

Effects of Indoor and Outdoor Learning Strategies on Performance and Retention in Biology Concepts among Secondary School Students in Adamawa State, Nigeria

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Abstract

This study investigated comparative effects of indoor and outdoor learning strategies on biology student's academic performance and retention in senior secondary schools of Adamawa State, Nigeria. Three research questions were raised and three null hypotheses were formulated and tested at 0.05 level of significance guided the study. The study adopted quasi-experimental design, which involves a pretest-posttest, post-posttest, non-equivalent, control group, design. The population of the study was 48,760 SSII biology students across five education zones of Adamawa State. A sample of 514 SSII biology students from four intact classes were purposively selected for the study. The instruments for data collection were adapted Biology Academic Performance Test (BAPT) which were subjected to face and content validation. The BAPT scores were subjected to K-R 21 to determine the reliability of the instrument. The reliability index of 0.78 was obtained. Data were analyzed using mean and standard deviation to answer the research questions, while ANCOVA and Independent sample t – test were used to test the hypotheses. The findings of the study revealed that: there is significant differences in the mean achievement scores of Biology students taught using indoor and outdoor learning strategies, $F_{(1, 191)} = 14.314, p < 0.00$, there is significant differences in the mean retention scores of Biology students taught using indoor and outdoor learning strategies, $F_{(1, 191)} = 8.513, p < 0.00$, there is significant gender difference on students' academic achievement in biology when taught with indoor and outdoor learning strategy. There is a significant difference in the mean retention scores of Biology students using the same learning strategies based on gender $F_{(1, 191)} = 0.000, p > 0.05$ Based on the findings it was recommended that, School administrators should encourage biology teachers to use teacher-students based activities such as indoor and outdoor learning strategies during teaching and learning of biology content.

Key words: Indoor, Outdoor, Gender, Learning Strategy, Students' Academic Achievement, Biology,

Introduction

Education is primarily concerned with the strategies and practices used to facilitate learning in schools. It serves as the channel through which a society passes on its accumulated knowledge, beliefs, and values to future generations (Amae, 2020). In essence, education equips learners to play meaningful roles in shaping and improving their communities. In today's world marked by rapid technological progress and continual innovation strengthening science education has become essential for any nation seeking to achieve or maintain advanced status (Aliyu & Mustapha, 2018). At the secondary level, one key role of science education is to help learners develop an organized scientific understanding that may support them in everyday problem-solving through subjects such as Biology, Chemistry, and Physics. Biology, in particular, focuses on the study of living organisms, exploring their features, structures, functions, interactions within their environments, genetic relationships, and patterns of distribution across different regions (Joda, 2018; Joda & Mohammed, 2017). The aim is to develop a thorough grasp of biological ideas that can lead to effective and meaningful instruction in



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Biology. Both indoor and outdoor learning experiences require attention to biological and environmental related factors that shape students' educational achievement. Indoor settings provide controlled environmental and physical conditions such as managed temperature, lighting, biology resources and adaphic factors that are designed to promote concentration and organized teaching (Okon, 2015; Joda, 2018).

Indoor Learning strategy refers to situations where students are taught using laboratory method within the four corners of a classroom (Reid, 2018). This approach relies on teacher led instruction, predetermined curricula, organized schedules, and a variety of teaching materials, including books and digital technologies. Indoor settings are stocked with numerous learning resources such as classrooms and that support high-quality teaching (Yaşin, 2016; Priest, 2024). As a result, the structured nature of indoor learning often helps students meet their academic performance. Such environments can also ease student anxiety and promote a sense of inclusion, thereby enriching the overall learning experience. On the other hand, Outdoor learning strategy include excursions and fieldwork carried out in open-air environments ranging from school compounds to community sites such as botanical garden where students can interact directly with real-life materials and situations (Moses, 2018). Such methods strengthen the bond between schools and their surrounding communities, giving students a stronger sense of context and relevance in what they learn (Okon, 2015; Tsai & Yaşin, 2016). According to Richmond et al. (2018) outdoor education enhances social connectedness by increasing students' sense of belonging and improving peer relationships. Learning beyond the classroom enables students to engage with their surroundings in ways that encourage creativity, inquiry, and active, hands-on learning (Harun & Salamuddin, 2017; Morohunfolo, 2020). Consequently, outdoor learning can foster better collaboration, greater self-confidence, stronger leadership skills, and improved academic outcomes. Another contributor to students' low achievement is gender-related factors. Gender encompasses the socially defined roles, expectations, and characteristics that a society assigns to males and females. Research has documented gender gaps in science performance, often tied to cultural, social and psychological factors that shape learners' attitudes and participation in science subjects (Lappin, 2019). Edarho (2020) found that male students performed better than females when taught science through outdoor methods, showing significantly higher retention scores. Other studies, however, indicate that gender does not substantially affect students' retention; when given equal learning opportunities, both boys and girls can perform equally well (Ma, 2017; Kolawole & Popoola, 2017; Joda & Mohammed, 2019; Nzeri, 2024). Conversely, some researchers have reported notable differences in biology performance and retention in favor male students (Ariyo, 2016; Onah & Ugwu, 2019). Therefore, this study seeks to examine comparative effects of indoor and outdoor learning strategies on biology students' academic performance and retention in senior secondary schools in Adamawa State, Nigeria.

Statement of the Problem

In spite of the importance of Biology, it is alarming to note that most students still see and learn Biology as an abstract subject which may be as a result of ineffective use of the teaching strategies. Statistical report of students' performance in 2018 - 2024 respectively showed that out of 31,134 candidates examined for Biology in May/June WASSCE, 32.41% candidates failed. 25.32% failed in Biology in 2023 and 39.65% failed in Biology in 2024. This situation is disturbing and not in the best interest of the science and technological growth and development of Adamawa State in particular and the nation at large. The low achievement and weak retention seen among biology students' issues central to this study have been linked to students' lack of interest in certain biology topics such as ecology, genetics, and classification, as well as the reliance on teaching methods that do not adequately support or engage learners (Isiugo-Abanihe, Long & Ibiene, 2018). The problem of this study therefore, is to investigate the comparative effects of indoor and outdoor learning strategies on biology student's academic performance and retention in senior secondary schools of Adamawa State, Nigeria.

Purpose of the Study

The purpose of the study is to determine the comparative effects of indoor and outdoor learning strategies on biology student's academic performance and retention in senior secondary schools of Adamawa State, Nigeria. The specific objectives of the study are to compare the:

1. Effect of indoor and outdoor learning strategies on Biology students' academic performance in senior secondary schools of Adamawa state.



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2. Effect of indoor and outdoor learning strategies on Biology students' retention in senior secondary schools of Adamawa state.
3. Effect of indoor and outdoor learning strategy of male and female biology students' performance in senior secondary schools of Adamawa state

Research Questions

The following research questions are formulated to guide this study.

1. What are the pretest and posttest mean performance scores of biology students when taught with indoor and outdoor learning strategies?
2. What are the pretest and posttest mean retention scores of biology students when taught with indoor and outdoor learning strategies?
3. What are the pretest and posttest mean performance scores of male and female biology students when taught with indoor and outdoor learning strategies?

Research Hypotheses

The following null hypotheses were formulated and will be tested at 0.05 levels of significance to guide the Study;

- H₀₁:** There is no significant difference in the mean pretest and posttest performance scores of biology students taught with indoor and outdoor learning strategies in senior secondary schools of Adamawa state.
- H₀₂:** There is no significant difference in the mean pretest and posttest retention scores of biology students taught with indoor and outdoor learning strategies in senior secondary schools of Adamawa state.
- H₀₃:** There is no significant difference in the mean pretest and posttest performance scores of male and female biology students taught with indoor and outdoor learning strategies in senior secondary schools of Adamawa state by gender

Methodology

This study employed pretest-posttest, post-posttest quasi-experimental group design. The area of the study is Adamawa State Nigeria. The population of the study consist of 48,760 of all the senior secondary school SS II biology students in Adamawa state. Sample of this study was 192 Biology SS II students' were draw from four intact classes of Senior Secondary Schools (SSS II) in Numan Education zone of Adamawa State. Purposive sampling techniques were used to select four senior secondary schools from the three education zones. The sampled students in each intact class were randomly assigned to experimental groups I and II by ballots. The first two picked papers were assigned as experimental group I (indoor learning). The second two picked papers were assigned as experimental group II (outdoor learning). The selected biology teachers in each school followed the school time table as provided by the school management. The instrument used was Biology Academic Performance Test (BAPT) which contains 50 items. The instrument consists of 50 multiple choice objective tests items with four options (A-D) with one key and three distracters developed to assess the academic performance of the groups. The instrument was adapted from West African examination past question papers from 2019-2024 in biology. The instrument was delimited to Ecology, classification of living things, and environmental biology. The Biology Academic Performance Test (BAPT) was subjected to face and content validity. To ensure the quality, reliability, and internal consistency of the Biology Academic Performance Test (BAPT), the instrument was subjected to a pilot test involving 30 SS II students from Government Day Senior Secondary School Demsa in the Numan Education Zone. The BAPT was analyzed using the Split-Half Method, and the internal consistency was calculated using the Kuder-Richardson Formula 21 (K-R21). A reliability coefficient of 0.78 was obtained. The first week pre-test was administered to both the experimental I and II groups. Indoor and outdoor strategies were carryout for four weeks. The Experimental Groups 1 were taught using the Indoor strategy in the biology in the classroom and experimental group 2 were taught using outdoor teaching strategy outside the classroom environment. After the treatment, post-test were administered to the experimental groups which lasted for one week. The same Biology Performance Test for the pretest and posttest were administered to the subjects as the post post-test (Retention test) which took place two weeks after administration. The BPT were reshuffled as post post test to determine the retention after two weeks of administration. The data collected were analyzed using mean and standard deviation to answer the 3 research questions. For testing the 3 null hypotheses, the Analysis of Covariance (ANCOVA) and Independent Sample *t* – Test were tested at a 0.05 level of significance. The decision rule to be taken on testing the hypothesis is that if $P < 0.05$ level of significance, reject the null hypothesis and if the $p > 0.05$ level of significance do not reject the hypothesis.



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Presentation of Results

Research Question 1: What are the pretest and posttest mean performance scores of biology students when taught with indoor and outdoor learning strategies?

Table 1: Mean and Standard Deviation of Pre – Test and Post Test Scores Difference of Students Taught with Indoor and Outdoor Learning Strategies.

Group	N	Pre – test		Post – test		Mean difference
		M	S. D	M	S. D	
Indoor	97	25.12	7.01	38.13	6.19	13.01
Outdoor	95	24.30	6.63	43.72	10.92	19.42

Table 1 presents the mean and standard deviation of pretest and posttest scores for students taught Biology using two different instructional strategies: indoor and outdoor learning strategy. In the indoor group, the pretest mean score was 25.12 with a standard deviation of 7.01, while the posttest mean score increased significantly to 38.13 with a standard deviation of 6.19. This resulted in a mean difference of 13.01, indicating a substantial improvement in students' achievement after the intervention. For the outdoor group, the pretest mean score was 24.30 with a standard deviation of 6.63, and the posttest mean score was 43.72 with a standard deviation of 10.92, yielding a mean difference of 19.42. This group also showed a significant improvement, with the outdoor learning showing the highest mean difference, followed closely by the indoor learning strategy.

Research Question 2: What are the pretest and posttest mean retention scores of biology students when taught with indoor and outdoor learning strategies?

Table 2: Mean and Standard Deviation of Post Test and Retention Scores Difference of Students taught Biology using Indoor and Outdoor Learning Strategies

Group	N	Post – test		Retention		Mean difference
		M	S. D	M	S. D	
Indoor	97	38.13	6.19	42.05	5.34	3.92
Outdoor	95	43.72	10.92	49.13	6.03	5.41

Table 2 provides the mean and standard deviation of posttest and retention scores for the same groups. In the indoor group, the posttest mean score was 38.13 with a standard deviation of 6.19, and the retention mean score was 42.05 with a standard deviation of 5.34, resulting in a mean difference of 3.92. For the outdoor group, the posttest mean score was 43.72 with a standard deviation of 10.92, and the retention mean score was 49.13 with a standard deviation of 6.03, yielding a mean difference of 5.41.

Research Question 3: What are the pretest and posttest mean performance scores of male and female biology students when taught with indoor and outdoor learning strategies?

Table 3: Mean and Standard Deviation of Pre – Test and Post Test Scores Difference of Male and Female Students taught Biology using Indoor and Outdoor Learning Strategies

Group	Gender	n	Pre – test		Post – test		Mean difference
			M	S. D	M	S. D	
Indoor	Male	53	11.34	2.01	15.67	3.22	4.33
	Female	44	13.07	3.70	18.34	2.01	5.27
Outdoor	Male	52	10.59	3.10	23.03	5.31	12.44
	Female	43	14.27	4.82	20.63	7.02	6.36

Table 3 examines the mean and standard deviation of pretest and posttest scores for male and female students taught Biology using the same learning strategies. In the indoor group male students had a pretest mean score of 11.34 with a standard deviation of 2.01, and a posttest mean score of 15.67 with a standard deviation of 3.22, resulting in a mean difference of 4.33. Female students had a pretest mean score of 13.07 with a standard deviation of 3.70, and a posttest mean score of 18.34 with a standard deviation of 2.01, yielding a mean difference of 5.27. For the outdoor group, male students had a pretest mean score of 10.59 with a standard deviation of 3.10, and a posttest mean score of 23.03 with a standard



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deviation of 5.31, resulting in a mean difference of 12.44. Female students had a pretest mean score of 14.27 with a standard deviation of 4.82, and a posttest mean score of 20.63 with a standard deviation of 7.02, yielding a mean difference of 6.36. These results indicate that female students generally showing slightly higher mean differences in the indoor while male students performing better than female in the outdoor learning strategy.

Hypotheses Testing

H₀₁: There is no significant difference in the mean pretest and posttest performance scores of biology students taught with indoor and outdoor learning strategies in senior secondary schools of Adamawa state

Table 4: Summary of ANCOVA of Difference between the Mean Academic Achievement Scores of Students taught Biology using Indoor and Outdoor Learning Strategies

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2837.761a	2	753.701	9.310	.000	.193
Intercept	16701.490	1	16701.490	152.531	.000	.233
Pretest	53.682	1	53.682	.649	.462	.003
Learning Strategies	2370.108	1	2185.054	14.314	.000	.407
Error	10763.327	190	87.583			
Total	274323.000	192				
Corrected Total	141274.510	191				

a. R Squared = .169 (Adjusted R Squared = .151)

The ANCOVA results in Table 4 reveal significant differences in the mean achievement scores of Biology students taught using different instructional strategies, $F_{(1, 191)} = 14.314$, $p < 0.00$. Since the computed p-value (0.00) is less than 0.05 level of significant, therefore, the null hypothesis of no significant difference is rejected. This implies that there is significant difference in the achievement scores of students taught biology with indoor and outdoor learning strategies in senior secondary schools of Adamawa state.

H₀₂: There is no significant difference in the mean pretest and posttest retention scores of biology students taught with indoor and outdoor learning strategies in senior secondary schools of Adamawa state

Table 5: Summary of ANCOVA of Difference between the Mean Retention Scores of Students Taught Biology using Indoor and Outdoor Learning Strategies

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2623.497a	3	874.499	9.809	.000	.169
Intercept	17086.807	1	17086.807	191.652	.000	.569
Pretest	94.951	1	94.951	1.065	.304	.007
Learning Strategies methods	2385.211	2	1192.606	8.613	.000	.516
Error	12927.537	190	89.155			
Total	292085.000	192				
Corrected Total	15551.034	191				

a. R Squared = .169 (Adjusted R Squared = .152)

The ANCOVA results in Table 5 indicate significant differences in the mean retention scores of Biology students taught using different instructional strategies, $F_{(1, 191)} = 8.513$, $p < 0.00$. Since the computed p-value (0.00) is less than 0.05 level of significant, therefore, the null hypothesis of no significant difference is rejected. This implies that there is a significant difference in the achievement retention scores of students taught biology with indoor and outdoor learning strategies in senior secondary schools of Adamawa state.

H₀₃: There is no significant difference in the mean pretest and posttest performance scores of biology students taught with indoor and outdoor learning strategies in senior secondary schools of Adamawa state by gender

Table 6: Summary of Independent Sample t – Test of Students' Academic Achievement Based on Gender when Taught Biology with Indoor and Outdoor Learning Strategies

Achievement scores	Gender	n	Mean	S. D	DF	t – value	P – value	Remarks
Indoor learning strategy	M	53	18.6023	8.5735	96	7.531	0.001	H ₀₃ rejected
	F	44	20.6808	6.3764				



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Outdoor learning strategy	M	52	25.5741	10.4065	95	3.175	0.000	H ₀₃ rejected
	F	43	23.3005	18.4701				

From Table 6, presents the analysis of independent sample *t* – test of students’ academic achievement based on gender when taught biology with indoor and outdoor learning strategies. For students taught using indoor learning strategy $t=7.531$; $df=(1, 96)$, $P<0.05$. Since the computed P-value (0.000) is less than 0.05 level of significance, the null hypothesis is rejected. This implies that there is significant gender difference on students’ academic achievement in biology when taught with indoor learning strategy. Also, For students taught using outdoor, $t=3.175$, $df = (1, 95)$, $P<0.05$. Since the computed P-value (0.000) is less than 0.05 level of significance, the null hypothesis is rejected. This implies that there is significant gender difference on students’ academic achievement in biology when taught with outdoor learning strategy.

Findings of the Study

1. There significant difference in the achievement scores of students taught biology with indoor and outdoor learning strategies in senior secondary schools of Adamawa state.
2. There significant difference in the retention scores of students taught biology with indoor and outdoor learning strategies in senior secondary schools of Adamawa state.
3. There is significant gender difference and treatment on students’ academic achievement in biology.

Discussion of Findings

There significant difference in the achievement scores of students taught biology with indoor and outdoor learning strategies in senior secondary schools of Adamawa state. These findings align with Eriwell (2021) reported that students taught biology through outdoor instruction outperformed those taught indoors. In the same vein, Olagunju and Oloyede (2021) found that outdoor learning experiences significantly improved students’ environmental attitudes. Jeremiah (2023) also observed that teaching ecological concepts was more effective when delivered through outdoor methods. Conversely, Jan-Erik (2018) and Saroja (2023) showed that indoor and outdoor learning approaches work best when used together, as both contribute to enhancing students’ academic achievement. Their studies further indicated that students generally expressed a preference for outdoor settings when learning science. Overall, outdoor learning serves as a valuable supplement to conventional classroom instruction, particularly in encouraging students to be more physically active. The result also show there significant difference in the achievement retention scores of students taught biology with indoor and outdoor learning strategies in senior secondary schools of Adamawa state. The findings of this study are consistent with Emmanuel (2024), who reported a significant difference in students’ retention scores when comparing those taught through outdoor activities with those taught using the lecture method. Similarly, Oyovwi (2020) and Berberoğlu (2020) found that students who learned in outdoor environments such as ecological parks, botanical gardens and conservation areas demonstrated much stronger conceptual understanding and longer-lasting retention than students taught with indoor learning strategy. The findings also indicated that there is significant gender difference and treatment on students’ academic achievement in biology. This finding agreed with Edarho (2020) found a significant difference in the mean retention scores between male and female students taught science with outdoor science activities in favour of male students. Saidu and Suleiman (2024) revealed that there was no significant change in the performance of students at different ability levels but gender played a significant role in the performance of students in biology. On the contrary, Adesoji (2018) found no significant difference in academic performance between male and female students after exposure to outdoor laboratories. This implies that indoor and outdoor learning strategies are gender friendly at different levels and also improve student performance.

Conclusion

The study concluded that both indoor and outdoor instructional approaches influence biology students’ performance and retention in senior secondary schools in Adamawa State. However, outdoor learning proved to be more effective than indoor methods. Additionally, both strategies were found to be supportive and suitable for learners of all genders.

Recommendations

Based on the findings of this study, the following recommendations are made;

1. School administrators should encourage biology teachers to integrate both indoor and outdoor, activity-based instructional strategies that actively involve students in learning process.



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2. School administrators should support biology teachers by organizing seminars and workshops focused on how to implement effective indoor and outdoor teaching strategies.
3. School administrators should encourage biology teachers to actively involve both male and female students in lessons, ensuring that indoor and outdoor learning strategies are integrated during instruction

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