



**EFFECT OF LABORATORY METHOD ON THE ACADEMIC PERFORMANCE OF
SECONDARY SCHOOL STUDENTS' IN BIOLOGY IN ETHIOPE WEST LOCAL
GOVERNMENT AREA OF DELTA STATE**

ELOHOR AKPENI

Department of Biology, Demonstration Secondary School,
Delta State College of Education, Mosogar, Delta State.
akpenielohor1@gmail.com
09076064212

ISAAC EFE AKPOMEMIYERE

Department of Mathematics, School of Sciences,
Delta State College of Education Mosogar, Delta State.
isaac.efe@descoem.edu.ng isaacefe2@gmail.com
08034131247

Abstract

The study examined the effect of Laboratory method on the academic performance of Secondary School Students' in Biology in Ethiope West L.G.A of Delta State .Three research questions were raised and three hypotheses were formulated and tested. The study adopted a quasi-experimental design. A total of 200 SSS2 Students' were randomly Selected from five public secondary schools and divided into experimental (110) and control groups (90). The experimental group received instruction using the laboratory method, while the control group was taught using the traditional (lecture) method. Data was collected using the Biology Students' Achievement Test (BSAT) and a structured questionnaire which was validated by experts and analyzed using independent sampled t-test and ANOVA at 0.05 level of significance. The reliability coefficients for BSAT using Cronbach's Alpha was 0.70.The instruments indicated that they are reliable. The findings of the study revealed that: students' taught using the laboratory method perform significantly better than those taught through lecture; students who frequently participated in laboratory practical showed significantly more positive attitudes than those who did not; there was no significant difference in performance between male and female students. The study concludes that the laboratory method is an effective instructional strategy for improving students' achievement and interest in Biology. Based on these findings, the study recommends, among others, that to improve students' academic performance in Biology, Biology teachers' should adopt laboratory teaching methods regularly.

Keywords: Laboratory Method, Traditional Method, Biology, Academic Performance, Secondary School

Introduction

Biology is a core science subject which plays a critical role in shaping the scientific literacy and competence of senior secondary school students, especially for those aspiring to careers in medicine, nursing, pharmacy, Zoology, agriculture, biotechnology, and environmental science (Eze, 2017). Biology is defined as the study of life, it is evolution and the structures, functions, processes and interactions with each other and with their environment. The general goal of biology teaching is to equip the learner with the basic knowledge, skills and attitudes that will enable one to live an independent and useful life both to himself/ herself and the larger community in which he/she lives (NERDC, 2013). Furthermore, one primary function of biology teaching is to help students understand biology concepts, principles, theories and laws. In Nigeria, the importance of Biology in the secondary school curriculum cannot be overemphasized, as it is a requirement for various science-related



disciplines in tertiary institutions (Achor & Imoko, 2015). However, over the years, the academic performance of students in Biology has been a source of concern for educators, policymakers, and stakeholders in the educational sector, particularly in Ethiope West Local Government Area of Delta State. Various studies have shown that ineffective teaching method is a significant factor contributing to students' poor performance in science subjects (Ezeudu & Essien, 2020; Adebayo & Musa 2020). Traditional teaching approaches such as the lecture method emphasized that rote memorization and passive learning, often fail to stimulate students' interest, critical thinking, and practical understanding of scientific concepts (Ezeudu et al., 2016 & 2017). In contrast, the laboratory method has been identified as a more effective educational strategy that enhances experiential learning, conceptual understanding, and academic performance in science subjects (Udo & Essien, 2020; Akinola & Fatima, 2020; Tanimu & Usman, 2024; Dairo et al., 2024).

Laboratory method involves hands-on activities, experiments, and practical investigations that enable students to construct knowledge through inquiry and exploration (Adebayo & Musa, 2021; Avbenagha, et al., 2024). It bridges the gap between theory and practice, providing students with opportunities to apply scientific principles in real-world contexts. WAEC (2019) recommended that Biology teachers' should upgrade their teaching skills to modern methodology of teaching/learning of Biology. Laboratory method can clarify abstract concepts such as cell division, photosynthesis, and osmosis, making them more comprehensible and engaging for students (Chukwu & Adebayo, 2018). The use of laboratory method also fosters collaborative learning and improves students' problem-solving skills, which are essential for academic success and lifelong learning. Even though the proven benefits of laboratory instruction, its implementation in many Nigerian schools, particularly in rural and semi-urban areas like Ethiope West, it remains limited due to challenges such as inadequate laboratory facilities, insufficient instructional materials, and lack of trained science teachers (Okonkwo & Eze, 2022). These challenges often subject teachers to resort to less effective teaching methods, which adversely affect students' academic achievement in Biology.

Modern educational reforms and policies have emphasized the need for learner-centered and activity-based instructional approaches to improve science education outcomes in Nigeria (Federal Ministry of Education, 2020). Hence, there is a growing interest in evaluating the effectiveness of the laboratory method on students' academic performance, particularly in specific local contexts like Ethiope West Local Government Area. Understanding how the laboratory method influences learning outcomes in Biology within this context is crucial for informing teaching practices, curriculum development, and policy decisions aimed at improving science education. Eze & Nwosu (2018) opined that Laboratory instruction leads to improved academic achievement, increased interest in science and a better attitude towards learning. In Nigeria, the federal government through its National policy on education recommends the use of practical and experimental methods in the teaching of science subjects. In spite of the policy, many schools still struggle with inadequate laboratory equipment, untrained teachers, and insufficient instructional materials in teaching of science subjects. According to Adebayo and Oyekan (2020), Scholars have attributed this trend to several factors including poor instructional strategies lack of interest, limited resources and the dominance of lecture -based teaching methods. This study aim at investigating the effect of laboratory method in enhancing the academic performance of students in biology in some selected schools, Ethiope West local Government Area of Delta State, Nigeria. It seeks to find out whether students taught using laboratory instruction perform better than students taught using lecture or traditional method.

Statement of the Problem

In spite of the various emphases on practical methods of teaching science (Biology), many secondary schools in Nigeria still rely heavily on traditional methods of teaching due to lack of laboratory facilities, shortage of instructional materials, and limited teacher training. Consequently, abstract biological concepts are often taught without hands-on laboratory instruction, affecting students' understanding and retention. This affects the understanding and retention of the subject matter. Biology, as a core science subject in senior secondary schools, plays a crucial role in students' understanding of life processes and their application in real-world situations. However, despite the importance of biology in national development and its relevance to careers in medicine, agriculture, and biotechnology,



students' academic achievement and retention in the subject remain a major concern. Studies and examination reports have consistently highlighted poor performance and low retention rates among secondary school students in biology. This issue raises critical questions about the teaching methods employed in schools, particularly the use of laboratory instructions. Traditional teaching methods, which are often theoretical and teacher-centered, have been widely used in Nigerian secondary schools. Teachers' may not adequately engage students or facilitate long-term retention of biological concepts. Laboratory-based instruction, which involves hands-on experiments, observations, and practical applications, is believed to enhance students' understanding and memory retention. Despite this potential, many schools either underutilize laboratory instruction or lack the necessary facilities and trained personnel to implement it effectively. This situation creates a gap in knowledge regarding the impact of laboratory instruction on students' academic achievement in biology. Furthermore, there is limited empirical research examining the specific effects of laboratory instruction on students' performance and retention, particularly in the Nigerian context. Many studies have focused on general teaching methods without isolating the role of laboratory instruction. As such, it is unclear whether laboratory-based teaching significantly improves students' understanding and long-term retention compared to conventional teaching methods. This gap necessitates an investigation into the effectiveness of laboratory instruction in enhancing students' academic achievement in senior secondary school Biology.

Therefore, this study seeks to determine the effect of laboratory method on the academic achievement of students in Biology and to find out whether frequent use of laboratory instruction method, attitude and gender influences students' performance senior in secondary schools. It aims to provide evidence-based recommendations for educators, policymakers, and curriculum developers to improve the teaching and learning of biology in senior secondary schools in Ethiope West LGA, Delta State.

Objectives of the Study

1. To find out if students who participate in laboratory practical perform similarly as those who do not.
2. To find out if Biology students who participate in laboratory activities exhibit more positive attitudes towards Biology than those who do not participate.
3. To investigate the influence of gender on students' academic achievement when taught using laboratory Methods in Ethiope West local Government Area of Delta State.

Research Questions

The following research questions guided the study:

1. Is there a difference between the frequency of students who participate in Biology laboratory practical and those who do not participate?
2. Do students who participate in laboratory activities exhibit more positive attitudes towards Biology practice than those who do not participate?
3. Are there differences in mean of students who participate in biology practical based on gender?

Hypotheses

The following null hypotheses were formulated for testing at $p < 0.05$

1. There is no significant difference between frequency of students who participate in biology practical and those who do not.
2. There is no significant difference in attitude score between students who participate in laboratory practical and those who do not participate in laboratory practical.
3. There is no significant difference on biology achievement of students who participate in biology practical in the laboratory based on gender.

Methodology

The research adopts a quasi-experimental design. This design was suitable as it enabled the researchers to compare the academic performance of students taught using the laboratory method with those taught using traditional lecture methods. The design was non-randomized, meaning students in the selected schools were not randomly assigned to experimental or control groups. However, the pre-test and post-



test method was used to compare the performance before and after intervention. The target population for this study consists of Senior Secondary School (SS2) students offering Biology in all the secondary schools in Ethiopie West Local Government Area of Delta State, Nigeria. According to the records from the Ministry of Education Oghara (2025), 1200 SS2 students enrolled in Biology in the 24 public secondary schools across the Local Government Area. A purposive sampling technique was used to select schools and students. Purposive sampling ensured that schools with varying levels of academic performance in Biology were included. The steps involves in sampling was as follows:

Selection of Schools: From the list of schools in Ethiopie West Local Government Area, 5 schools were purposively selected. The schools were categorized based on their academic performances in Biology to ensure diversity in the sample.

Selection of Students: From each school, 40 students were randomly selected to participate in the study, giving a total sample size of 200 students. This includes students' who has consistently shown interest and aptitude in Biology. To collect data for this study, the following instruments were used: Section A: Biology Students' Achievement Test (BSAT): A pre-test and post-test was developed to assess students' academic performance in Biology. The 30-item test will cover topics commonly taught in SS2, focusing on the practical aspects of Biology.

Pre-Test: The test was administered to all the students before and after the intervention to establish a baseline measure of their knowledge and academic performance.

Post-Test: The test was administered after the intervention to assess any changes in students' performance due to the laboratory method.

Section B: Questionnaire for students: A structured questionnaire was used to gather students' opinions on the interest of students and frequency of the use of laboratory practical in biology. The questionnaire was designed to capture information about students' interest in carrying out biology practical and the number of times such practical were done. The validity of the instruments was established through expert judgment. The Biology Students' laboratory Achievement Test (BSAT) was reviewed by experts in the field of Biological Science, Measurement and Evaluation to ensure they are appropriate for the research context. Based on their feedback, necessary adjustments were made. To ensure the reliability of the instruments, a pilot test was conducted on a small sample of students in a school similar to those selected for the study but not included in the final sample. The test- retest method was used to determine the consistency of the instruments. The reliability coefficient was calculated using Cronbach's Alpha for internal consistency. A reliability coefficient of 0.70 or higher was considered acceptable for the study. The following steps were taken to collect data for the study:

1. **Pre-Test Administration:** The pre-test was administered to both the experimental and control groups before the intervention. It was conducted in the participating schools during regular school hours.
2. **Implementation of the Intervention:** All the students were given a pre-test and then were taught on biology practical topics throughout the 6 weeks period and these activities were in the Biology laboratory. After the 6-weeks Biology practical session, a post test was given. **Post-Test Administration:** After the 6-week intervention, the post-test was administered to the students to assess any changes in their academic performance in Biology.

The data were analyzed using both descriptive and inferential statistics: **Descriptive Statistics:** Mean, standard deviation, and percentage were used to summarize the demographic information of the students, their responses to the questionnaires, and their scores on the pre-test and post-test. **Inferential Statistics:** An independent sampled t-test and ANOVA where was used to compare the academic performance (pre-test and post-test scores) of the experimental group (laboratory method) and the control group (lecture method). Hypothesis 1 and 2 were analyzed with t-test while Hypothesis 3 was analyzed using ANOVA statistics. The significance level was set at 0.05, meaning that any difference with a p-value less than 0.05 will be considered statistically significant.

Results

Research Question One: Will there be a difference between frequency of participation in biology practical and student's achievement in Biology achievement test?



Table 1: Frequency of participation in biology practical and students’ achievement

Frequency of participation	Mean	N	Std. Deviation
very frequent	12.87	38	2.00
Frequent	12.89	47	2.27
not frequent	11.80	25	3.32
Total	12.63	110	2.48

The table 1 shows that the mean of the students who participated very frequently in Biology practical is 12.87, while the means of those who participated frequently is 12.89. Those who did not participate frequently have a mean of 11.80. The results show that the means are close but a test of hypothesis three showed whether the differences are significant or not.

Research Question Two: Do students who participate in laboratory activities exhibit more positive attitudes towards Biology practice than those who do not participate?

Table 2: Attitude scores of students who carry out practical in laboratory and those who do not

	Physical location	N	Mean	Std. Deviation	Std. Error Mean
Attitude score	Laboratory	110	32.25	8.25	0.79
	Classroom	90	22.92	10.64	1.12

Table two shows the attitude mean scores and standard deviation of students who carry out practical in laboratory and those who do not. There is a difference in mean of those who carry out practical in the laboratory (32.25) and those who do not (22.92). The independent sampled t-test analysis in hypothesis will tell if the difference is significant or not.

Research Question Three: Are there differences in means of students who participate in Biology practical based on gender?

Table 3: Biology Achievement of those who participate in Biology Practical in the Laboratory by Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
BSAT	Male	58	12.66	2.20	0.29
	Female	52	12.62	2.78	0.39

Table 3 shows the means and standard deviation of the students. The means and standard deviation for the males is 12.65, 2.20 while for the females is 12.61 and 2.78. The result shows there is a slight difference in favor of the males. The test of hypothesis will show if the difference is significant or not

Hypotheses One: There is no significant difference between frequency of participation in Biology practical and students’ achievement.

Table 4: Frequency of participation in biology practical and students’ achievement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	22.644a	2	11.322	1.867	.160
Intercept	16107.641	1	16107.641	2656.428	.000
Frequency	22.644	2	11.322	1.867	.160
Error	648.810	107	6.064		
Total	18236.000	110			
Corrected Total	671.455	109			

a. R Squared = .034 (Adjusted R Squared = .016)

Table 4 shows that the means of students who participate very frequently in Biology practical in their laboratories is 12.86 followed by those who participate frequently (12.89), and the means of those who do not participate is 12.63. The ANOVA test shows calculated value $F=1.86 < 3.84$ table value and $p=0.160 > 0.00$, means an acceptance of the hypotheses 1, that there is no significant difference between frequency of participation in biology practical and student achievement in Biology.



Hypothesis Two: There is no significant difference in attitude score between students who participate in laboratory practical and those who do not in favor of those who participate in laboratory practical.

Table 5: Independent Sampled t-Test for attitude score of students taught biology Practical in laboratory and classroom

		t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
attitude score	Equal variances assumed	6.988	198	0.000	9.33	1.34
	Equal variances not assumed	6.815	165.419	0.000	9.33	1.37

The table 5 shows that the attitude score means of the students’ who participated in laboratory practical is 32.25 and those who do not have an attitude mean score of 22.92. The t-test result shows that there is a significant difference with a calculated t-test result of 6.98 > 1.96 table value and $p=0.00 < 0.05$. Therefore, hypotheses two is rejected meaning there is a significant difference between those who participate in laboratory practical and those who do not in favor of those who participate.

Hypotheses Three: There is no significant difference on Biology achievement of students who participate in biology practical in the laboratory based on gender.

Table 6: Independent Sampled t-test analysis of students taught

		t-test for Equality of Means				
		T	df	Sig. (2-tailed)	(2-Mean Difference)	Std. Error Difference
BSAT	Equal variances assumed	.084	108	0.93	0.04	0.48
	Equal variances not assumed	.083	97.099	0.93	0.04	0.48

The independent sampled t-test analysis shows t calculated value (0.084) is lesser than the t critical or t-table value of 1.96. Thus, hypothesis three is accepted, meaning there is no significant difference in the achievement of students who participate in biology practical based on gender.

Discussion of Findings

This study investigated the effect of laboratory methods on the academic performance of senior secondary school students in Biology in Ethiope West Local Government Area of Delta State, Nigeria. The result of the study revealed that students who participated in laboratory practical had significantly higher achievement scores in the Biology test compared to those who did not participate. This indicates that the laboratory method positively influenced students’ academic performance. This finding supports the work of Adebayo and Musa (2024), Avbenagha et al. (2024) and Udo and Essen (2020), who found that hands-on, activity-based learning strategies improve students’ understanding and retention in science subjects.

Moreover, the study found a significant difference in attitude between students who participated in laboratory practical and those who did not. Those who engaged in laboratory activities had a more positive attitude toward Biology. This is in agreement with the findings of Avbenagha et al. (2024); Okonkwo and Eze (2023); and Akinola and Fatima (2020), who emphasized that practical activities increase student interest, motivation, and engagement in learning science subjects. The study revealed that students who frequently participated in laboratory practical had slightly higher mean scores than those who participated less frequently. The difference was not statistically significant. This suggests that the quality and exposure to laboratory work may be more important than the frequency of participation alone.



Furthermore, the study showed that gender had no significant effect on the academic performance of students in Biology practical. Both male and female students performed similarly, indicating that when given equal opportunities, both genders can excel in science subjects. This is in line with the findings of Adebayo and Musa (2024) and Avbenagha et al. (2024), who reported that gender is not a barrier to achievement in science if the teaching approach is effective.

Conclusion

The study revealed that laboratory method of teaching significantly enhance students' academic performance and attitude in Biology if frequently used and gender do not significantly influence achievement when students' are exposed to practical-based learning.

Recommendations

Based on the results obtained from this research, the following recommendations were made:

1. Biology teachers should adopt laboratory methods regularly to improve students' understanding and performance in the subject.
2. School administrators should ensure that well-equipped laboratories are available and accessible to students in both public and private schools.
3. Educational policy makers should integrate more practical sessions into the senior secondary school Biology curriculum.
4. Workshops and training should be organized for teachers to improve their skills in facilitating practical sessions effectively.
5. Gender-sensitive policies should continue to be implemented to ensure equal opportunities for both male and female students in science education.
6. Provisional association like the Science Teacher Association of Nigeria (STAN), Biology Society of Nigeria (BSN) and research centers such as Nigeria Educational and Research Development Council (NERDC) should incorporate laboratory instruction in their science curricular at secondary school level to encourage the use of the strategy among teachers. They should also organize workshops and seminars on how to use laboratory instruction to teach specific biology topics.

References

- Achor, E. E., & Imoko, B. I. (2015). Comparative effects of two problem-solving models on students' academic achievement in Biology. *Journal of Science Teachers Association of Nigeria*, 50(1), 28–35.
- Adebayo, A., & Musa, H. (2024). Effectiveness of virtual laboratory in teaching biology in Nigerian secondary schools. *Nigerian Journal of Educational Technology*, 19(1), 45–58.
- Akinola, O. O., & Fatima, B. (2021). Improving student performance in biology using guided laboratory practices. *Journal of Biology Education and Research*, 4(2), 85–94
- Avbenagha, E. A; Ntaka, N. N.& Reginald, .A. (2024) Effect of laboratory assisted method on the attitude and academic performance of Physics students' in Delta State, Nigerian. *African Journal of Studies in Education. Faculty of Education, University of Benin*, 19(1), 115-126.
- Chukwu, L. C., & Adebayo, J. O. (2018). Enhancing Biology teaching through practical activities: A study of senior secondary schools in Nigeria. *African Journal of Educational Research*, 22(3), 49–59.
- Dairo, M. M., Adewale, S. B., & Ahmed, A. A. (2024). Effect of laboratory practical on students' academic achievement in Biology, Chemistry, and Mathematics. *Journal of Science Education*, 10(1), 52–63. <https://nigerianjournalsonline.com/index.php/JOSE/article/view/5965/5791>
- Eze, A. C. (2017). Effectiveness of laboratory method in teaching biology among senior secondary students. *Journal of Science and Technical Education*, 4(2), 80–89.
- Eze, J. E., & Nwosu, A. A. (2018). The effects of laboratory method on biology students' achievement and retention. *Journal of Science Teachers Association of Nigeria*, 53(1), 102–112.
- Ezeudu, F. O., & Eze, J. E. (2017). Influence of laboratory environment on students' attitude and achievement in biology. *Journal of Science Teachers Association of Nigeria*, 52(2), 35–42.
- Ezeudu, F. O., Ezeudu, S. A., & Eya, N. M. (2017). Impact of laboratory method on secondary school students' achievement and interest in biology. *International Journal of Science and Research*,



6(4), 812–816.

Ezeudu, F. O., Eze, J. U., & Okonkwo, S. A. (2016). Influence of instructional methods on secondary school students' academic achievement in Biology. *Journal of Education and Practice*, 7(16), 73–78.

Federal Ministry of Education. (2020). *National Policy on Education* (6th ed.). NERDC Press.

NERDC (2013). *Senior Secondary Education Curriculum: Science Subjects*. Nigerian Educational Research and Development Council.

Okonkwo, C. A., & Eze, J. U. (2023). Laboratory strategies and students' retention in senior secondary biology: A gender perspective. Zenodo. <https://zenodo.org/records/13358683>

Tanimu, S. A., & Usman, I. M. (2024). Impact of laboratory method on students' academic performance in biology among senior secondary schools in Katsina State, Nigeria. *Kano Journal of Educational Studies*, 2(1), 45–56. <https://www.ajol.info/index.php/kje/article/view/293122>

Udo, M. E., & Essien, R. E. (2020). Influence of laboratory method on students' interest and academic performance in physics. *International Journal of Educational Research*, 6(3), 90–99.

WAEC (2019). *Executive summary of entries, results and chief examiner's report on the WASSCE in Nigeria*. WAEC Press Ltd.