INVESTIGATING THE EFFICACY OF OUTDOOR LABORATORY ACTIVITY ON STUDENTS' INTEREST AND ACHIEVEMENT IN BIOLOGY IN EBONYI STATE, NIGERIA

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Abstract

This study investigated the effect of outdoor laboratory activity on student interest and academic achievement in biology among secondary school students in Abakaliki, Ebonyi State. The study employed a quasi-experimental research design, specifically the pre-test, post-test, nonequivalent control group, using two intact classes from separate schools. The sample consisted of 58 students, with 28 students in the experimental group and 30 in the control group. The instruments for data collection were the Biology Achievement Test (BAT) and the Biology Students' Interest Inventory (BSII). The experimental group was taught using outdoor laboratory activities, while the control group received instruction through the conventional lecture method. The data collected were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA) statistics. The findings revealed that students in the experimental group showed a greater interest in biology and significantly higher academic achievement compared to their counterparts in the control group. The study concluded that outdoor laboratory activities are an effective instructional strategy for enhancing students' active and sustainable interest in biology. Based on these findings, it was recommended that biology teachers integrate outdoor laboratory activities into their teaching, and that school administrators and the government provide the necessary resources to support such practical approaches to science education.

Key Words: Academic Achievement, Biology Education, Outdoor Laboratory, Students' Interest, Secondary Education

Introduction

Science as a field of human endeavor is both a systematically organized body of knowledge about the natural world and a dynamic process of inquiry. It involves making observations, formulating hypotheses, conducting experiments, and drawing evidence-based conclusions (Udu 2017; Bada & Olusegun, 2021). In education, science is not merely the transmission of factual information; it is the development of students' ability to think critically, solve problems, and apply knowledge to real-life situations. The nature of science emphasizes active engagement in investigative processes, fostering curiosity, and cultivating the skills necessary to interpret and evaluate evidence (Udu, 2020; Yusuf, Ibrahim, & Suleiman, 2021). Consequently, science instruction should create opportunities for learners to participate actively in the generation and application of scientific knowledge rather than remain passive recipients of information (Udu et al. 2020). Within the sciences, biology occupies a distinct position as the study of living organisms, their structures, functions, interactions, and evolution. Biology education is inherently practical because many of its concepts—such as ecological interactions, physiological processes, and biodiversity—can be observed directly in natural environments (Ogbu & Ede, 2023; Olarinoye & Abdul, 2022).

Field-based and laboratory-based activities allow students to connect abstract theoretical concepts to tangible phenomena. Such approaches not only enhance conceptual understanding but also contribute to measurable improvements in academic performance (Njoku & Mgbomo, 2021). For instance, when students investigate plant adaptations in a school garden or measure population sizes in a nearby habitat, they engage with biology in a contextually rich and memorable way, leading to better retention and transfer of knowledge. Laboratory-based instruction—whether indoor or outdoor—places learners at the center of the investigative process, enabling them to handle materials, record observations, and analyze results. Inquiry-based and guided discovery approaches further enhance learning by requiring students to generate questions, design experiments, and conclude their findings (Yusuph & Agbalajobi, 2023). One particularly effective strategy within practical science teaching is the outdoor laboratory. An outdoor laboratory refers to any structured learning activity conducted outside the traditional indoor laboratory, where students can directly interact with nature to collect data, conduct experiments, or make systematic observations (Rickinson et al., 2023). Examples include biodiversity surveys, water quality testing in local streams, soil analysis in agricultural plots, and population studies in school grounds. Outdoor laboratory experiences offer a unique blend of cognitive, psychomotor, and affective benefits; they make learning more relevant, foster collaborative skills, and deepen students' connection to the subject matter (Hastika, Saefudin, & Supriatno, 2024).

Empirical studies reinforce the positive effects of outdoor laboratory activities on students' learning outcomes. Egwu & Okigbo (2021); Adeosun, Idowu & Yara (2022); Maikano (2022); Ogunleye (2024) and Gagare (2024) reported in their different studies that students who participated in well-structured outdoor experiences demonstrated significantly higher achievement, retention, and understanding in biology than those taught using lecture methods. Despite the well-documented benefits, the effectiveness of outdoor laboratory activities depends on factors such as teacher preparation, availability of resources, curricular alignment, and adequate safety measures. Poorly planned or infrequently implemented outdoor experiences may fail to produce the desired gains in interest or achievement. In Nigeria, where science education faces challenges such as overcrowded classrooms, limited laboratory facilities, and constrained teaching time, outdoor laboratory activities offer a promising avenue for making science instruction more engaging and effective (Aghogho & Hyelyankuri, 2023). However, there is still a need for empirical studies that specifically examine the influence of these activities on both the affective (interest) and cognitive (achievement) domains within biology education. Therefore, this study seeks to investigate the effect of outdoor laboratory activities on students' interest and achievement in biology.

Purpose of the Study

The main purpose of the study is to investigate the effect of outdoor Laboratory activities on Students' Interest and Achievement. Specifically, the study aims to determine the:

1. Mean interest scores of students taught biology using outdoor laboratory activities and those taught using the lecture method.
2. Mean achievement scores of students taught biology using outdoor laboratory activities and those taught using the lecture method.

Research Questions

The following research questions guided the study:

What are the mean interest scores of students taught biology using the outdoor laboratory and those taught using the lecture method?

What are the mean achievement scores of students taught biology using outdoor laboratory activities and those taught using the lecture method?

Hypotheses

The following null hypotheses were formulated and tested at a 0.05 Level of significance: Ho1: There's no significant difference in the mean interest scores of students taught biology using outdoor laboratory activity and those taught using the lecture method.

Ho2: There's no significant difference in the mean achievement scores of students taught biology using outdoor laboratory activities and those taught using the lecture method

Method

This study adopted a **quasi-experimental research design of the non-equivalent control group type.** This study was carried out in **Abakaliki town, the capital of Ebonyi State, Nigeria.** Abakaliki, with its mix of urban schooling conditions and availability of diverse natural environments, provides a suitable setting to explore the effect of **outdoor laboratory activities** on students' interest and achievement.

The population of this study comprised all **Senior Secondary School Two (SS II) biology students** in public secondary schools in **Abakaliki town, Ebonyi State**, which is 13201 students (Ebonyi State Post Primary Schools Management Board, PPSMB, 2024). SS II biology students were purposively chosen because they are in the middle of their senior secondary program. They have been introduced to the fundamentals of biology at SS I and are now handling more **complex ecological topics.**

The sample consists of 58 students of SS11 in two secondary schools. A simple random sampling technique (sampling with replacement) was used in drawing the two schools. Using a toss of a coin, one of the two schools was chosen as the experimental group and the other as the control group. This was to ensure that each member of the Population has an equal probability of being drawn. In each of the two schools, one intact class was randomly sampled. All students in each of the two intact classes were used for the study. In the experimental group, there are 28 students, while in the control group, there are 30 students.

Two instruments were used for the study, and they are the Biology Achievement Test (BAT) and Biology Interest Inventory (BII). BII is made up of two sections, A and B. Section A solicited the respondents' personal data, while Section B solicited information on the respondents' level of interest in biology. BII is a four-point response scale of Strongly Agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points, and Strongly Disagree (SD) = 1 point, for positive response, while the reverse is used for negative response. BAT is a 20-item multiple-choice test developed by the researcher. BAT is made up of sections A and B. Section A solicited information on the respondent's personal data, while Section B contains multiple-choice questions based on ecosystem, components, and sizes, local biotic communities, major biomes of the world, and population studies by sampling method. A test blueprint was developed based on the relative emphasis on each of the subtopics in the curriculum by the researcher. The Biology Achievement Test (BAT) and Biology Interest Inventory (BII) were used as Pre- test and post – test.

BII and BAT were validated by three experienced biology lecturers in the Science Education Department from Alex Ekwueme University, Ndufu-Alike. They were given the research topic, research questions, and hypotheses, and were required to comment on the appropriateness of the instrument with reference to the purpose of the study, and also the clarity of the questions

All the corrections and suggestions pointed out were made to enhance the validity of the instruments. Initially, the BAT was a 30-question multiple-choice test, which, after validation, 10

questions were dropped, while 20 questions were administered to students. The BII and BAT were administered to 20 SSII biology students from a non-target school outside the area of study for the pilot study. The data collected from the trial testing of the BII and BAT were subjected to a reliability test, using the Kuder-Richardson formula 20 and the Cronbach's alpha reliability statistics

The Cronbach Alpha statistics analyzed the students' responses to the BII items based on four factors (Academic, Vocational, Leisure, and General interest). All items of the BII gave a reliability coefficient of 0.83. The Kuder Richardson formula 20 determined the reliability of BAT, with a coefficient of 0.63. The indices obtained showed that the BII and BAT were internally consistent and stable for the study.

Experimental Procedure

The biology class teacher in the selected schools was used for the study, both for the experimental group and the control group. The researcher first administered a pre-test of the instruments in both groups of selected schools. Then, after six weeks, a post-test with the same instruments was re-administered to both groups of selected schools, in which the questions were re- shuffled, and the teacher was used to carry out the post- test on the students in the classroom. The teachers were provided with the lesson plan by the researcher as a guide and other instructional materials needed to teach the students. The experimental group was taught with an outdoor Laboratory teaching method, which involved taking students around the school garden and carrying out experiments on population studies by sampling, local biotic communities, and ecological components and sizes. The control group was taught with the conventional lecture method in the school laboratory. The two groups were taught the same biology content, which includes ecosystem, components and sizes, local biotic communities, major biomes of the world, and population studies by sampling method. The teacher and student followed their activities as planned by the researcher, both in the experimental group and the control group. Efforts were made to control extraneous variables such as the teacher's variable, intergroup variable, and Hawthorne effect.

BII and BAT were administered as a pre-test for both experimental and control groups. The pretest and post- test were analyzed and used to answer the research questions and test the hypothesis. The research questions were answered using mean and standard deviation. Twoway Analysis of Covariance (ANCOVA) was used to test the hypothesis at the 0.05 level of significance. Two ways ANCOVA was used because two independent variables were involved, and it also took care of error due to initial differences in ability among research participants.

Results

Research question 1: What are the mean interest scores of students taught biology using outdoor laboratory activities, and those taught using the lecture method?

Table 1: Descriptive Statistics of Students' Interest Scores in Biology in the Experimental and Control Groups

	N	Pre-interest		Post-interest		Gain Score
		Mean				
Teaching methods			SD	Mean	SD	
Experimental (OLA)	28	2.79	1.02	2.87	0.83	0.08
Control (LM)	30	2.85	0.99	2.81	0.99	-0.04
Total/Gain Score Difference	58	2.82	0.99	2.84	0.91	0.12

Table 1 shows a summary of the descriptive statistics of the students' interest in biology when taught using outdoor laboratory activities and the lecture method. The result shows that in the experimental group, the overall mean and standard deviation scores of the students on the postinterest scale were 2.87 and 0.83, respectively, while in the pre-interest scale, they had 2.79 and 1.02, respectively. These results show a mean difference of 0.08 between the post-interest and pre-interest responses of the students in the experimental group. Similarly, in the control group, the overall mean and standard deviation scores of the students in the post-interest scale were 2.81 and 0.99, respectively, while in the pre-interest scale, they obtained mean and standard deviation scores of 2.85 and 0.99, respectively. This shows a negative mean difference of -0.04 in the post-interest and pre-interest responses of the students. The Table shows further that the mean response of the students in the post-interest scale of the experimental group was higher than that of their counterparts in the control group, with a numerical difference of 0.12. However, the table did not show whether the observed mean difference was statistically significant or could be attributed to a sampling error. The result was, therefore, subject to inferential statistics with ANCOVA to test the null hypothesis 1 as shown in Table 3 below. Meanwhile, the standard deviation of the students in the experimental group was lower than that of their counterparts in the control group. This shows that the individual responses of the students in the experimental group were more clustered around their overall mean than those of their counterparts in the control group.

Research question 2: What are the mean achievement scores of students taught biology using outdoor laboratory activities, and those taught using the lecture method?

Table 2: Mean Achievement and Standard Deviation Scores of Students in the Experimental and Control Groups

Teaching methods (Treatment)		Pre-test		Post-test		Gain Score
	N	Mean	SD	Mean	SD	
Experimental (OLA)	28	9.61	4.27	15.32	2.26	5.71
Control (LM)	30	8.03	3.25	12.73	2.20	4.70
Total/Gain Score Difference	58	8.79	3.83	13.98	2.57	1.01

Table 2 contains the post-test and pre-test mean scores with standard deviations of the experimental and control groups. The Table shows that the experimental group taught using the outdoor laboratory activities (OLA) had a post-test mean score of 15.32 with a standard deviation

of 2.26. And a pre-test mean score of 9.61, with a standard deviation of 4.27. The result shows a mean gain score of 5.71. Similarly, the Table shows that the control group taught using the lecture method had a post-test mean score of 12.73, with a standard deviation of 2.20. And a pre-test mean score of 8.03, with a standard deviation of 3.25. This shows a mean gain score of 4.70. This result shows that the outdoor laboratory activities (OLA) and the lecture method (LM) improved the students' academic achievement in biology. Meanwhile, the table shows further that the students in the experimental group taught biology using the OLA had a higher mean achievement gain score than their counterparts in the control group taught using the lecture method, with a numerical difference of 1.01 observed. However, the Table did not show whether the observed difference in the mean achievement gain scores of the experimental and control groups was statistically significant or could be attributed to error variance. To ascertain the significance or otherwise of the observed difference, the result was subjected to inferential statistics with the ANCOVA to test the corresponding null hypothesis 2 as shown in Table 4 below. Meanwhile, the standard deviation of the control group in the post-test was lower than that of the control group. This implies that the individual scores of the students in the experimental group were more clustered around their overall mean than those of their control counterparts.

Testing of the Null Hypotheses

Hypothesis 1: There's no significant difference in the mean interest scores of students taught biology using outdoor laboratory activities and those taught using the lecture method.

Table 3: Summary of Analysis of Covariance Result of Mean Interest Scores of Students taught Biology using Outdoor Laboratory Activities, and the Lecture method

Tests of Between-Subjects Effects
Dependent Variable: Post-test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	46.30[a]	2	23.15	1200.35	0.00	0.98
Intercept	0.23	1	0.23	11.89	0.00	0.18
Pre-interest	46.26	1	46.26	2398.31	0.00	0.98
Group	0.10	1	0.10	5.07	0.03	0.08
Error	1.06	55	0.02			
Total	515.34	58				
Corrected Total	47.36	57				

a. R Squared = 0.978 (Adjusted R Squared = 0.977)

Table 3 shows the summary of the ANCOVA statistics, which were conducted to compare the experimental and control groups' interest in biology while controlling for the pre-interest effect. The results indicated that there was a statistically significant difference between the experimental and the control groups at p = 0.03. The partial Eta squared value of 0.08 obtained shows the magnitude of the effect size, which was considered small. Therefore, the null hypothesis one (Ho1), which states that there is no significant difference in the mean interest scores of students taught biology using outdoor laboratory activities and those taught using the lecture method, was therefore rejected at a 0.05 alpha level. This means that the earlier observed mean difference in the interest of the students in the two teaching strategies shown in Table 1 above was significant. This further

shows that the outdoor laboratory activities (OLA) were more effective in improving the students' interest in biology than the lecture method, under the experimental conditions of this study.

Hypothesis 2: There's no significant difference in the mean achievement scores of students taught biology using outdoor laboratory activities and those taught using the lecture method.

Table 4: Summary of ANCOVA Results of Mean Achievement Scores of Students taught Biology using Outdoor Laboratory Activities, and Lecture Method

Tests of Between-Subjects Effects
Dependent Variable: Post-test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	97.03[a]	2	48.51	9.60	0.00	0.26
Intercept	1707.47	1	1707.47	337.86	0.00	0.86
Pre-test	0.02	1	0.02	0.00	0.95	0.00
Group	92.31	1	92.31	18.27	0.00	0.25
Error	277.96	55	5.05			
Total	11715.00	58				
Corrected Total	374.98	57				

a. R Squared = 0.259 (Adjusted R Squared = 0.232)

Table 4 exhibits the summary of ANCOVA statistics, which was conducted to compare the effectiveness of the outdoor laboratory activities instructional strategy with the lecture method in improving students' academic achievement in biology while controlling for the pre-test effect. The results indicated that there was a significant difference between the experimental group and the control group at p = 0.00. The partial Eta squared value of 0.25 shows the magnitude of the effect size, which was considered small. Therefore, the null hypothesis two (Ho2), which states that there is no significant difference in the mean achievement scores of students taught biology using outdoor laboratory activities and those taught using the lecture method, was therefore rejected at a 0.05 alpha level. This means that the earlier observed mean difference between the two teaching methods, as shown in Table 2 above, was statistically significant. This further proves that the outdoor laboratory activities instructional strategy was more effective in improving the students' academic achievement in biology than the lecture method, under the prevailing experimental conditions of this study.

Discussion of Results

Effect of Outdoor Laboratory Activities on Students' Interest in Biology.

The result of Research Question 1 and Hypothesis 1 showed a significant difference in students' interest scores in Favor of the experimental group (OLA). The ANCOVA result revealed that the experimental group performed better in interest (F (1,55)= 5.07, p = 0.03), indicating that integrating Outdoor Laboratory activities, such as: School compound/garden-based activities,

Local Field trips, Excursions – stimulates students' curiosity and enhances their engagement in Biology.

This Finding therefore agrees with Ugwu (2023) and Rickinson et al (2023), whose findings showed that outdoor laboratory activities significantly increase students' interest in biology by helping to maintain their enthusiasm and attention.

The present result also agrees with the Interest Development Theory, which explains that situational triggers like novelty and hands – on experience can sustain interest when supported by meaningful tasks. This, outdoors Laboratory activities offer students the opportunities to see biology in action, thereby improving their willingness to learn. There has not been any research work yet that contradicts the findings that outdoor laboratory activities had an improving effect on Students' interest in biology.

Effect of Outdoor Laboratory Activities on Students' Academic Achievement in Biology.

The analysis of Research Question 2 and Hypothesis 2 revealed a significant difference in students' academic achievement scores in favor of the experimental group. The ANCOVA result showed that students taught OLA outperformed their counterparts in academic achievement ($F(1,55) = 5.05$, $p = 0.00$).

This finding resonates with Njoku and Mgbomo (2021) and Maikano (2022), who found that outdoor Laboratory activities help to improve students' retention of ecological concepts more than indoor lessons. This, therefore, helps to increase their academic excellence and achievement. The relatively small effect sizes observed (Partial Eta Squared value of 0.08 for interest and 0.25 for achievement) suggest that while OLA had a meaningful influence, other factors like logistical issues, for example, funding, teacher preparedness, and safety concerns, also contribute to learning outcomes. Not opposing, the present study therefore strengthens the evidence that Outdoor Laboratory activities are more effective than lecture methods on improving students' mastery of ecology-related topics like: ecosystem, component, and sizes; local biotic components, major biomes of the world, population studies by sampling method.

Conclusion

This study investigated the effect of outdoor laboratory activities on students' interest and achievement in biology among SS II students in Abakaliki, Ebonyi State. From the findings, it is clear that outdoor laboratory activities have a positive and significant influence on both interest and achievement when compared with the conventional lecture method. Students who participated in outdoor activities not only showed improved enthusiasm for learning biology but also performed significantly better in achievement tests covering ecological topics such as ecosystems, local biotic communities, major biomes, and population studies. The results, therefore, confirm that practical, field-based instructional methods are more effective than traditional classroom lectures in promoting meaningful learning.

References

Adeosun, M. I., Idowu, F., & Yara, P. O. (2022). Effects of virtual field trips on students' achievement and situational interest in ecology. *Advance Journal of Education and Social Sciences.*

Aghogho, L. G., & Hyelyankuri, D. (2023). Impact of outdoor learning resources on senior secondary school students' academic performance in biology concepts. *Gombe Journal of Education, 2*(1), 22–28.

Bada, S. O., & Olusegun, S. (2021). Constructivist learning theory: The foundation of modern pedagogy. *Journal of Education and Practice, 12*(3), 45–53.

Egwu, S. O., & Okigbo, E. C. (2021). Effect of field trip on secondary school students' academic achievement in ecology in Anambra State. *South Eastern Journal of Research and Sustainable Development, 4*(1), 140–156.

Gagare, H. B. (2024). The effectiveness of the outdoor laboratory strategy on academic performance and retention among senior secondary school biology students in Katsina State, Nigeria. *International Journal of Innovation Research and Advanced Studies.*

Hadiza, B. G. (2024). Outdoor laboratory strategy and academic performance and retention among senior secondary school biology students in Rimi Zone, Katsina State. *International Journal of Innovation Research and Advanced Studies.*

Hastika, A. D., Saefudin, & Supriatno, B. (2024). Exploring students' perceptions of outdoor biology learning activities in a botanical garden. *Jurnal Penelitian Pendidikan IPA, 10*(5), 2379–2387.

Maikano, S. (2022). Impact of outdoor and indoor laboratory experiences on secondary school biology students in ecology. *ATBU Journal of Science, Technology and Education.*

Njoku, M. I. A., & Mgbomo, T. (2021). Influence of outdoor laboratory instruction on secondary school students' interest and achievement in biology: Field trip and demonstration methods comparison. *Rivers State University Journal of Education.*

Ogbu, A., & Ede, A. (2023). Biology as a gateway subject: Implications for career choice in science. *Journal of Educational Development, 14*(4), 66–78.

Ogunleye, A. T. (2024). Effect of experiential learning strategy on biology senior secondary school students' academic performance in Ogun State. *Lagos Journal of Contemporary Studies in Education, 2*(2).

Olarinoye, S. A., & Abdul, M. A. (2022). Relevance of biology education in addressing contemporary environmental challenges. *International Journal of Biology Education, 11*(2), 14–23.

Rickinson, M., Dillon, J., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., & Benefield, P. (2023). A review of research on outdoor learning. *Journal of Education Research Review, 7*(2), 89–105.

Udu, D. A. (2020). Impact of Teacher Professional Development Programmes on Science Lecturers' Knowledge and Use of Modern Technologies in Teaching in Tertiary Institutions. Journal of the Nigerian Academy of Education (NAE), 16(1), 111-128.

Udu, D. A., Nmadu, S. J., Chidebe, C. U., Okechine, B. C., Anudu, A. P., & Precious, C. A. (2020). Non-randomized Trial of POGIL for Improving Undergraduates' Academic Achievement in Science Education. Universal Journal of Educational Research, 8(9), 4019 - 4027. DOI: 10.13189/ujer.2020.080927.

Udu, D. A. (2017). Effect of Cooperative Learning Instructional Strategy on Academic Retention of Senior Secondary School Students in Organic Chemistry. *African Journal of Science, Technology and Mathematics Education, University of Nigeria, Nsukka*. **3**(1), 133-146.

Yusuph, J. T., & Agbalajobi, M. K. (2023). The role of student interest in sustained learning and academic performance in science. *Journal of Educational Psychology, 11*(1), 7–20.

Yusuf, A., Ibrahim, M., & Suleiman, T. (2021). Impact of practical activities on students' academic achievement in biology in selected secondary schools in Sokoto State. *Journal of Educational Evaluation and Research, 9*(3), 45–56