European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.1147019 Volume 3 | Issue 12 | 2017

EFFECTIVENESS OF EXPERIENTIAL TEACHING STRATEGY ON STUDENTS' ACHIEVEMENT AND SCORING LEVELS IN SENIOR SECONDARY SCHOOL PHYSICS

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Abstract:
This study investigated the effectiveness of Experiential Teaching Strategy (ETS) on students' achievement and scoring levels in senior secondary school physics. The study adopted the pretest, posttest, non-randomized control group quasi-experimental design. Simple random sampling technique was used to select two schools used for the study. Two research questions were raised to guide the study. Also, two null hypothesis were formulated and tested for acceptance or rejection at 0.05 significance level. The sample used for the study was ninety five (95) senior secondary two (SS2) physics students randomly selected from the two schools in Akure, Ondo State, Nigeria. The study made use of Physics Achievement Test (PAT) with internal consistency of 0.82 using Kuder Richardson Formular 21. The data collected were analysed using descriptive statistics, t-test and Analysis of Covariance (ANCOVA). Finding of the study showed that Experiential Teaching Strategy (ETS) had significant effect on physics student's achievement (t-cal = 3.572, p = 0.000) and scoring level ($F_{(2, 38)}$ = 16.025 at p = 0.000) in the concepts of Optics in physics. The findings also showed that the high scorers benefitted most from the treatment followed by the average and low scoring students. The study concluded that teachers should be encouraged to adopt the use of Experiential Teaching Strategy in teaching the concept of Optics in physics in order to improve student's achievement in the subject.

Keywords: experiential teaching strategy, achievement, scoring levels

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1. Introduction

Physics is one of the basic science subjects required for the development of any nation. It is an important aspect of science that has contributed greatly to the development of any nation. Omosewo (2009) defined physics as a branch of science that deals with energy and matter and their interactions. Advancement in physics has really contributed in great deal to areas such as medicine, Information Communication and Technology and also Crime control to mention a few. The development of satellites and space ships has also added a boost to the discoveries physicist have achieved. The knowledge of physics education has also made the gathering, storage and availability of information which was once difficult in the world of computer technology easy.

The senior secondary school physics seeks to ensure that students are well exposed to basic concepts, creative and development of process skill and attitudes, and the appreciation of the relevance of physics in the society. The specific objectives to be achieved by the senior secondary school physics curriculum as stated in the Nigerian Educational Research and Development Council (FRN, 2013) include to:

1. provide basic literacy of physics for functional living in the society;
2. acquire basic concepts and principles of physics as preparation for further studies;
3. acquire essential scientific skills and attitudes as preparation for technological applications of physics; and
4. stimulate and enhance creativity.

The structure of the senior secondary school physics is spiral in nature, and the entire curriculum is built on two major concepts: Motion and Energy. These two concepts were further broken down into six themes which include:

1. Interaction of matter, space and time;
2. Conservation principles;
3. Wave- motion without material transfer;
4. Fields at rest and in motion;
5. Energy quantisation and duality of matter; and
6. Physics in technology.

Optics is one of the topics taught at the senior secondary school two (SS2) level. It is a topic that is discussed under theme 3 of the senior secondary physics curriculum. The choice of optics is due to the fact that it is one of the difficult concepts as reported by the West African Examinations Council Physics chief examiners report (WAEC, 2012)

Table 1 summarizes the enrolment and performance of students in the West African Senior School Certificate Examination (WASSCE) in the past five years.

Table 1: Candidates' Enrolment and Performance in May/June Senior School Certificate Examinations in Biology, Chemistry and Physics in Nigeria: 2012-2016

Year	Biology			Chemistry			Physics		
	Total sat	Credit passed (A1-C6)	% Pass	Total sat	Credit passed (A1-C6)	% pass	Total sat	Credit passed (A1-C6)	% Pass
2012	1,646,150	587,044	35.66	627,302	270,570	43.13	624,658	429,415	68.74
2013	1,648,363	852717	51.73	639,296	462,517	72.34	637,023	297,988	46.77
2014	1,365,384	766,971	56.17	636,268	397,649	62.49	635,729	386,270	60.76
2015	1,181,535	627,770	53.13	658,650	458,547	69.61	657,850	391,114	59.45
2016	1,087,683	802,483	73.77	667,131	546,733	81.95	666,830	508,367	76.23

Source: Statistics Section WAEC Office Yaba Lagos 2016

Table 1 shows that despite the relative good performance of students in Physics examinations, there is still the need for improvement especially when the performance of students in physics is compared with the performance of students in chemistry. If Nigeria is to develop scientifically, there is the need to take the teaching of the science subjects, especially physics seriously.

Experiential teaching emphasizes the role of hands-on, personal experience in constructing knowledge. Experiential teaching strategies are particularly useful for skill development because they provide learners with an opportunity to practice their skills and reflect on the experience. Thus, experiential teaching methods are well-suited for working with teachers as teaching requires automating teaching skills, or the ability to engage in practiced behaviours with minimal cognitive processing. In experiential strategy, once a potential activity has been identified, it has to be framed properly to be fully experiential. Experiential strategy begins by thinking of problems to be solved rather than information to be remembered (Wurdinger, 2005).

A problem or question must be intertwined with activities, projects, and field-based experiences. This will help ensure that a combination of thinking and doing occurs in the learning process (Wurdinger, 2005). Hence, experiential education first immerses learners in an experience and then encourages reflection about the experience to develop new skills, new attitudes, or new ways of thinking. It also stimulates the learners so that they can learn well. Experiential learning can occur either by taking a step by step process that distinctly leads to learning something or is derived from the real world environment (Wurdinger & Carlson, 2010).

1.1 Statement of the Problem

The performance of Nigerian senior secondary school students in physics have not been excellent in the last five years. Studies carried out by researchers have attributed this situation to numerous factors, such as poor attitude, poor motivation, as well as poorly sourced teaching and learning environment and poor teaching methods (Crouch, Watkins, Fagen & Mazur, 2007; Ogunleye, 2000; Ogunleye and Babajide, 2011; Harry, 2011 and Erinosho, 2013).

With the decline experienced in the enrolment of students in Physics and the relatively good performance of Physics students in the subject, there is still room for improvement in the subject. Foreign researchers such as Roberts & Harlin (2007), Akella (2010), Wurdinger & Carlson, (2009) have worked on the effect of experiential teaching strategy on students' performance in Physics. Their works have concentrated mostly on students' motivation and achievement when experiential teaching strategy was used. Finding from the reviewed literature showed that little or no study have been carried out on the effect of experiential teaching strategies in Nigeria. Despite all the researches that have been carried out through the use of carefully planned instructional strategies and models to better the status of physics teaching and learning, all these strategies gave a little improvement over the conventional expository method, which is been used in the secondary schools.

However, there seems to be a neglect of some other types of instructional strategies like experiential teaching strategies and how it affects students' achievement and scoring levels in physics. Hence, this study sought to determine the effects of experiential teaching strategy on students' achievement and scoring levels in Physics.

1.2 Purpose of the Study

The study examined the effectiveness of experiential teaching strategy on student achievement and scoring levels in senior secondary school physics. Specifically, the study determined the;

1. effect of experiential teaching strategy on student's achievement in physics
2. influence of scoring levels on student's achievement in physics when taught using experiential teaching strategy.

1.3 Research Questions

1. What is the effect of experiential teaching strategy on student's achievement in physics?
2. What is the influence of scoring levels on student's achievement in physics when taught using experiential teaching strategy?

1.4 Research Hypothesis

HO_1: There is no significant difference in the achievement of senior school student's taught physics using experiential teaching strategy and those taught using conventional teaching strategy.

HO_2: There is no significant influence among the achievement of low, average and high student's scoring levels when taught using experiential teaching strategy.

2. Research Method

The study adopted the pretest posttest, non-randomized control group quasi-experimental design. Simple random sampling technique was used to select two schools used for the study in Akure, Ondo State, Nigeria. The sample used for the study was ninety three (93) senior secondary two (SS2) physics students. The study made use of Physics Achievement Test (PAT) with internal consistency of 0.82 using Kuder-Richardson Formular 21.

One intact class was randomly selected from each school used for the study. One of the intact classes was taught the concept of optics using experiential teaching strategy while the other intact class was taught the concept of optics using the conventional teaching strategy. Students were divided into three scoring levels (high, average, low) based on the result obtained from the pretest administration of Physics Achievement Test (PAT).

Students who scores fell above the upper quartile (Q3) were classified as high scorers, those who scores fell below lower quartile (Q1) were classified as low scorers while those whose scores fell between the upper quartile (Q3) and lower quartile (Q1) were classified as average scorers. The teaching of the experimental and control groups lasted for six weeks. The pretest and posttest contained the same question except that it was reshuffled before administration in each case. The data collected were analysed using descriptive statistics and Analyses of Covariance was used to test the two null hypotheses.

4. Results

Research Question 1: What is the effect of experiential teaching strategy on student's achievement in physics?

Table 2: Mean Gain Scores of Students' Taught Using Experiential Teaching Strategy and Conventional Teaching Strategy

Group	Group Statistics	Pretest	Posttest	Mean Gain Score	Difference
Experiential Teaching Strategy	N	42	42		
	Mean	25.667	57.762	32.095	
	Std. Dev.	7.999	9.162		
					5.831
Control	N	53	53		
	Mean	24.415	50.679	26.264	
	Std. Dev.	9.506	9.930		

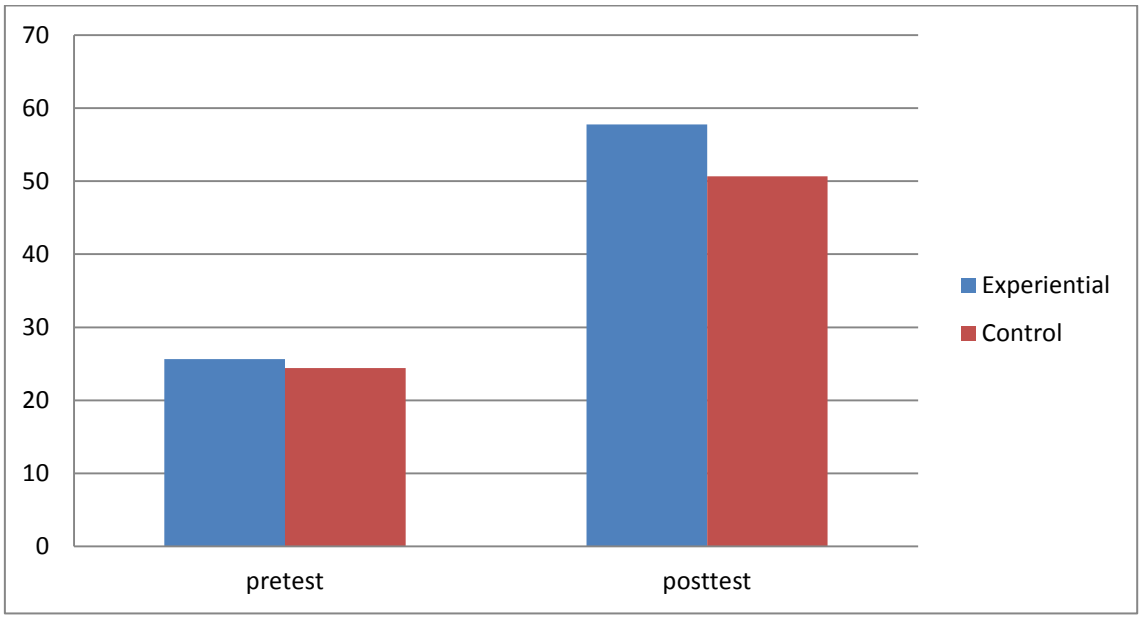

Figure 1: Bar Chart on Mean Scores of Pretest and Posttest of Students Taught Physics Using Experiential Teaching Strategy and Control Group

Table 2 shows the mean gain scores of students that participated in the physics achievement test. The mean gain score of students taught physics using experiential teaching strategy was 32.095 while the mean gain score of students in the control group was 26.264. The mean gain score of those taught using experiential teaching strategy was 5.831 higher than that of the control group.

Figure 1 shows the pretest and posttest mean score bar heights of the experimental group (Experiential Teaching Strategy) and the control group. The bar heights of the pretest mean core of the two groups are almost the same, hence, it implies that the two groups were equivalent before treatment. The bar heights of the posttest mean scores of the experimental group (Experiential Teaching Strategy) was higher that

the control group. Therefore, there was difference in the performance of the experimental and control groups in favour of the experimental group after treatment..

Research Hypothesis One: There is no significant difference in the achievement of senior school student's taught physics using experiential teaching strategy and those taught using conventional teaching strategy.

Table 3: Independent Samples t-test of the Students Taught Physics Using Experiential Teaching Strategy and those in the Control Group

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
									Lower	Upper
Pretest	Equal variances assumed	0.988	0.323	0.683	93	0.496	1.25157	1.83307	-2.38854	4.89168
	Equal variances not assumed			0.697	92.638	0.488	1.25157	1.79677	-2.31664	4.81978
Posttest	Equal variances assumed	1.037	0.311	3.572	93	0.001	7.08266	1.98302	3.14478	11.02054
	Equal variances not assumed			3.605	90.814	0.001	7.08266	1.96446	3.18038	10.98493

Table 3 shows the independent sample t-test for the pre-test scores and post-test scores. For the pre-test scores, the t-test value = 0.683, df = 93, p-value = 0.496. Since the p-value is greater than 0.05 level of significance, there is no significant difference between the achievement of student's before the treatment. This implies that the two groups were equivalent before the experiment.

For the post-test scores, t-test value = 3.572, degree of freedom = 93, and p-value = 0.001. Since the p-value is less than 0.05 level of significance, the mean of posttest scores of experiential group = 57.762 is significantly greater than the mean of posttest scores of control group = 50.679. Therefore, the null hypothesis was rejected. It is thus claimed that a significant difference existed in the achievement of senior school students taught physics using experiential teaching strategy and their counterpart in the control group.

This shows that the use of experiential teaching strategy had significantly improved the achievement of students in the experimental group.

Research Question 2: What is the influence of scoring levels on student's achievement in physics when taught using experiential teaching strategy?

Table 4: Mean Gain Scores of Low, Average and High Scoring Student's Performance Taught Using Experiential Teaching Strategy

Group	Group Statistics	Pretest	Posttest	Mean Gain Score	Difference
	N	5	5		
Low	Mean	17.200	43.600	26.400	
	Std. Dev.	1.789	2.608		
					6.193
	N	27	27		
Average	Mean	23.185	55.778	32.593	
	Std. Dev.	2.558	4.309		
					1.007
	N	10	10		
High	Mean	36.600	70.200	34.000	
	Std. Dev.	8.947	5.534		

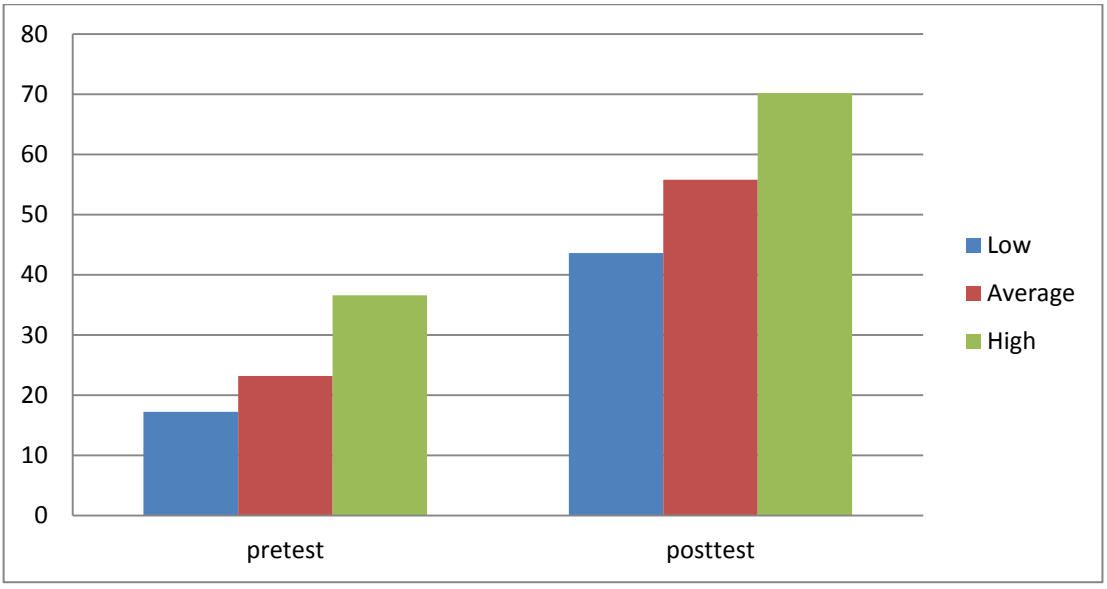

Figure 2: Bar Chart of the Mean Scores of Pretest and Posttest of Students Taught Physics Using Experiential Teaching Strategy and Control Group based on Scoring Levels

Table 4 shows the pretest and posttest mean scores of the low, average and high scoring students taught physics using experiential teaching strategy. The mean gain score of the low, average and high scoring students were 26.400, 32.593 and 34.000 respectively. The

high scoring students had the highest mean gain score followed by the average scoring students while the low scoring students had the least mean gain score.

Figure 2 shows the pretest and posttest mean score bar height of the students taught physics using experiential teaching strategy based on student's scoring levels. The bar height of the pretest mean score of the three groups are not equal, hence, it implies that the three groups were not equivalent before treatment. The bar heights of the posttest mean scores of the three groups were not also equal. This implies that there was a difference in the performance of students taught physics using experiential teaching strategy based on the low, average and high scoring students.

Research Hypothesis Two: There is no significant difference among the achievement of low, medium and high student's scoring levels when taught using experiential teaching strategy.

Table 5: Analysis of Covariance of Mean Gain Scores of Students Taught Physics Using Experiential Teaching Strategy Based on Scoring Levels

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3150.620[a]	3	1050.207	137.141	.000
Intercept	1838.521	1	1838.521	240.083	.000
Pretest	494.468	1	494.468	64.570	.000
Group	245.430	2	122.715	16.025	.000
Error	290.999	38	7.658		
Total	143572.000	42			
Corrected Total	3441.619	41			

a. R Squared = .915 (Adjusted R Squared = .909)

Table 5 shows the analysis of covariance table containing the source of variations, sum of squares, degree of freedom, mean squares, *F*-test values and corresponding p-values. From the table, $F_{(2, 38)} = 16.025$ at $p = 0.000$, since the p-value is less than 0.05 level of significance, the null hypothesis was rejected. Therefore, there was a significant difference among the achievement of high, average and low scoring students exposed to experiential teaching strategy. This implies that the use of experiential teaching strategy improved students' achievement in Physics irrespective of student's scoring level. The posttest mean scores of the three groups show that, the high scoring students with a mean of 70.200 benefitted most in the study, followed by the average scoring students with a mean score of 55.778 and the low scoring students benefitted the least with mean score of 43.600.

5. Discussion

The result of the study showed that there was statistically significant difference in the achievement of students taught optics using experiential teaching strategy compared with their counterparts in the control group . The mean gain scores of students were 32.095 and 26.264 for experiential teaching strategy and control group respectively. Experiential teaching strategy had the greater effect on the performance of students in the physics achievement test (PAT).

The result of this study indicated that experiential teaching strategy improved the achievement of student's in physics. This was in agreement with Holzer & Andruct (2000) and Bohn & Schmidt (2008) who found out that experiential teaching strategy permits students to assess their highest level of understanding and mastery of the area under discussion thus, assisting students to personalize their learning experiences.

The result of this study also indicated that there was statistically significant difference in the achievement of students taught physics using experiential teaching strategy based on their score levels. The mean gain score of low, average and high scoring students were 26.400, 32.593 and 34.000 respectively. The high scorers had the highest mean gain score followed by the average and low scorers respectively. This showed that the high scorers benefitted most followed by the medium and low scoring students when experiential teaching strategy was used.

This was in agreement with Adebayo (2006) who found out that treatment (Concept mapping) had positive effect on the three scoring levels (high, medium, low). The findings was also in agreement with Afolabi & Akinbobola (2009), and Omiola, Enuwa, Awoyemi & Bada (2012) who found out that treatment had positive effect on physics performance based on the three scoring levels.

6. Conclusion

Experiential teaching strategy had significant effect on students' achievement (p-value of 0.001 is less than 0.05 level of significance).The findings of this study revealed that the use of experiential teaching strategy in the teaching and learning process enhanced student's achievement in physics significantly. It can be concluded that experiential teaching strategy improved student's performance in physics.

Also, student's scoring levels in physics had significant effect on student's achievement when taught using experiential teaching strategies. It could be concluded that the three categories of scoring levels (low, average, high) differ in the manner they

benefitted from this study. Findings showed that $F_{(2, 38)} = 16.025$ at $p = 0.000$ is less than 0.05 level of significance,

7. Recommendations

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

1. Experiential teaching strategy is also an effective instructional strategy, therefore its use should be encouraged for teaching and learning physics at the senior secondary school level of education.
2. The professional bodies like National Teacher Institute (NTI), Nigerian Institute of Physics (NIP), Science Teachers Association of Nigeria (STAN) and Teachers Registration Council of Nigeria (TRCN) should organize seminars and workshops for teachers on how to use experiential teaching strategy for effective teaching and learning process.
3. Teacher's emphasis should shift from teacher-centered approach of teaching to a more activity-based learning strategy such as experiential teaching strategy. This is so because experiential teaching strategy improved the achievement of students in physics irrespective of students scoring levels in senior secondary school physics.
4. The Ministries of Education at both State and Federal levels should organize workshops for in-service teachers of physics on the use of experiential teaching strategy. This will help teachers to know how to use experiential teaching strategy in passing instruction to their students effectively.

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