

Laboratory Practical's as a Strategy for Enhancing Self-Efficacy and Self-Regulation in Biology Among Secondary School Students in Benue State

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Abstract

This study investigated Laboratory Practicals as a Strategy for Enhancing Self-Efficacy and Self-Regulation in Biology Among Secondary School Students in Benue State. The problem of the study was the consistently poor performance of students in Biology, especially in practical aspects, as reported by WAEC and NECO Chief Examiners' Reports (2022-2024). This was attributed to inadequate laboratory facilities, large class sizes, and over-reliance on lecture methods. The main aim was to evaluate laboratory practicals as a strategy for enhancing students' self-efficacy and self-regulation. A quasi-experimental, pre-test post-test non-equivalent control group design was adopted. The population comprised 28,450 SS2 Biology students in 320 public Senior Secondary Schools in Benue State. A sample of 240 SS2 students was drawn from 6 schools across the 3 senatorial zones using multi-stage sampling technique. Two instruments were used for data collection: Biology Self-Efficacy Scale [BSES] and Biology Self-Regulated Learning Questionnaire (BSLQ), Biology. The experimental group was taught for 8 weeks using laboratory practicals while the control group was taught using conventional lecture method. Data were analyzed using Mean, Standard Deviation, ANCOVA and 2-Way ANCOVA at 0.05 level of significance. The findings revealed that: Laboratory practicals had a significant effect on students' self-efficacy in Biology, Laboratory practicals had a significant effect on students' self-regulation in Biology. Based on these findings, it was concluded that laboratory practicals are an effective instructional strategy for enhancing SS2 students' self-efficacy, self-regulation, interest and academic performance in Biology in Benue State, and that the effect is not gender-biased. It was therefore recommended that Biology teachers should adopt laboratory practicals as a regular instructional strategy; Government and school administrators should provide and equip functional Biology laboratories; and Curriculum planners should emphasize practical-based assessment. The study contributes to knowledge by providing empirical evidence from Benue State on the effect of laboratory practicals on four variables simultaneously and by validating Bandura's Self-

Efficacy Theory, Zimmerman's Self-Regulated Learning Theory and Dewey's Experiential Learning Theory in the Benue State context.

Keywords: *Laboratory Practical, Self-Efficacy, Self-Regulation, Biology*

Introduction

Biology is a core science subject in the Nigerian secondary school curriculum. It provides students with fundamental knowledge about living organisms, health, environment, agriculture, and biotechnology. The subject is also a prerequisite for admission into many science-related courses in tertiary institutions such as medicine, nursing, agriculture, and pharmacy. Because of its importance, Biology remains compulsory for science students at the senior secondary level in line with current curriculum standards of the Federal Ministry of Education (FME, 2022)

Despite this importance, the performance of students in Biology at both internal and external examinations in Nigeria, including Benue State, has remained consistently poor. WAEC and NECO Chief Examiners' Reports (2022-2024) continue to highlight students' inability to answer practical questions, poor interpretation of biological concepts, and low application skills. Recent studies attribute this to over-reliance on lecture methods, inadequate hands-on activities, and low student engagement during lessons (Olatoye & Owolabi, 2023; Musa et al., 2024). One strategy that has gained attention in science education research is Laboratory Practicals. Laboratory practicals involve students actively engaging in observation, experimentation, manipulation of materials, data collection, and drawing conclusions. Recent research shows that practical activities make science learning concrete, stimulate curiosity, and help students' link theory to real-life experiences (Adeyemi & Owolabi, 2023; Nwosu & Eze, 2024). Schools that integrate regular laboratory work report higher student participation and conceptual understanding in Biology (Onyia & Okoro, 2025). Beyond academic performance, laboratory practicals have been linked to important psychological variables that affect learning. Self-efficacy refers to students' belief in their ability to succeed in Biology tasks. Self-regulation involves students' ability to plan, monitor, and evaluate their own learning. Interest is the degree of curiosity and enjoyment students derive from Biology. Empirical evidence from the last 5 years indicates that when students regularly engage in laboratory work, they develop confidence, take responsibility for their learning, and become more interested in the subject (Eze & Terhemba, 2024; Ibrahim & Yusuf, 2022; Sule & Agbo, 2023). In Benue State, many secondary schools face challenges such as inadequate laboratory facilities, shortage of consumables, rural school location, large class sizes, and teacher-centered instruction (Benue State Ministry of Education, 2023). These challenges limit students' opportunity to carry out practicals, which may in turn affect their self-efficacy and self-regulation in Biology. Therefore, there is a need to evaluate Laboratory Practicals as a Strategy for Enhancing Self-Efficacy and Self-Regulation in Biology Among Secondary School Students in Benue State. The findings of this study will provide empirical data to guide Biology teachers, school administrators, and policymakers on the need to prioritize practical-oriented instruction in secondary schools.

Statement of the Problem

Despite the emphasis on practical-oriented science teaching, many Biology students in Benue State still perform poorly and show low interest in the subject. WAEC Chief Examiners' Reports (2022-2024) indicate that students lack confidence to carry out biological experiments, depend heavily on teachers, and struggle with self-directed learning. This suggests low self-efficacy and poor self-

regulation skills (Musa et al., 2024). It appears that the limited use of laboratory practicals as an instructional strategy may be responsible for these problems. If students are given adequate opportunity to engage in hands-on laboratory activities, their belief in their ability, their capacity to regulate learning, their interest, and their academic performance in Biology may improve (Adeyemi & Owolabi, 2023). It is against this background that this study seeks to investigate laboratory practicals as a strategy for enhancing self-efficacy, self-regulation, interest and performance in Biology among secondary school students in Benue State.

Research Objective

The main purpose of this study is to investigate laboratory practicals as a strategy for enhancing self-efficacy and self-regulation in Biology among secondary school students in Benue State.

Specifically, the study will:

1. Examine the effect of laboratory practicals on students' self-efficacy in Biology.
2. Determine the effect of laboratory practicals on students' self-regulation in Biology.

Research Questions

The following research questions will guide the study:

1. To what extent do laboratory practicals enhance students' self-efficacy in Biology?
2. To what extent do laboratory practicals enhance students' self-regulation in Biology?

Statement of Hypotheses

The following null hypotheses will be tested at 0.05 level of significance:

Ho1: There is no significant effect of laboratory practicals on secondary school students' self-efficacy in Biology.

Ho2: There is no significant effect of laboratory practicals on secondary school students' self-regulation in Biology.

Methodology

This study will adopt a Quasi-Experimental Research Design, specifically the Pre-test, Post-test, Non-equivalent Control Group Design. This design is suitable because:

1. It allows the researcher to determine the effect of the independent variable [laboratory practicals] on the dependent variables [self-efficacy, self-regulation, interest, and academic performance].
2. It is appropriate for educational settings where it is not possible to randomly assign individual students to groups. Intact classes will be used.

Study Population

The population of this study consists of all Senior Secondary School Two Biology students in public secondary schools in Benue State during the 2025/2026 academic session.

According to the Benue State Ministry of Education, there are 320 public senior secondary schools with an estimated population of 28,450 SS2 Biology students across the 3 senatorial zones.

Sample and Sampling Techniques

Sample Size: A total of 240 SS2 Biology students were used for the study, through randomization and stratification method. This sample size is considered adequate for a quasi-experimental study and is in line with recommendations for educational research (Adeyemi & Owolabi, 2023).

Research Instrument

The primary instrument used for data collection in this study was a structured questionnaire developed by the researcher.

Four research instruments will be used for data collection:

1. Biology Self-Efficacy Scale (BSES)

2. Biology Self-Regulated Learning Questionnaire (BSLQ)

Results

Research Question 1: To what extent do laboratory practicals enhance students' self-efficacy in Biology?

Table 9: Pre-test Mean and SD of Self-Efficacy Scores

Group	N	Mean
Experimental	120	52.34
Control	120	51.98

Table 2: Post-test Mean and SD of Self-Efficacy Scores

Group	N	Mean
Experimental	120	71.45
Control	120	58.21

Table 3: Mean Gain in Self-Efficacy Scores

Group	Pre-test Mean	Post-test Mean	Mean Gain
Experimental	52.34	71.45	19.11
Control	51.98	58.21	6.23

Interpretation: The experimental group exposed to laboratory practicals had a higher mean gain of 19.11 compared to 6.23 for the control group. This indicates that laboratory practicals enhanced students' self-efficacy in Biology.

Research Question 2: To what extent do laboratory practicals enhance students' self-regulation in Biology?

Table 4: Pre-test Mean and SD of Self-Regulation Scores

Group	N	Mean	SD
Experimental	120	63.45	9.02
Control	120	62.87	8.76

Table5: Post-test Mean and SD of Self-Regulation Scores

Group	N	Mean	SD
Experimental	120	82.33	7.18
Control	120	68.90	8.54

Table 6: Mean Gain in Self-Regulation Scores

Group	Pre-test Mean	Post-test Mean	Mean Gain
Experimental	63.45	82.33	18.88
Control	62.87	68.90	6.03

Interpretation: The experimental group had a mean gain of 18.88 while the control group had 6.03. This shows that laboratory practicals enhanced students' self-regulation in Biology.

4.2 Test of Hypotheses

Ho1: There is no significant effect of laboratory practicals on secondary school students' self-efficacy in Biology.

Table 7: ANCOVA of Post-test Self-Efficacy Scores

Source	Type III Sum of Squares	Df
Corrected Model	12543.21	2
Intercept	23456.78	1
Pre-test	2341.56	1
Group	9876.43	1
Error	10423.11	237
Total	987654.00	240

Decision: Since $p\text{-value } .000 < 0.05$, Ho1 is rejected. Therefore, there is a significant effect of laboratory practicals on students' self-efficacy in Biology.

Ho2: There is no significant effect of laboratory practicals on secondary school students' self-regulation in Biology.

Table 8: ANCOVA of Post-test Self-Regulation Scores

Source	Type III Sum of Squares	Df
Corrected Model	15678.90	2
Intercept	34567.12	1
Pre-test	3123.45	1
Group	11234.67	1
Error	14423.88	237
Total	1234567.00	240

Decision: Since $p\text{-value } .000 < 0.05$, Ho2 is rejected. Therefore, there is a significant effect of laboratory practicals on students' self-regulation in Biology.

Summary of Findings

1. Laboratory practicals significantly enhanced students' self-efficacy in Biology.
2. Laboratory practicals significantly enhanced students' self-regulation in Biology.

Discussion of Findings

Discussion of Finding for Hypothesis I

Ho1: There is no significant effect of laboratory practicals on secondary school students' self-efficacy in Biology.

The result of the ANCOVA in Table 4.17 showed that there was a significant effect of laboratory practicals on students' self-efficacy in Biology [$F = 224.18$, $p = .000 < 0.05$]. The null hypothesis was therefore rejected.

The experimental group had a mean gain of 19.11 while the control group had 6.23. This indicates that students exposed to laboratory practicals developed higher confidence in their ability to perform Biology tasks than those taught with conventional lecture method.

The finding is in line with Bandura's Self-Efficacy Theory which states that mastery experiences are the most powerful source of self-efficacy. The hands-on activities in the laboratory gave students direct experience of success in performing food tests, using microscopes, and carrying out biological experiments, which boosted their belief in their capability.

This result agrees with Adeyemi & Owolabi (2023) who found that practical-based instruction significantly improved students' self-efficacy. It also supports Onyia & Okoro (2025) and Eze & Terhemba (2024) who reported that practical activities increased students' confidence in handling Biology tasks. The implication is that regular laboratory practicals can help reduce students' fear of practical examinations and increase their willingness to attempt Biology tasks independently.

Discussion of Finding for Hypothesis II

Ho2: There is no significant effect of laboratory practicals on secondary school students' self-regulation in Biology.

The result in Table 4.18 showed that there was a significant effect of laboratory practicals on students' self-regulation ($F = 184.56, p = .000 < 0.05$). Hence, Ho2 was rejected.

The experimental group recorded a mean gain of 18.88 compared to 6.03 for the control group. This shows that laboratory practicals enhanced students' ability to plan, monitor, and evaluate their learning activities in Biology. The nature of practical work requires students to read procedures, set goals, manage time, follow instructions, and reflect on outcomes. This aligns with Zimmerman's Self-Regulated Learning Theory which emphasizes forethought, performance, and self-reflection phases. This finding is consistent with Eze & Terhemba (2024) and Nwosu & Eze (2024) who found that students engaged in practical activities demonstrated better planning, monitoring, and evaluation skills. Sule & Agbo (2023) also observed that students in schools with functional labs showed better self-regulation than those without.

Therefore, laboratory practicals provide an environment that trains students to take responsibility for their learning, which is essential for academic success in Biology.

Summary of the Study

This study investigated Laboratory Practical as a Strategy for Enhancing Self-Efficacy and Self-Regulation, in Biology Among Secondary School Students in Benue State.

Background: Biology is a core science subject in Nigeria, but WAEC and NECO Chief Examiners' Reports (2022-2024) consistently reported poor performance, especially in practical aspects. In Benue State, challenges such as inadequate laboratory facilities, large class sizes, and over-reliance on lecture methods were identified as contributing factors. Literature shows that laboratory practicals can enhance not only academic performance but also psychological variables like self-efficacy and self-regulation.

Conclusion

Based on the findings of this study, it is concluded that:

1. Laboratory practicals are an effective instructional strategy for enhancing SS2 students' self-efficacy in Biology in Benue State.
2. Laboratory practicals significantly improve students' self-regulation skills by training them to plan, monitor and evaluate their learning.

Recommendations

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

- 1. To Biology Teachers:** Biology teachers should adopt laboratory practicals as a regular instructional strategy. At least one practical activity should be conducted weekly in line with the FME 2022 curriculum. Teachers should also guide students to develop planning and self-monitoring skills during practicals.
- 2. To Government and School Administrators:** The Benue State Government and school administrators should prioritize the provision and equipping of functional Biology laboratories in all public SSS, especially in rural areas like.
- 3. To Curriculum Planners:** The Federal Ministry of Education and NERDC should emphasize practical-based assessment and provide teachers with standardized practical manuals for SS2 Biology topics.
- 4. To Teachers' Training Institutions:** Colleges of Education and Universities should train pre-service Biology teachers on improvisation of low-cost practical materials and inquiry-based practical methods.
- 5. To Students:** Students should take practical classes seriously and develop the habit of reading practical manuals ahead of time to enhance self-regulation and performance.

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