



FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

5th INTERNATIONAL CONFERENCE

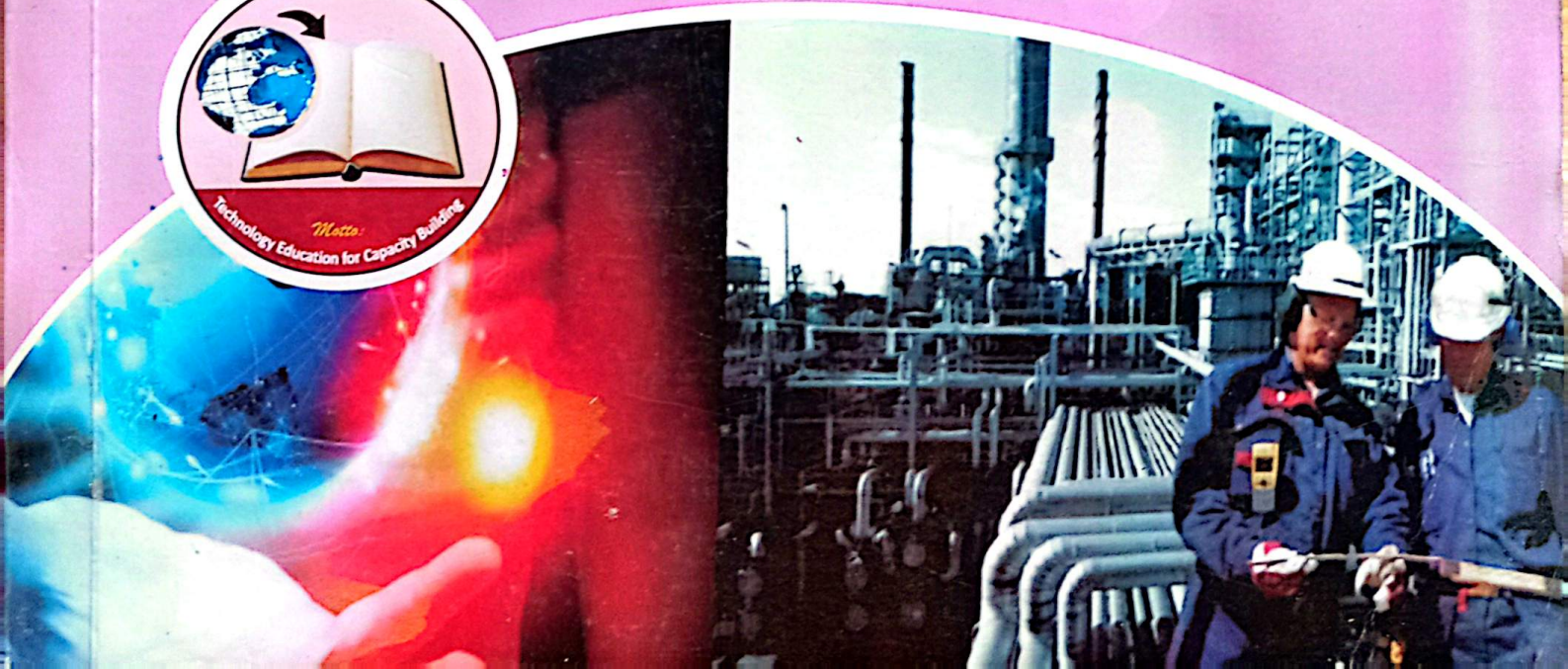
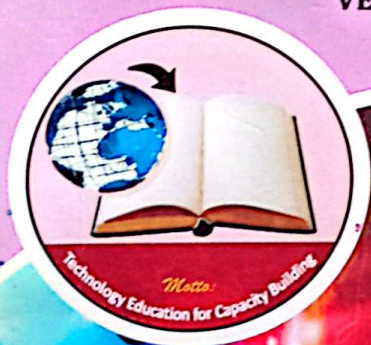
THEME

**ENHANCING SCIENCE AND TECHNOLOGY EDUCATION
IN A DWINDLING ECONOMY**

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Acknowledgments

Preface

Brief History of School of Science and Technology Education

Address Delivered By Professor Bernard Numgwo Atsumbe, Dean School of Science and Technology Education

Address The Vice-Chancellor, Professor Musbau Adewumi Akanji, FNSBMB, FAS, Federal University of Technology, Minna

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THE EFFECT OF EXPERIENTIAL LEARNING APPROACH ON SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE IN PHYSICS IN ILORIN, KWARA STATE

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Abstract

The study investigated the effects of experiential learning approach on senior secondary school students' performances in physics. The research design was a quasi-experimental, pretest-posttest, non-equivalent and non-randomized control group design. The study was conducted in two schools randomly selected and involved a total of 102 Senior Secondary School II students. The experimental group was exposed to the experiential learning approach while the control group was not. The experimental and control groups were given pretest in the first week of the research after which the treatment was applied and the post-test was administered in the sixth week using Physics Performance Test (PPT). The data collected were analyzed using analysis of covariance (ANCOVA), and the hypotheses put forward tested at an alpha level of 0.05. The study revealed that the students that were exposed to the experiential learning approach performed better than those that were not. It was recommended that teachers should expose students to experiential learning approach while delivering classroom instruction so as to enhance better understanding of the concepts of physics which is one of the keys to the sustainable development of the economy.

Introduction

The application of science and technology today has been proven to sustain the economy of several countries in the world. According to Ogunleye (2002) science is a dynamic human activity concerned with understanding the workings of our world. This understanding helps man to know more about the universe and devise strategies to contributing to the development of the residing nation. Without the applications of science, it would have been difficult for man to explore the other planets of the universe. It is obvious that the knowledge of science has developed several countries through its branches such as biology, chemistry, physics, astronomy, health science and others.

Physics is an enterprise which plays a key role in the progress of mankind. It generates fundamental knowledge, which is essential for the required technological advancement needed to propel the economic engine of the world. It extends and enhances human understanding of scientific disciplines, exciting intellectual adventures and inspires dynamic frontiers of human knowledge about the environment (Jegede and Adedayo, 2013). This means that the ultimate aim of physics teaching and learning should be the understanding of its scientific processes and application in everyday activities. Physics is sometimes referred to as the science of measurements and its knowledge has contributed greatly to the production of instruments and devices of tremendous benefits to the human race (Olaniyan & Omosewo, 2015). It provides the basic knowledge and understanding of principles, whose applications contribute immensely to the quality of life in the society. Physics, a subject in the secondary schools has been plagued by one major problem. This is the problem of poor performance in the Senior School Certificate Examinations (SSCE) level (Omosewo, 2002).

Physics is one of the major subjects meant to provide the basic knowledge and development needed in technology, its effective teaching and learning are crucial issues for consideration (Jegede & Adedayo, 2013). The teaching of physics in secondary schools is intended to produce young scientists who would be able to design the technological devices that would make day-to-day activities easier and living more comfortable (Ajayi, 2008). The teaching and learning of this important subject needs serious attention in order to enhance a sustainable technological development in Nigeria (Jegede & Adedayo, 2013). Research reports by (Ajayi, 2007; Owolabi & Adedayo, 2012) revealed that performance of students in physics is very appalling, this fact calls for attention. Some of the reasons for poor performance in physics have been blamed on the way science in general and physics in particular is being taught in secondary schools (Ogunneye & Lasisi, 2008), perceived abstract and difficult nature of physics (Nwankwo & Madu, 2014). Wambugu, Changeiywo and Ndiritu (2014) stated in their research work that

the teaching methods employed by a teacher has been shown to reflect on students' understanding of the subjects, thereby concluding that it is necessary to use methods which utilize instructional activities that students are involved in doing and thinking of the applications of what they are carrying out.

The Merriam Webster Dictionary defines learning as the activity or process of gaining knowledge or skill by studying, practicing, being taught, or by experiencing something. It could be said to be a measurable and relatively permanent change in behavior through experience, instruction, or study. Simon Fraser University defines experiential learning as the strategic, active engagement of students in opportunities to learn through doing and reflection on those activities, which empowers them to apply their theoretical knowledge to practical endeavors in a multitude of settings inside and outside the classroom. Experiential learning is a process through which students develop knowledge, skills, and values from direct experiences outside a traditional academic setting. The experiential learning theory was made popular by educational theorist David A. Kolb, who along with John Fry, developed the experiential learning theory, which is based on the idea that learning is a process whereby knowledge is created through transformation of experience. The knowledge results from the combination of grasping and transforming experience (Kolb, 1999). The Kolb's experiential learning model portrays a four stage learning cycle; two dialectically related modes of grasping experience and two dialectically related modes of transforming experience:

Eryilmaz (2004) observed that gender contributes to poor achievements of students in physics. Gender according to Yang (2010) refers to the social attributes and opportunities associated with being male and female and the relationships between women and men, girls and boys, as well as the relationship between women and those between men. According to Mbajiorgu (2003), female enrollments in physics and science subjects generally are very poor. This is in line with the study by Gonzuk and Chargok (2001) which revealed that the number of females who study physics in secondary and tertiary institutions is small compared to the number of boys. The poor performance in physics is no gender exception as it cut across both male and female but it is very important to find out the level of failure between male and female so as to proffer adequate solution to it (Aina & Akintunde, 2013).

The teachers' method of teaching may go a long way in enhancing effective learning by the students. The traditional method of teaching physics in schools involves "chalk and talk" activities which is fully teacher centered. In this case, the students are passive learners in the classrooms who regard the teacher as the repertoire of knowledge (Jegede and Adedayo, 2013). There is agitation to inculcate 21st century to science teaching in Nigeria. These include inquiry method, collaborative learning, experiential learning approach, discovery method, and so on. They are purely child-centered approaches. Here, the students are guided to discover to discover facts and construct their own ideas and understanding of the concepts of the study. However, Nwagbo (1995) noted that science teachers shy away from activity-oriented instructional methods that are more effective and stick to inadequate methods of teaching. It is obvious that the study of physics cannot be effectively carried out without an empirical analysis of some of the factors that impede the study of the subject and some of the factors that may improve students' performances in the subject, some of which have been listed above. Therefore, this present study sought to determine the effects of experiential learning approach on senior secondary school students' performance in physics in Ilorin, Kwara State.

Literature Review

Baker and Robinson (2016) investigated the effects of experiential learning approach to instruction on the successful intelligence of secondary school agricultural science students. The experiential learning was compared to the conventional teaching method (direct instruction). The purpose of the study was to examine the effects of the experiential learning approach on the successful intelligence of the secondary school agricultural students, measured across three domains- practical intelligence, analytical intelligence and creative intelligence. It was concluded that students who received the experiential learning produced higher creativity scores that were domain specific. Also, they scored higher in their practical use of knowledge when compared to their direct instruction counterpart. While both experimental and control groups yielded similar analytical knowledge scores.

A study by Weinberge, Basile and Albright (2011) examined the effect of a summer enrichment programmed grounded in experiential learning approaches, intended to increase student motivation in

science and mathematics. A sample of 336 students was asked to complete the Science and Mathematics Students' Motivation Assessment (SMSMA) following the experiential treatment. Through the use of paired sample t-test, it was found that students became more interested and developed a higher expectancy of success in mathematics, but reported a lower attainment value following the experience indicating that mathematics did not define them as a person. In science, statistically significant gains were found in students' interest, perceptions of usefulness, importance of science in defining themselves, and expectations for future success in science.

Kolb's experiential learning model portrays a four stage learning cycle; two dialectically related modes of grasping experience and two dialectically related modes of transforming experience:

1. Concrete Experience: At this stage a new experience of situation is encountered or a reinterpretation of existing experience takes place.
2. Abstract Conceptualization: This is the process of making sense of what has been happening and involves interpreting the events and understanding the relationships between them.
3. Reflective Observation: This means taking time-out from doing and stepping back from the task and reviewing what has been done and experienced. Here, lots of questions are being asked and communication channels are opened to members of the class.
4. Active Experimentation: This final stage of the learning cycle considers how the learners are going to put what they have learnt into practice.

Cheriyian (2010) tested the effectiveness of Kolb's Experiential Learning Model on Achievement in Mathematics of Students at secondary school level. The samples were 332 secondary school students of government and aided schools following the state syllabus of Kerala. The study found out that achievement in mathematics of students taught using Kolb's Experiential Learning Model is significantly higher than those taught using activity oriented methods for total sample and relevant subsamples.

Purpose of the Study

The main purpose of this study was to investigate the effects of Experiential Learning Approach on senior secondary school students' performance in physics in Kwara State, with specific emphasis on Ilorin South Local Government Area. The study also sought to investigate:

1. The performance of students taught Physics using experiential learning approach and those taught without.
2. The difference in performance of students who were taught physics using the experiential learning approach and those taught physics without experiential learning approach.
3. The difference in the performance of male and female students who were taught physics using the experiential learning approach.

Research Questions

The following research questions were raised and answered to guide this study:

1. What is the performance of students when taught Physics using experiential learning approach and those taught without?
2. Is there any difference in the performance of students who were taught physics using the experiential learning approach and those taught physics without experiential learning approach?
3. Is there any difference in the performance of male and female students who were taught physics using the experiential learning approach?

Research Hypotheses

The following research hypotheses were stated based on the research questions raised for this study and were tested in the course of the study:

H_{01} : There is no significant difference in the performance of students when taught physics using the experiential learning approach and those taught physics without experiential learning approach.

H_{02} : There is no significant difference in the performance of male and female students when taught physics using the experiential learning approach.

Significance of the Study

The findings of this study may form part of the efforts that are being made to have greater achievement of students in physics who will contribute their acquired experience to the sustainable development of the

nation. The findings may contribute empirical information that would be of immense benefit to teachers, students, researchers and other stakeholder in the national economic development. The findings of this study may help teachers to adopt different teaching approaches that will make the teaching and learning of physics to be more stimulating, interesting and understanding. Teachers may also find the study helpful in developing and strategizing lessons with appropriate steps involving the experiential learning approach. The findings of this study may help physics students to gain better understanding of concepts in physics which will enhance their performances in internal and external examinations. It may also make students to be proficient in solving different problems associated with inquiry based activities in the society for sustainable economic development of the Nigeria. The findings of this study may serve as a reference point for Government and future researchers on related research works in science education.

Methodology

Population and Sampling

The population for this study was all senior secondary school students offering physics in Ilorin. The target population was all senior secondary two (SS2) students offering physics in Ilorin South Local Government Area. This was because the students would have acquired experience on electricity or been taught the concept of electric fields as they would have been exposed to the basics of it in their SS1. The sample for this study was students of two intact classes of schools randomly selected by the researcher and each was assigned one instructional package;

School 1: Experiential Learning Approach

School 2: No treatment

Instrumentation

The instruments for this study were in two categories;

- a. Physics Performance Tests (PPT).
- b. Physics Instructional Package (PIP).

a. Physics Performance Tests

These were designed by the researcher. They involved questions drawn from the WASSCE series past questions. The PRE-PPT included 20 questions and the POST-PPT included 25 questions in total. The content area of the PRE-PPT was topics from the SS1 physics syllabus while the POST-PPT content involved questions on electric fields. The PRE-PPT tested for knowledge levels while the POST-PPT tested for understanding, comprehension, application, an achievement levels. The tests were given to three experts to scrutinize and determine the suitability. All corrections made by these experts enabled the researcher to eliminate and reconstruct ambiguous items in the instrument. This instrument was administered to a set of 20 students that were not part of the participating schools which also enabled the researcher to identify, reconstruct and rule out some items that seemed to be too difficult and too easy in Physics Performance Test (PPT). The reliability of the instrument was carried out using split half method of reliability. Then their scores in the two halves were subjected to reliability using Cronbach Alpha Method and the reliability coefficient of 0.71 was therefore obtained.

b. Physics Instructional Package

This was designed by the researcher based on the content of electric fields (electrostatics, coulomb's law and electric force, electric field lines of force, electric current and ohm's law, resistors and resistance, capacitors and capacitance), process and steps involved in the ELA was explored and implemented. The package consisted of lesson plans for four weeks.

Procedure for Data Collection

The researcher designed an instructional package well-grounded in the ELA. This package was administered to the corresponding school during the second to fifth week of the experiment. The experimental group was taught using the ELA while the control group was taught without any treatment. During the ELA, the teacher first started by reinterpreting existing experience/encounters the students should have. The teacher then related the experience with the concept to be learned. The teacher asked the students to discuss their experiences and asks them to make conclusions from the analogies after which the teacher explained the topic in detail. The teacher treated examples afterwards and gave them exercises to practice. During the sixth week, a posttest was administered to the students and their scores were obtained.

Data Analysis and Results

The data gathered from both the experimental and the control groups were analyzed using frequency and percentage to present the demographic data of the participants. Mean and standard deviation were used to answer the research question one while the other research questions were hypothesized and tested with the use of Analysis of Covariance (ANCOVA).

Table 1:

Demographic Information of the groups

Groups	Gender	Frequency (%)	Sub-Total (%)
Experimental II (Exp. Learning Approach)	Male	20 (12.5%)	39(24%)
	Female	19 (11.9%)	
Control	Male	19 (11.9%)	63(39%)
	Female	44 (27.5%)	
Total			102(100%)

Table 1 showed the demographic information of the groups (experimental and control groups). Out of 102 (100%) students that were sampled for this study, 39(24%) of the participants were in the experimental group (Experiential Learning Approach) out of which 20(12.5%) were male and 19(11.9%) were female, whereas 63(39%) of the participants constituted the control group out of which 19(11.9%) were male and 44(27.5%) were female.

Answering of Research Question

Research Question: *What is the performance of students in Physics before and after the treatment?*

Table 2: Descriptive Statistics of Students' Performance in Physics before and after the Treatment

Groups		Mean	S.D.	Min	Max	Remark
Experimental (Exp. Learning Method)	Pre-test	8.38	2.08	4.00	12.00	Low
	Post-test	16.66	4.25	7.00	24.00	High
Control	Pre-test	6.96	1.90	2.00	11.00	Low
	Post-test	12.14	3.45	3.00	20.00	Fair

As revealed in Table 2, the performance of students (both the experimental and control groups) in the post-test was higher than their performance in the pre-test. This implies that the performance of students (both the experimental and control groups) before the treatment was low, however after the treatment, the academic performance of students taught using the experiential learning approach was 16.66 while the performance of students taught without experiential learning was 12.14. This implies that use of experiential learning in teaching and learning of physics improved the performance of students.

Hypotheses Testing

Hypothesis One: *There is no significant difference in the performance of students when taught Physics using the experiential learning approach and those taught without.*

Table 3: Analysis of Covariance Showing the Difference in the Performance of Students when Taught Physics Using the Experiential learning Approach and Those Taught Physics without

Source	Type III Sum of Squares	d f	Mean Square	F	Sig.
Corrected Model	636.902 ^a	2	318.451	24.583	.000
Intercept	590.140	1	590.140	45.557	.000
Pre-test	143.940	1	143.940	11.112	.001
Treatment	287.925	1	287.925	22.227	.000
Error	1282.441	99	12.954		
Total	21549.000	102			
Corrected Total	1919.343	101			

a. R Squared = .332 (Adjusted R Squared = .318)

Table 3 showed that the F-value of 22.23 was obtained with a p-value of 0.00 computed at 0.05 alpha level. Since p-value (0.00) is less than alpha level (0.05), the null hypothesis one was not retained and thus, there was a statistically significant difference in the performance of students when taught Physics using the experiential learning approach and those taught physics without ($F_{(1,99)} = 22.23, p < 0.05$).

Table 4:
Pairwise Comparisons Analysis Showing the Effect of the Treatment on Students' Performance in Physics

Treatment	Mean	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
Experimental (I)	16.66 ^a	4.52 [*]	0.77	0.00	2.12	5.20
Control (J)	12.14 ^a	-4.52 [*]	0.77	0.00	-5.20	-2.12
Grand Mean = 14.40						

* the mean difference is significant at 0.05 level

To determine the direction of the significance, the Multiple Comparison Analysis was depicted in Table 4 to show where the difference lies (i.e. the effect of the treatment on students' performance). Table 4 revealed that students in the experimental group 2 that were taught Physics with experiential learning approach had higher mean score of 16.66 than those in the control group that were taught Physics without the experiential learning approach had a mean score of 12.14. This implied that students taught with the use of experiential learning approach performed better than those taught without in Physics Performance Test (PPT).

Hypothesis Two: *There is no significant difference in the performance of male and female students when taught Physics using the experiential learning approach.*

Table 5: Analysis of Covariance Showing the Difference in the Performance of Male and Female Students That Were Taught Physics Using the Experiential learning Approach

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	132.664 ^a	2	66.332	4.310	.021
Intercept	213.962	1	213.962	13.904	.001
Pretest	76.787	1	76.787	4.990	.032
Gender	14.042	1	14.042	.912	.346
Error	554.003	36	15.389		
Total	11520.000	39			
Corrected Total	686.667	38			

a. R Squared = .193 (Adjusted R Squared = .148)

*not significant at $p > 0.05$

Table 5 showed that the F-value of 1.97 was obtained with a p-value of 0.16 computed at 0.05 alpha level. Since p-value (0.16) was greater than alpha level (0.05), the null hypothesis four was retained and thus, there was no statistically significant difference in the performance of male and female students that were taught Physics using the experiential learning approach ($F_{(1,93)} = 1.97, p > 0.05$).

Discussion of Findings

Findings from this study revealed that the performance of students (both the experimental and control groups) before the treatment was low, however after the treatment, the academic performance of students taught using the experiential learning approach was higher than the performance of students taught without. This may due to the fact that experiential learning approach exposed students beyond the traditional and regular method thereby resulting in students' higher performance in Physics. This outcome corroborates Wambugu, Changeiywo and Ndiritu (2014) whose findings indicated that the integration of

modern teaching approaches in instructional delivery resulted in high students' understanding of the subjects and academic performance when compared with the use of traditional teaching method alone.

This study also revealed that there was a statistically significant difference in the performance of students when taught Physics using the experiential learning approach and those taught physics without. Students taught with the use of experiential learning approach were found to perform better than those taught without. This result is in agreement with Cheriyan (2010) who found out that achievement in mathematics of students taught using Kolb's Experiential Learning Model is significantly higher than those taught using activity oriented methods for total sample and relevant subsamples.

In addition, the results obtained from this study revealed that the performance of male and female students taught Physics using experiential learning approach do not differ as no statistical discrepancy was found in the performance of male and female students that were taught using the experiential learning approach. This outcome supports the findings of Weinberge, Basile and Albright (2011) which showed that the performance of male and female students exposed to experiential learning in Mathematics were statistically the same. However, this outcome disagrees with Shaibu and Mari (1997) who observed a gender difference in achievement in science process skills in favor of the female students.

Conclusion

The Experiential Learning Approach enhanced better performance of students. It could also be concluded that the use of experiential learning approach did not reveal any significant difference in the results towards gender as both male and female students that were exposed to the ELA performed well in Physics.

Recommendations

With respect to the findings of this study, the following recommendations are proffered:

1. Teachers should expose students to experiential learning approach while delivering classroom instruction so as to enhance better understanding of the concepts of physics which is the key to the sustainable development of the Nigerian economy.
2. Teachers should take into consideration both male and female students while teaching using the experiential learning approach since the sustainable development of the Nigerian economy depend on the contribution both male and female.
3. There should be seminars, conferences and workshops on how to sustain and develop the country's economy where in-service teachers would be trained in the knowledge and skills of effective implementation of experiential learning approaches in schools since the approach was found to improve students' academic performance.
4. School authorities and educational administrators should see that the experiential learning approach is integrated into secondary school curriculum in Science subjects.

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