Assessment of the Effects of Indoor and Outdoor Laboratory Experiences on Secondary School Students Achievement and Retention in Ecology - A Case Study of Jalingo Education Zone, Taraba State, Nigeria

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Abstract

This study was carried out to assess the effects of indoor and outdoor laboratory experiences on achievement and retention in ecology among secondary school students in Ardo-Kola Local Government Area of Jalingo Education Zone in Taraba State, Nigeria. A quasi-experimental research design, which utilized pretest, posttest, and post-posttest, was adopted. The population of the study consisted of 849 SSII students from 11 public schools in the Ardo-Kola Local Government Area of the State. One out of 11 schools was randomly selected as a sample, and two groups were used as the experimental and control groups. The experimental group was taught using an outdoor teaching strategy, while the control group was taught using an indoor strategy. Two intact classes were selected to form a sample of 60 students. The instrument used for the study was the Ecology Achievement Test (EAT). Research questions were answered using means and standard deviation, and the hypotheses were tested at the 0.05 level of significance. The t-test statistical tool was used in analyzing the collected data. Major findings of the study revealed that the ecology concept favored outdoor teaching strategies. The study further confirmed that outdoor teaching strategies enhanced student achievement and retention, and they are gender-friendly. From the results of the analysis discussed, recommendations were made, one of which was that there is a need for teaching and learning strategies involving student participation, such as outdoor teaching strategies, which enhance student achievement and retention.

Keywords: Indoor and Outdoor Laboratory Experiences, Retention, Biology Science, Academic achievement, Ecology

1. Introduction

It is impossible to overstate the importance of science in any civilization since science as a discipline of study fosters a scientific culture that advances society. In actuality, a country's degree of scientific achievement has always been a crucial indicator of its level of growth. According to their level of scientific and technological progress, which in turn determines the level of socioeconomic and industrial growth, countries are classified as developed or underdeveloped. The poor rate of scientific and

technological advancement in Africa has been blamed for the continent's slow rate of growth (Oyovwi, 2020).

Therefore, it is essential to investigate biology teaching methods, particularly the hands-on method. Numerous activity-based teaching techniques have reportedly been used to enhance biology instruction at the secondary school level, according to Saudi and Sukeiman (2014). These include investigative techniques, live demonstrations, process-based learning, cooperative learning, and laboratory activities. These instructional techniques are typically used in a classroom setting, but there are certain biological topics that secondary school students must investigate through outdoor laboratory activities. For instance, the teaching approach used by teachers in the numerous research described is restricted to indoor laboratory investigations. According to Stanley (2008) and Duniya (2009), outdoor laboratory activities are frequently disregarded or, in certain cases, replaced with the conventional lecture technique. In contrast to the indoor laboratory, where materials are brought to the classroom for students to observe and conduct investigations within the constrained classroom environment, Stanley (2008) and Duniya (2009) asserted that the outdoor laboratory is more effective than the indoor laboratory in the teaching of Biology concepts because it requires students to handle, observe, and gather information on-the-spot. The purpose of this study is to ascertain the impact of outdoor laboratory teaching methods on secondary school students' academic achievement and Biology course retention.

It has become important to look into ways to develop students' Biology skills in light of the central roles that retention plays in the teaching and learning process, as well as how retention helps students remember what they have learned and produces desirable learning outcomes. Any attempt to address the issue of low accomplishment in Biology may not be substantially helpful if students' retention abilities are not taken into consideration, as achievement in Biology depends on how learned information are retained.

Achor, Ogbeba, and Amadu (2014) claim that by using an effective teaching and learning technique that promotes high retentions, the low achievement in biology among senior secondary school students might be improved. The majority of students in Taraba State do not participate in outdoor learning activities that would allow them to touch, feel, and independently classify flora and animals. For the most part, teachers can only teach in a classroom setting. School outdoor activities could be one of many ways used to teach and enhance student retention because ecology deals with the relationships between organisms in their external environment and students need to be practically involved in the study of species in their natural habitats. Against this backdrop, the current study investigated the impact of school outdoor activities on senior secondary school students' retention in Ecology.

1.2. Statement of the Problem

Secondary school students have been shown to have low academic achievement in Biology. It is of significant worry to stakeholders that students continue to perform poorly in their academics despite the traditional teaching methods utilized by their professors, which appears to be caused by the students' inability to participate in outdoor and indoor educational experiences. The purpose of this study is to evaluate the impact of outdoor and indoor teaching experiences on students' academic progress and retention in secondary schools in Jalingo education zone Taraba State, Nigeria.

1.3. Purpose of the Study

The outdoor instructional strategy is an innovation to the teaching of ecology by making use of the natural environment. Therefore, this research work was conducted to find out the followings:

(1) Determine the outdoor and indoor teaching experiences effect on achievement of learnt ecological concepts among senior secondary school biology students.
(2) Determine the outdoor and indoor teaching experiences effect on the mean retention scores of Senior Secondary Students in ecology.
(3) Determine the outdoor and indoor teaching experiences effect on gender in ecology.

1.4. Research Question

Three research questions were formulated to guide this study.

(1) What are the outdoor and indoor teaching experiences effects on achievement of learnt ecological concepts among senior secondary school biology students?
(2) What are the outdoor and indoor teaching experiences effects on the mean retention scores of Senior Secondary Students in ecology?
(3) What are the outdoor and indoor teaching experiences effects on gender in ecology?

1.5. Research Hypothesis

Three hypothesis were formulated and tested at 0.05 level of significant,

Ho_1: There is no significant difference in the outdoor and indoor teaching experience effect on achievement of learnt ecological concepts among senior secondary school biology students

Ho_2: There is no significant difference in the outdoor and indoor teaching experience effect on the mean retention scores of Senior Secondary Students in ecology.

Ho_3: There is no significant difference in the outdoor and indoor teaching experience effect on gender in ecology.

2.4. Review of Related Empirical Studies

Saidu and Suleiman (2014) studied the effects of an outdoor laboratory teaching technique on the performance of students enrolled in the Nigeria Certificate in Education (NCE) Programme with varying levels of competence in Biology. After being exposed to teacher-directed outdoor teaching, the performance of children with high, medium, and low ability levels was compared. After therapy, there was no significant change in the performance of students at different ability levels. Long (1981) and Adesoji (2008) discovered that outdoor teaching strategies influenced the academic performance of low achievers. Furthermore, there was no significant difference in academic performance between male and female students after exposure to outdoor laboratories, indicating that it is gender friendly and that the outdoor laboratory technique was endorsed in teaching Science. This would significantly improve student performance regardless of skill level or gender. The study by Gbeleke and Daniel (2018) was concerned with the impact of outdoor learning resources on the performance of senior secondary school students in Biology subjects. This was done to establish an empirical foundation, to determine a more appropriate technique of teaching and learning Biology ideas, and to provide adequate information on the value of employing outdoor learning resources. The study's findings revealed that outdoor learning materials considerably improved secondary school students' performance in Biology subjects. Oyovwi's (2020) research looked at the effects of outdoor science activities on student academic achievement and retention in science in the Delta South Senatorial District. The findings revealed a substantial difference in the mean achievement and retention ratings between students taught with outdoor science activities

and those taught without. There was no significant difference in mean achievement scores between male and female students taught science with outdoor science activities, but there was a significant difference in mean retention scores in favour of male students.

2. Materials and Methods

2.1. Area of the Study

The study area was Ardo-kola local government area in Taraba State, Nigeria. Ardo-Kola Local Government Area is part of Jalingo Education Zone. It has been observed that there is poor achievement in Biology Science in the area which is contributed to many factors amongst which is the method of instructional strategy. The area is also selected for its concentration of the many public senior secondary schools, availability of instructional media and qualify teachers in the state since it is close to the state capital.

2.2. Research Design

The design for this research was Quasi-experimental which employed pre-test, post-test, post-posttest non-equivalent control group design. Pre-test was administered before the treatment by the researcher. This was to determine the equivalents in their academic achievement. Post-test was administered after the treatment to determine the effect of treatment achievement (Outdoor teaching experience) on the subjects while post-posttest was administered after the posttest to measure retention. This was done using the same instrument (Ecology Achievement Test). Experimental group received treatment using outdoor and indoor teaching experience while Control group was taught using indoor teaching strategy.

2.3. Population

The population of the study consisted of 849 SSII students from 11 public schools in Ardo-Kola Local Government Area of Jalingo Education Zone. These public senior secondary schools were coeducational schools to enable the researchers obtained gander participation in the experimental and control groups during the study.

2.4. Sample and Sampling

Two secondary schools was drawn from the secondary schools in Ardo-kola local government area in Taraba State through a simple random sampling. A total of sixty senior secondary school students drawn from two intact classes of SSII were involved in the study. In each school selected intact class of senior secondary school (SSII) Students were used. Out of the two secondary schools that were used for the study, one was assigned to the treatment group while the other was assigned to the control group through a simple toss of coin. In all, 30 students were used for treatment group and 30 students for control group.

3. Instrumentation

The Ecology Achievement Test (EAT) was used in the study. Two tests were used to measure achievement, one pretest was used to test students' pre-requisite knowledge in topic (Ecology) relating to the one to be covered during the study. The post-test measure students' achievement at the conclusion of the study. The objectives test was set to determine the academic achievement of the students before treatment and after the treatment. The pre-test assessed students' achievement on the topic listed out for the research. The post-test also assessed students' academic achievement on the topic. The Ecology Achievement Test consists of 40 items were used which covered all the topic (Ecology). The multiple choice questions with four options each (A-D) was used.

3.1. Validation of the Instrument

The instrument, Ecology Achievement Test (EAT) and the lesson plans underwent validation from experts in Biology Science education and measurement and evaluation in order to determine its effectiveness in measuring what it was expected to measure.

3.2. Reliability of the Instrument

The reliability co-efficient for instrument was determined using the Kuder-Richardson Formula 21 which determines the suitability of the instruments for the study.

3.3. Administration

To control for possible pre-existing differences in overall ability between the treatment and control groups a pretest was administered to both groups before the commencement of the experiment in the respective schools. The treatment group was taught with outdoor teaching experience while the control group was taught with indoor teaching experience using the same content outlined for two weeks. Two tests were used to measure academic achievement: one pretest was used to test students' pre-requisite knowledge in the topic (Ecology) related to the ones that was covered during the study. The post-test measured students' academic achievement at the conclusion of the study.

4. Method of Data Analysis

Data collected was analyzed using descriptive analysis of mean and standard deviation in answering research question 1, 2 and 3. Inferential statistics of T-test statistics was used to test hypothesis at 0.05 level of significance.

4. Results and Discussions

The data collected for the purpose of this study were analyzed based on the research questions using mean and standard deviation.

4.1. The First Question

What are the outdoor and indoor teaching experience effect on achievement of learnt ecological concepts among senior secondary school biology students?

The descriptive statistics of mean and standard deviation were used to answer this research question and the summary of the results is presented in Table 4.1.

Table 4.1: Means and Standard Deviation of the Experimental (Outdoor) and Control (Indoor) Groups in Ecology Achievement Test (EAT)

Groups	N	Mean	SD	MD
Experimental group posttest	30	51.73	12.68	6.97
Control group posttest	30	44.76	14.43	

Table 4.2: Presents t-test of Posttest Means Score of the Control and Experimental Groups in Ecology Achievement Test (EAT)

Groups	N	Mean	SD	df	t-cal	t-crit	p-value	Decision
Experimental group	30	51.73	12.68	58	3.63	1.98	0.00	Significant
Control group	30	44.76	14.43					

Results in Table 4.1 shows the mean score of the experimental group was 51.73 and a standard deviation of 12.68, while the mean scores for the control group was 44.76 and a standard deviation of 14.43. The mean difference of the experimental and control group was 6.97 in favor of the experimental group. This shows that the experimental group had higher mean score than the control group, which implied that the effect of the treatment had impacted on the experimental group. The results in Table 4.2 shows that the t-cal is 3.63 and the p-value = 0.00 at degree of freedom (df) = 58. Since the p-value = 0.00 < α = 0.05. It means that there is a significant difference in the mean scores of the experimental and control groups. The significant difference is in favour of the experimental group exposed to Outdoor teaching strategy as indicated by the mean scores. With this result the Null hypothesis 1 was therefore rejected.

4.2. The Second Question

What are the outdoor and indoor teaching experience effect on the mean retention scores of Senior Secondary Students in ecology?

A descriptive statistics of mean and standard deviation were used to answer this research question and the summary of the result is presented in Table 4.3.

Table 4.3: Mean and Standard Deviation of the Experimental (Outdoor) and Control Group (Indoor) in Ecology Retention Test (ERT)

Groups	N	Mean	SD	MD
Experimental group posttest	30	55.09	14.14	10.33
Control group posttest	30	44.76	14.43	

Table 4.4: Present t-tests of Posttest Means Scores of Experimental (Outdoor) and Control (Indoor) Groups in Ecology Retention Test (ERT)

Group	N	Mean	SD	df	t-cal	t-crit	p-value	Decision
Experimental group	30	55.09	14.14	58	2.86	1.98	0.00	Significant
Control group	30	44.76	14.43					

Results in Table 4.3 show that the mean scores of the experimental group was 55.09 and a standard deviation of 14.14, while the means scores for the control group was 44.76 and a standard deviation of 14.43. The means difference of the experimental and control group was 10.33 in favour of the experimental group. This proved that the experimental group had mean scores more than the control group. It implied that the effect of the treatment had impact on the experimental group. The results in Table 4.4 shows that t-cal is 2.86 and the p-value = 0.00 at degree of freedom (df) = 58. Since the p = 0.00 < α = 0.05. It means that there is a significant difference in the mean scores of the experimental and

the control groups in retention level of the students. The significant difference is in favour of the experimental group in retention level exposed to Outdoor teaching strategy as indicated by the mean scores. With this result the Null hypothesis 2 was therefore rejected.

4.3. The Third Question

What are the outdoor and indoor teaching experience effect on gender mean retention in ecology?

Descriptive statistics of mean and standard deviation were used to test this research question and the summary of the result is presented in Table 4.5.

Table 4.5: Mean and Standard Deviation of the Experimental (Outdoor) and Control Groups based on Gender

Groups	N	Mean	SD	MD
Males posttest	26	24.72	3.38	1.88
Females posttest	34	22.84	5.55	

Table 4.6: Present t-test Analysis of Posttest Mean Score of the Male and Female Groups in Ecology

Group	N	Mean	SD	df	t-cal	t-crit	p-value	Decision
Males posttest	26	25.14	3.21	58	1.546	0.127	0.000	Not sig.
Females posttest	34	23.50	4.82					

Result in Table 4.5 above shows that the mean score of the experimental group was 24.72 and a standard deviation of 3.38, while the mean score for the control group was 22.84 and a standard deviation was 5.55. The mean difference of the experimental and control group was 1.88 in favor of the experimental group. This proved that the male group had mean score than the control group. This implied that the effect of the treatment had positive impact on the male group. The results in Table 4.6 shows that t-cal is 2.86 and the p-value = 0.00 at degree of freedom (df) = 58. Since the $p = 0.00 < \alpha = 0.05$. It means that there is a significant difference in the mean scores of the experimental and the control groups in retention level of the students. The significant difference is in favour of the experimental group in retention level exposed to Outdoor teaching strategy as indicated by the mean scores. With this result the Null hypothesis 3 was therefore rejected.

5. Discussion of Finding

The objective of this study was to assess the Effect of Outdoor and Indoor Teaching Experiences on Secondary School Students Achievement and Retention in Ecology in Ardo-Kola Local Government Area of Taraba State, Nigeria. To achieve this, two groups of students were formed, the experimental and control groups. Students in experimental group were exposed to outdoor teaching strategy while those in control group were exposed to indoor strategy. The two groups of students were taught same concept (Ecology). The data of this study where based on scores of students in the Ecology Achievement Test (EAT). The results of posttest was used to compare their achievement according to the variable being measured which were analysed according to research hypotheses developed for the study. This unit presented explanation of results obtained from the hypotheses tested and acknowledged the published works of other authors to be stated herein after.

Table 4.2 revealed that the Outdoor teaching strategy enhanced academic achievement of experimental group. This confirmed the findings of Ahmad (2014)) which stated that knowledge gains were found to be significant with experimental group using field trip teaching strategy more than their counter part that were strictly taught in the class using lecture method. In the study conducted by Oloyede and Asaaju (2016) to examine the interactive effect of outdoor activities and school location on secondary school students' environmental problem solving skills in Biology, showed a significant main effect of outdoor activities on students' environmental problem solving skills and significant main effect of school location on students' environmental problem solving skills. Maikano (2019) confirmed that there is a significant difference between the retention tests mean scores of the experimental and the control groups in favour of the experimental group. This implies that the experimental group taught ecological concepts using the outdoor laboratory approach retained the learnt concept higher than the control group taught the same ecological concept using the indoor laboratory approach.

Table 4.4 showed that there was a significant difference between mean score of experimental and control group. Students taught using Outdoor teaching strategy retained more ecology concept than those taught using Indoor teaching strategy. This agrees with the study of Achor, Ogbeba and Amadu (2014) examined the effect that school outdoor activities could have on senior secondary two students' retention in ecology who recommended that field trip teaching strategy. The study said that there was a statistically significant difference in the mean retention scores of student taught using outdoor activities and lecture method. The author recommended outdoor teaching strategy in science because of its influence on retention more than their counter part that were strictly taught in the class using lecture method.

Table 4.6 showed that there was no significant different between male and female experimental and control groups taught using Outdoor and Indoor teaching experience. This study is in conformity with the work of Achor, Ogbeba and Amadu (2014) who said there was no statically significant difference between the mean retention scores of boys and girls exposed to school.

6. Conclusion

Generally, it was confirmed that there was high significant difference between the mean scores of experimental and control groups in ecology concept. In addition, there was high significant difference between experimental and control groups on retention ability. There is no significance difference between male and female in learning ecology concept using Outdoor teaching strategy. However, it was statistically shown that Outdoor teaching strategy favoured experimental group in learning ecology concept.

7. Recommendations

Based on the finding of the study the following recommendations were made: Teaching and learning strategy involving students' participation such as Outdoor to be encouraged at secondary schools where this is often neglected. The use of Outdoor teaching strategy should be encourage in secondary schools, hence it enhanced better retention. Outdoor teaching strategy is gender friendly, it should be encouraged among Males and Females students at secondary school level. All materials needed for carrying out Outdoor should be provided by government and cooperate organizations because it motivates students to learn effectively.

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Teacher Name: Name of School: Subject: Topic: Sub-topic: Duration: Number of Student: Gender: Behavioral Objectives:	Researchers Govt. Day Secondary School, Kofai Biology Ecological Concept Ecosystem 40 minutes 30 students Boys and Girls By the end of the lesson students should be able to: 1. Define ecosystem 2. List the factors of ecosystem 3. Explain the two factors of ecosystem 4. Differentiate between the two factors
	Insect net, chart Students were taught Ecology

Lesson Development

Stages	Teacher's Activity	Student's Activity	Time
Introduction	The teachers introduce s the lesson by asking question on the previous knowledge as follows 1. What is cell ecology 2. Describe ecology	Students understand the term	5 mins
Development Step 1	The teacher defines ecosystem as the units of interacting communities and the environmental factors which operate in them.	Student listen keenly to the teacher	10 mins
Step 2	The teacher state the two factors of ecosystem as: 1. Abiotic 2. Biotic		5 mins
Step 3	The teacher explain the two factors as follows: Abiotic factor in the ecosystem include physical factor such as wind, rainfall, temperature, humidity, pressure, turbidity, etc. the factors vary from one locality, to another biotic factors in the habitat are all the microscopic plant and animals in a particular habitat. The components interact with one another and with their local environment.	Students listen to the teacher	
Step 4	The teacher differentiate between the two factors as follows: Biotic factors are the living microscopic plant or animal, while abiotic are non-living factors		
Evaluation	The evaluate by asking the students the following questions: 1. Define ecosystem 2. List the factors of the ecosystem 3. Differentiate the two factors	Students answer the teacher by giving possible answers	
Summary	The teacher summarizes the lessons by going through what has been taught, such as: 1. Define ecosystem 2. Explain the two factors of ecosystem 3. Differentiate between the two factors		
Conclusion	The teacher concludes the lesson by highlighting in the main point.		
Assignment	discuss pyramid of number in an ecosystem		

Name of teacher	Researchers
Name of School	GDSS Kofai
Subject	Biology
Class	SS II
Topic	Trophic level
Date	22/10/2021
Time	8:00 am
Duration	40 mins
Number of student	50

Objective	By the end of the lesson students should be able to: 1. Define trophic level 2. State five trophic levels
Teaching Aids	
P/Knowledge	Students were taught food web.

Lesson development

Stages	Teachers Activity	Students Activity	Time
Introduction	The teacher introduces the lesson by asking students the following questions: 1. Defined food web		5 min
Development Step 1	The teacher introduces the lesson by defining trophic level as the number of links by which food energy is transferred from producers to final consumers. It is also the position of an organism in the food chain and ranges from a value of one (1) for marine mammals and humans.	The student listen to teachers definition	10 min
Step 2	The teacher state the five trophic levels as: 1. Guinea grass (1st trophic level) 2. Grasshopper (2nd trophic level) 3. Toad (3rd trophic level) 4. Lizard (4th trophic level) 5. Hawk (5th trophic level)		10 min
Evaluation	The teacher evaluates the lesson by asking the student questions: 1. Define trophic level 2. State five (5) trophic levels.		5 min
Summary	The teacher summarizes the lesson by explaining the main points from the lesson		5 min
Conclusion	The teacher concludes the lesson by copying notes on the chalkboard to students also by giving the assignment.		5 min
Assignment	Differentiate between pyramid of number and pyramid of energy		

Name of Teacher	Researchers
Name of School	Destiny Success Academy
Class	SS II
Subject	Biology
Topic	Food Web
Date	22/10/2021
Time	8:00 am
Duration	40 mins
Number of Students	50
B/Objective	By the end of the lesson students should be able to: 1. Define food web 2. List two example of food web in terrestrial and aquatic habitat. 3. State three differences between food web and food chain
Teaching materials:	Insect, lizard, grass
Previous knowledge	Students were taught food chain.

Lesson Development

Stages	Teacher's Activity	Student Activities	Time
Introduction	The teacher introduces the lesson by asking questions on the previous knowledge as follows: 1. Define food chain 2. Give one example of terrestrial food chain.	Students define food chain give example of food chain in a terrestrial habitat.	5 min
Development Step 1	The teacher introduces the lesson by defining food web as a complex feeding relationship among organisms in the same environment with two or more inter-related food chains graphical representation of food chain. It is also the natural inter-connection of food chains and a graphical representation of what-eats-what in ecological community.	Student listen to teacher's definition of food Web.	10 min
Step 2	The teacher give the two examples of food web in terrestrial and aquatic habitat as follows: Example of food web in terrestrial habitat	Students listen to teacher explanation.	10 min
Step 3	The teacher states the three (3) differences between food web and food chain as follows: 1. Food web is a complex feeding relationship while food chain is a linear feeding relation 2. Food web involves two or more food chains while food chain involves only one food chain. 3. In food web organisms have greater chance of survival. While in food chain organisms have lesser chance of survival.		10 min
Evaluation	The teacher evaluates the lesson by asking	Students attempt the	5 min

	students the following questions: 1. Define food web 2. Give two example of food web- a terrestrial and aquatic habitat. 3. State three (3) differences between food web and food chain.	questions	
Summary	The teacher summarizes the lesson by explaining the main points from the lesson		5 min
Conclusion	The teacher concludes the lesson by copying notes to students and also by giving them assignment.		5 min
Assignment	State three (3) principles governing level and pyramid.		