in Physics when exposed to advance organizer strategy (AOS) and conventional lecture method (CLM).

Table 6: ANCOVA Summary Result on the Difference in the Achievement of SS II Students when exposed to Advance Organizer Strategy and Conventional Lecture Method

Source	Type III Sum of Squares	Df	Mean Square	F	p-value
Corrected model	18.019	14	18.019	.501	.488
Intercept	555.606	1	.555.606	15.458	.001
Groups	18.019	1	18.019	.501	.488
Error	646.981	5	35.943		
Total	**2870.000**	**20**			
Corrected Total	**665.000**	**19**			

Table 6 shows the analysis of covariance (ANCOVA) used to determine the difference in achievement in senior secondary Physics on the experimental and control groups. The result yielded $F(0.51) = 0.488$, $P<0.05$, since the P-value of 0.488 is higher than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant difference between the achievements of students taught Physics using advance organizer strategy and those taught using conventional lecture method. Therefore, this difference in achievement in Physics was in favour of the experimental group who were exposed to treatment.

Hypotheses Two

There is no significant difference between the achievement of SS II male and female students in Physics when exposed to AOS.

Table 7: ANCOVA Summary Result on the Difference in the Achievement of SS II Male and Female Students in Physics when exposed to Advance Organizer Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	p-value
Corrected model	300.833[a]	1	300.833	9.286	.007
Intercept	129757.633	1	129757.633	6.678	.000
Gender	300.833	1	300.833	.415	.007
Error	583.167	18	32.398		
Total	**138664.00**	**20**			
Corrected Total	**884.000**	**19**			

Table 7 reveals the analysis of covariance (ANCOVA) used to determine if a significant difference exists between the achievement of male and female students in Physics after using advance organizer strategy when the moderating effect of the post-test is controlled. The result yielded $F(9.286) = 0.07$, $P<0.05$. Since the P-value of 0.07 is greater than the 0.05 level of significance, the null hypothesis was accepted; this implies that there was no significance

difference between the achievement of male and female students in Physics when exposed to advance organizer strategy.

Hypotheses Three
There is no significance difference between SS II students' retention in Physics when exposed to AOS and CLM.

Table 8: ANCOVA Summary Result on the Difference in the Retention of SS II Students when exposed to Advance Organizer Strategy and Conventional Lecture Method

Source	Type III Sum of Squares	Df	Mean Square	F	p-value
Corrected Model	706.991	14	706.991	71.891	.000
Intercept	265.560	1	265.560	27.005	.000
Groups	706.991	1	706.991	71.894	.000
Error	138664.000	18	9.834		
Total		**20**			
Corrected Total	**978.200**	**19**			

Table 8 shows the result yielded $F(71.894) = 0.000$, $P<0.05$. Since the P-value is less than 0.05 level of significance, the null hypothesis is rejected, which shows that there is a significant difference between students' retention in Physics when exposed to advance organizer strategy and conventional lecture method. The difference was in favour of the experimental group.

Hypotheses Four
There is no significant difference in the retention of SS II male and female students in Physics when exposed to AOS.

Table 9: ANCOVA Summary Result on the Difference in the Retention of SS II Male and Female Students in Physics when exposed to Advance Organizer Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	p-value
Corrected Model	.766	1	.766	3.417	.081
Intercept	2.527	1	2.527	2.527	.004
Gender	.766	4	766	3.417	.081
Error	4.034	18	224		
Total	**44.000**	**20**			
Corrected Total	**978.200**	**19**			

Table 9 shows the result of the ANCOVA used to determine any significant difference between the retention of senior secondary two students in Physics based on gender. The result yielded $F(3.417) = 0.081$, $P<0.05$. Since the P-value of 0.081 is greater than the 0.05 level of significance, the null hypothesis failed to be rejected; this indicates that there is no significant difference between gender retention in Physics when exposed to advance organizer strategy.

Discussion

The finding from Table 2 shows that the mean gain difference between the experimental and control groups is 19.35, implying that the advance organizer strategy had a positive effect on students' achievement in Physics. Table 6 shows that there is a significant difference between the achievement of students taught Physics using advance organizer strategy and those taught using conventional lecture method. This finding agrees with that of Josiah and Pwol (2020) who found out that students' achievement depends on the method of teaching used by the teacher in the classroom.

The findings from Table 3 shows that male students had a higher achievement mean than the female students after exposure to advance organizer strategy. However, Table 7 reveals that there was no significant difference between the achievement of male and female students in Physics after being exposed to advance organizer strategy. This finding concurs with that of Josiah and Pwol (2020). From Table 4 the students who were exposed to advance organizer strategy retained higher than those not exposed to the treatment. Table 8 further reveals that there was a significant difference between students' retention in Physics when exposed to advance organizer strategy and conventional lecture method. The difference being in favour of the students in the experimental group. The result in Table 5 shows the mean scores of male and female students' retentions in Physics after treatment (advance organizer strategy) was administered. The male students retained more than their female counterparts after exposure to advance organizer strategy. However, Table 9 shows that there is no significant difference between gender retention in Physics when exposed to advance organizer strategy. This finding is in concordance with those of Achor and Gbadamosi (2020), Josiah and Pwol (2020).

Conclusion

The focus of this paper was the effect of advance organizer strategy on senior secondary two students' achievement and retention in Physics in Kafanchan, Kaduna State, Nigeria. The findings from the study revealed that students exposed to AOS have higher achievement level mean score and greater retention mean gain compared to those exposed to conventional teaching strategies of instruction.

Recommendations

The following recommendations were made based on the findings of the study:

1. AOS should be encouraged in schools as instructional strategy in the teaching and learning Physics.
2. Ministry of Education should provide a capacity building for teachers through training and retraining for effective implementation of AOS in senior secondary schools.

3. Curriculum planners should include AOS as the basis for planning Physics curriculum.
4. Authors of Physics textbooks should write their books to be student-centred and based on AOS.

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