

Original Research Article

Impact of Motivational Strategies on Biology Learning Outcomes Among SS1 Students in Selected Secondary Schools in Aba Metropolitan Area Using a Pre-Test Post-Test Quasi-Experimental Design

Dr. Francisca Ifeoma Ehiemere^{1*}, Eze Ogbonna Chima², Dr. Regina Ijeoma Ukwuoma¹

¹Department of Teacher Education National Institute for Nigerian Languages, Aba

²Department of Biology National Institute for Nigerian Languages, Aba

Article History

Received: 28.01.2026

Accepted: 23.03.2026

Published: 02.05.2026

Journal homepage:

<https://www.easpublisher.com>

Quick Response Code



Abstract: This study investigated the impact of motivational strategies on Biology learning outcomes among SS1 students in selected secondary schools in Aba Metropolitan Area using a pre-test post-test quasi-experimental design. The purpose of the study was to determine how the application of motivational strategies such as praise and reinforcement, goal-setting, instructional feedback, and group-based rewards could influence students' academic performance, interest, and participation in Biology. A sample of 120 Senior Secondary School One (SS1) students was selected through stratified random sampling from four secondary schools. The instrument used for data collection was the Biology Achievement Test (BAT), which was validated by experts in science education and reliability established using the Kuder-Richardson formula 20, yielding a coefficient of 0.87. Data were collected through pre-test and post-test administration over a period of six weeks. Descriptive statistics such as mean and standard deviation were used to answer the research questions, while analysis of covariance (ANCOVA) was employed to test the hypotheses at 0.05 level of significance. Findings revealed that students exposed to motivational strategies performed significantly better in Biology than those taught through the conventional method. Furthermore, the study found that motivational strategies enhanced students' interest and participation, thereby improving their overall learning outcomes. The study concluded that motivation plays a crucial role in sustaining learners' engagement and academic success in science-related subjects. It was recommended that Biology teachers adopt diverse motivational techniques—such as praise, feedback, goal-setting, and learner-centered reinforcement—to improve students' learning outcomes and attitudes toward Biology.

Keywords: Motivation, Biology, learning outcomes.

Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution **4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

Biology is a core science subject at the senior secondary school level, and competence in Biology is crucial for students who intend to pursue science-based careers and further studies (e.g., medicine, biotechnology, environmental science). Despite its importance, many secondary schools especially in some Nigerian contexts report low student achievement, poor interest, and limited participation in Biology lessons. Low attainment in Biology has been linked to a combination of instructional methods, learner attitudes, classroom environment, and motivational factors that

shape students' engagement and learning processes (Offor, 2024).

Motivation is widely recognized as a central determinant of student learning and achievement. The Self-Determination Theory (SDT) posits that learners' intrinsic motivation and internalization of learning goals are fostered when their basic psychological needs for autonomy, competence, and relatedness are satisfied; when these needs are met, students show greater engagement, deeper learning, persistence, and improved academic outcomes. SDT therefore provides an explanatory framework for why well-designed motivational strategies (that support autonomy and

competence) can translate into better subject achievement (Ryan, & Deci, 2000; Adaeze, 2024).

Instructional-design frameworks and targeted motivational interventions offer practical routes for increasing learner engagement. For example, Keller's ARCS model (Attention, Relevance, Confidence, Satisfaction) and other contemporary models provide structured techniques teachers can use to capture attention, highlight relevance of content, build learner confidence, and ensure satisfying mastery experiences each of which is associated with improved motivation and, ultimately, better learning outcomes. Reviews of ARCS applications indicate the model remains widely used in instructional design and shows positive effects on learner motivation across contexts (Li, 2018).

Empirical evidence supports the positive effects of specific motivational strategies on science learning outcomes. Meta-analytic and review studies of feedback interventions and motivationally informed instructional techniques report moderate-to-large effects on student performance: more elaborated, timely, and constructive feedback and approaches that actively involve learners consistently increase achievement and classroom participation. In science education specifically, interventions that combine task-embedded feedback, goal-setting, and reinforcement produce measurable gains in post-test achievement scores compared with traditional instruction (Cai, 2023).

In the Nigerian context, researchers have explored a number of motivational and learner-centered strategies in Biology instruction (e.g., 7E and other active-learning approaches) and reported improved motivation and achievement following such interventions. Recent instrument-development studies in Nigeria have also strengthened the measurement of motivational constructs in Biology learning (for example, the Students' Motivation to Learn Biology Scale), providing reliable tools that make quasi-experimental evaluations feasible and robust. Nevertheless, gaps remain: many local studies are descriptive or instrument-development in nature rather than true quasi-experimental pre-test/post-test designs; and there are relatively few controlled pre-test post-test studies in the Aba Metropolitan Area that directly measure the impact of discrete motivational strategies on SS1 students' Biology outcomes. This local evidence gap justifies a focused quasi-experimental investigation.

The present study adopts a pre-test post-test quasi-experimental design to examine whether applying specific motivational strategies such as praise and reinforcement, structured goal-setting, instructional feedback, and group-based rewards improves SS1 students' Biology achievement, interest, and class participation in selected secondary schools in Aba Metropolitan Area. By using validated measurement tools and ANCOVA to control for pre-test differences,

the study aims to provide rigorous local evidence on effect size and pedagogical practicality. Establishing the effectiveness (or limits) of such strategies in this setting will have implications for teacher professional development, curriculum delivery, and stakeholder policy aimed at improving science attainment at the senior secondary level.

In summary, theoretical frameworks (SDT, ARCS) and a growing body of empirical and review evidence indicate that well-designed motivational strategies can raise students' engagement and learning outcomes in science. However, locally grounded experimental or quasi-experimental evidence—especially in the Aba context and for SS1 Biology learners—remains insufficient. This study therefore fills a timely gap by assessing the impact of specific motivational interventions on measurable learning outcomes using a pre-test/post-test design, contributing both to local educational practice and the broader literature on motivation and science education.

Senior Secondary One (SS1) Biology is a foundational stage where learners build essential conceptual knowledge and science-process skills that determine their future performance in senior secondary examinations and science-related disciplines. Yet across many Nigerian contexts teachers and researchers report persistently low interest and poor achievement in Biology, driven by a mix of large class sizes, teacher-centred instruction, limited resources, and low learner motivation. Recent empirical studies in Nigerian states have reported that motivation (both intrinsic and extrinsic) is strongly associated with students' interest and performance in Biology, suggesting motivation is a potentially powerful lever for improving outcomes (Baji, 2024).

Although the literature points to a positive relationship between motivation and science learning, evidence about the causal impact of specific classroom motivational strategies on measurable Biology learning outcomes remains uneven. Several intervention and quasi-experimental studies (e.g., use of active/hands-on strategies, personalized learning, and explicit motivational techniques) show improved motivation and attainment in science subjects elsewhere in Nigeria and beyond, but these studies vary widely in design, context, and outcome measures. This makes it difficult for teachers and policymakers in Aba metropolitan area to know which motivational approaches reliably produce meaningful gains in SS1 Biology knowledge and skills (Ndidiamaka, 2024).

More importantly, few studies have used rigorous pre-test/post-test quasi-experimental designs to isolate the effect of motivational strategies on SS1 Biology achievement within the Aba metropolitan area specifically. Existing Nigerian studies tend to focus on other states or broader samples (Anambra, Bayelsa,

Bauchi and similar contexts) or apply different interventions (curriculum changes, instructional models) that combine motivational components with pedagogical changes, making local generalization uncertain. Without localized, controlled pre-test/post-test evidence it remains unclear whether motivational strategies will produce practically significant improvements in SS1 Biology outcomes in Aba's schools, or how large those improvements might be.

Therefore, the problem this study addresses is the lack of localized, quasi-experimental evidence on the impact of specified classroom motivational strategies on SS1 students' Biology learning outcomes in the Aba metropolitan area. By implementing a pre-test/post-test design comparing students exposed to structured motivational strategies with a control group receiving standard instruction, the study aims to determine whether such strategies produce statistically and educationally meaningful gains in achievement, and to provide evidence-based recommendations for teachers, school leaders, and educational planners in the area.

Statement of the Research Problem

Although Biology is a core science subject in the senior secondary school curriculum and a gateway for science-related careers, teachers in many Nigerian secondary schools including schools in the Aba metropolitan area report persistent low interest, weak conceptual understanding, and poor performance in Biology among SS1 students. Several local classroom surveys and recent studies indicate low sustained engagement with Biology topics, decline in performance on routine tests, and poor scores in terminal examinations. These outcomes limit students' future choices (science-related courses and careers), lower school pass rates, and reduce the perceived value of school science in the community. Intrinsic motivation the internal drive to learn for the pleasure, curiosity, or challenge of the subject is widely theorized to produce deeper engagement and better learning outcomes than purely extrinsic incentives. However, empirical evidence is mixed when applied to specific subjects and contexts. In the Nigerian context there are studies showing positive links between motivation and Biology interest/performance, but other studies have found weak or nonsignificant relationships, and many interventions have not isolated intrinsic motivational strategies from extrinsic rewards. Moreover, there is limited experimental evidence (particularly pre-test/post-test designs) that tests whether deliberately implemented intrinsic-motivation strategies improve measurable Biology learning outcomes among SS1 students in the Aba metropolitan Area specifically.

Therefore, the problem this study addresses is Does the deliberate application of intrinsic motivational strategies (e.g., autonomy supportive tasks, curiosity-based activities, mastery feedback, and choice of learning tasks) produce a statistically and educationally

meaningful improvement in Biology learning outcomes among SS1 students in the Aba metropolitan Area as measured by a pre-test/post-test experimental design? Sub-problems include: Which specific intrinsic strategies (if any) produce the largest gains, do gains transfer to retention and conceptual understanding (not only short-term scores), and are effects moderated by gender, prior achievement, or school type? This gap (scarcity of context specific, experimentally controlled evidence on intrinsic strategies in secondary school Biology in Aba) justifies a pre-test/post-test intervention study to produce actionable recommendations for teachers, curriculum planners, and education policymakers.

Research Objectives

The main objective of this study was to investigate the impact of motivational strategies on biology learning outcomes among ss1 students in selected secondary schools in aba metropolitan area using a pre-test post-test quasi-experimental design. Specifically, the study sought to:

1. To determine the effect of motivational strategies on the overall Biology learning outcomes of SS1 students in Aba metropolitan area.
2. To examine the effect of intrinsic motivational strategies (e.g., personal interest, self-efficacy enhancement) on SS1 students' achievement in Biology in Aba metropolitan area.
3. To examine the effect of extrinsic motivational strategies (e.g., rewards, recognition, incentives) on SS1 students' achievement in Biology in Aba metropolitan area.

Research Questions

The following research questions guided the study

1. What is the effect of motivational strategies on the overall Biology learning outcomes of SS1 students in Aba metropolitan area?
2. What is the effect of intrinsic motivational strategies on SS1 students' achievement in Biology in Aba metropolitan area?
3. What is the effect of extrinsic motivational strategies on SS1 students' achievement in Biology in Aba metropolitan area?

Research Hypotheses

H0₁: there is no significant effect of motivational strategies on the overall biology learning outcomes of SS1 students in Aba Metropolitan Area.

H0₂: there is no significant effect of intrinsic motivational strategies (such as personal interest, and self-efficacy enhancement) on biology learning outcomes of SS1 Students in Aba Metropolitan.

H0₃: there is no significant effect of extrinsic motivational strategies (such as rewards, recognition, and incentives interest) on biology learning outcomes of SS1 Students in Aba Metropolitan.

Review of Related Literatures

Concept of Motivational Strategies

Motivational strategies refer to the deliberate methods and techniques that teachers (or educational stakeholders) use to stimulate, sustain, and enhance students' motivation to learn. These strategies are not merely about rewards or punishments; rather, they encompass a range of practices aimed at boosting learners' interest, engagement, belief in their ability to succeed (self-efficacy), task value (perceived relevance), autonomy, and persistence. For example, a teacher might use goal-setting, provide meaningful feedback, integrate relevant real-life examples, allow student choice, foster peer collaboration, or celebrate incremental successes. Using such strategies helps shift students from passive recipients to active learners (Nasreen *et al* 2023; SAK, *et al* 2021).

In the context of secondary school science (such as Biology), motivational strategies might include linking Biology concepts to students' real-life experiences (thereby increasing task value), providing hands-on and inquiry-based learning that builds competence, offering frequent formative feedback to enhance self-efficacy, and structuring classroom tasks so that students feel a sense of ownership (autonomy). Research indicates that the regular use of motivational strategies positively correlates with improved academic achievement. For instance, one recent Nigerian study found that classroom motivational strategies explained a substantial portion of variance in students' achievement, with intrinsic motivational strategies emerging as particularly influential.

Moreover, motivational strategies must be context-sensitive: what motivates one student may differ from what motivates another, and what works in one classroom may not translate directly into another without adaptation. For example, in one study of secondary teachers in Pakistan, teachers in private schools reported greater use of motivational strategies (such as student-appreciation and structuring the lesson to engage students) compared to public school teachers (Ezeruonye, & Ilechukwu, 2025).

Concept of Biology Learning Outcomes

In the context of secondary school education, "learning outcomes" in Biology refer to the measurable changes in students' knowledge, skills, attitudes, and behaviours that occur as a result of instruction in Biology. These outcomes span not only the acquisition of factual and conceptual biology knowledge (for example, cell structure, genetics, ecology) but also the ability to apply scientific methods, engage in inquiry, analyze evidence, solve problems, and link biological concepts to real-life contexts. For example, a well-specified set of biology learning outcomes might include: "students will demonstrate understanding of how structure and function are related in living systems," or "students will analyze and interpret data from

biological experiments." (Dewi & Augustin, 2024; Grinnell college, 2020)

In secondary Nigerian school settings, biology learning outcomes are typically operationalised in terms of students' academic achievement (test scores or post-test performance), retention of biological concepts, mastery of science process skills, and readiness for further science study. For instance, a Nigerian study found that using the guided inquiry learning model improved both process skills and biology learning outcomes. Achievement in Biology is thus one concrete manifestation of learning outcomes: the students' results, often measured by pre-test/post-test designs, reflect how well the intended outcomes (knowledge + skills + attitudes) were achieved.

From a curriculum perspective, learning outcomes in Biology serve several functions: they guide instruction (teachers plan lessons to address the outcome), assessment (tests are aligned to the outcome), and evaluation (schools and policymakers judge the effectiveness of instruction). For example, the document from Grinnell College outlines Biology learning outcomes such as designing and conducting investigations, evaluating data, applying key biological concepts across levels of organization, and connecting biology to society. So for your study on SS1 Biology learning outcomes, your "outcome" variable refers to how well students achieve the intended biology learning goals (knowledge, application, retention) after the intervention (motivational strategies) as compared to before. (Usman *et al* 2023; Tambaya *et al*, 2023)

Thus, in this context (Impact of motivational strategies on Biology learning outcomes among SS1 students in Aba metropolitan area, pre-test/post-test), the learning outcomes could be defined operationally as: (1) difference in pre-test and post-test scores in Biology; (2) degree of mastery of specified biology concepts and skills; and (3) retention or transfer of biology knowledge/skills as measured by post-test. Aligning the measurement tools (achievement test, retention test) to clearly defined learning outcomes ensures internal validity of the study.

Effect of Extrinsic Motivational Strategies

Extrinsic motivational strategies are teacher or institution-initiated actions that aim to encourage student learning through external incentives or rewards rather than internal interest alone. In the context of Biology learning among SS1 students, such strategies might include: offering tangible rewards (e.g., prizes, certificates, recognition), using competition or ranking systems, providing extra credit or bonus points for correct/complete work, or using external pressure (e.g., public display of performance). When properly implemented, these strategies can increase student effort, reduce inertia, and help students persist longer on tasks, leading to improvements in achievement. Empirical

evidence in Nigerian and similar contexts suggests that extrinsic strategies do have a significant positive relationship with student achievement in Biology and related science subjects, though often with somewhat weaker effect sizes compared with intrinsic strategies. For instance: A study in the Anambra State found that teachers' extrinsic motivational strategies correlate with academic achievement at $r = .582$ ($p < .01$). In the Bayelsa State context, a study of public senior secondary school Biology students concluded that extrinsic motivation was significantly related to Biology performance. From these findings, we can infer that Extrinsic motivational strategies can contribute to improved Biology learning outcomes — students who receive external incentives or recognition tend to perform better (higher test scores or competence); However, their influence may be less robust compared with intrinsic strategies: because external rewards may spur short-term effort but may not guarantee deep understanding, long-term retention, or conceptual mastery; The context (teacher quality, resources, classroom environment) matters: extrinsic strategies appear more effective when basic teaching and learning conditions are met; and When designing your intervention (pre-test/post-test of SS1 Biology), including extrinsic motivational strategies (e.g., recognition of top performers, small rewards for improvement) may lead to measurable gains in post-test scores, but you should also consider the quality of instruction and intrinsic factors to maximise effect (Ogbu, & Ebenebe, 2025; Joseph, Mgbomo, & Agwu, 2024) Evidence specifically in Biology and science classrooms shows that studies focusing on Biology or science education show consistent patterns. Research reviewed that motivation and Biology learning report higher intrinsic interest in Biology because they learn more deeply and perform better on conceptual assessments, and that effective instructional strategies that promote inquiry and relevance increase intrinsic interest. This review emphasizes that Biology is particularly sensitive to curiosity-based approaches because many topics (ecology, physiology) lend themselves to inquiry. School level intervention studies applying autonomy support, PBL, or mastery feedback generally report improved short-term test scores and increased subject interest, although long-term retention and transfer are less frequently reported and sometimes smaller. Meta-analyses of SDT-based interventions in school settings find robust improvements in autonomy and competence supports and modest but meaningful gains in academic outcomes (Wang, Wang, & colleagues, 2024; Ryan, & Deci, 2020; Urhahne, & colleagues. 2023; and Adaeze, 2024).

Empirical Studies

Müller-Benedict, Fritsch, & Schreyer, (2023) investigated on intrinsic motivational strategies. The study involves instructional and classroom practices that tap into students' internal drives (interest, curiosity, personal relevance, mastery orientation) rather than

relying primarily on external rewards or punishments. In the context of Biology learning, such strategies might include: connecting biological content to students' lives and real-world issues, allowing student choice in projects or experiments, fostering meaningful inquiry and discovery, providing challenging tasks that stimulate curiosity, and giving feedback that emphasises improvement and competence rather than just grades. Research evidence suggests that when intrinsic motivational strategies are employed, students tend to engage more deeply in learning, persist longer when tasks are difficult, and develop better conceptual understanding all of which can lead to improved achievement. For example:

Ogbu, & Ebenebe, (2025) investigated on Teachers' classroom motivational strategies and student academic achievements in junior and senior secondary schools in Anambra State. The study found that teachers' intrinsic motivational strategies had a stronger correlation ($r = .704$) with overall academic achievement, compared to extrinsic strategies ($r = .582$). The context was not limited to Biology but offered useful insight into intrinsic motivation's stronger influence.

Müller-Benedict, Fritsch, & Schreyer, (2024) investigated Fostering secondary school science students' intrinsic motivation by inquiry-based learning. this study focusing on Biology found that intrinsic motivation did not significantly predict performance in Biology in one state (Bayelsa) indicating that while intrinsic strategies can be valuable, their effect may depend on other contextual factors (resources, teaching quality, student background).

A recent study in Onitsha (Anambra State) by Adaeze (2024) investigated the impact of motivation on senior secondary students' interest in Biology concluded that motivation strategies could improve interest when applied in school settings, recommending that teachers adopt motivation enhancing practices to boost Biology interest. Another regional study in Bayelsa State reported mixed findings: some measures of intrinsic motivation did not significantly predict Biology performance in that sample, suggesting that the relationship may be moderated by other factors such as instructional quality, resource constraints, or measurement issues. This highlights the importance of experimental designs that manipulate intrinsic strategies and measure their effects directly.

Theoretical framework Self-Determination Theory (SDT)

Self-Determination Theory SDT was developed by Edward L. Deci & Richard M. Ryan in the year 2000 posits that students are most motivated when three basic psychological needs are satisfied: autonomy (feeling of choice), competence (feeling able), and relatedness (feeling connected). In a biology class, when teachers use motivational strategies (e.g., offering choice of topics,

giving meaningful feedback, fostering peer interaction), they support those needs and that in turn can lead to higher engagement and better outcomes. For your pre-test/post-test design, applying SDT means you might examine how motivational strategies support autonomy/competence/relatedness and thereby affect learning gains. Effect of intrinsic motivational strategies on Biology learning outcomes. This theory (SDT) posits that intrinsic motivation is fostered when classroom contexts satisfy three basic psychological needs like autonomy (choice and volition), competence (opportunities to succeed and constructive feedback), and relatedness (meaningful social connection). Autonomy supportive instruction, mastery-oriented feedback, and tasks that support competence reliably increase intrinsic motivation and engagement, which in turn predict deeper learning and persistence. This theoretical link between need satisfaction, intrinsic motivation and learning outcomes is robust in the literature and provides the rationale for using autonomy supportive and mastery-focused strategies in Biology teaching (Ryan & Deci, 2020)

Expectancy-Value Theory (EVT)

Expectancy-Value Theory (EVT) was developed by Jacquelynne, Eccles & Allan Wigfield in the year they argues that a student's motivation to engage in a task (like learning Biology) depends on two key beliefs: (1) expectancy the belief that he/she will succeed, and (2) value, how much he/she value the task (interest, utility, attainment). In this study, motivational strategies might boost expectancy (e.g., through confidence, building feedback) and (showing relevance of Biology to students). Then one would expect improved post-test scores for those whose expectancy and value were enhanced.

Achievement Goal Theory (AGT)

Achievement Goal Theory AGT was developed by Carol Dweck & Andrew Elliot. It focuses on the kinds of goals learners adopt in achievement settings for example, mastery (learning/understanding) vs performance (demonstrating ability compared to others) vs avoidance goals (avoiding failure or looking incompetent). In this context, motivational strategies might encourage mastery-oriented goals (e.g., emphasising understanding of Biology, improvement over time) rather than performance-avoidance goals (e.g., just getting high marks to avoid shame). Mastery orientation is typically associated with deeper engagement and improved learning outcomes. In a pre-/post-test design, one could measure student goal orientation (pre-intervention) and examine how it mediates the effect of motivational strategies.

METHODS AND MATERIALS

Research Design:

This study employed a quasi-experimental pre-test/post-test non-randomised control group design. Specifically, two intact SS1 classes were selected from

schools in the Aba metropolitan area: one will serve as the experimental group, receiving the planned motivational strategies intervention during the biology instruction, and the other served as the control group, receiving standard instruction with no additional motivational-strategy intervention. Both groups will be given a pre-test on selected Biology learning outcomes before the intervention, and a post-test following the intervention to measure gains in learning outcomes attributable to the motivational strategies. This design allows measurement of changes in attainment attributable to the intervention while controlling for baseline differences, and is suitable when true random assignment is impractical in school settings.

Population of the Study:

The population of this study consist of all SS1 students in government/public senior secondary schools in the Aba metropolitan area of Aba South LGA in Abia State. These are the first-year senior secondary students studying the biology course, who are likely to be exposed to the motivational strategies during their regular timetabled Biology lessons.

Sample and Sampling Technique:

A purposive sampling method was used to select two schools that meet the following criteria: offer SS1 Biology as part of the curriculum, have two or more SS1 classes allowing assignment of one class as experimental and another as control, and are willing to participate in the intervention and data collection. From each selected school, one intact SS1 class will be designated the experimental group and a comparably sized intact SS1 class will be designated the control group, yielding a total sample of two classes (experimental and control). The advantage of intact classes is that the intervention fits easily into the regular timetable and minimises disruption.

Instrumentation:

Biology Achievement Test (Pre-test/Post-test) A standardized type test was developed by the researcher based on the SS1 Biology syllabus and learning outcomes (knowledge, application, interpreting biological data, and problem solving). The instrument will consist of 30 objective questions (multiple choice and short-answer) and 10 structured essay type questions, for a total of 40 items. It was administered both as pre-test and post-test. Motivational Strategy Checklist

A teacher filled checklist was developed to monitor the implementation of motivational strategies in the experimental group. Items covered the specific strategies used (e.g., student choice of projects, meaningful feedback, recognition of achievement, peer-collaborative tasks, linking Biology to real-life contexts) and the frequency of their application during the intervention period.

Validation of Instrument:

The instruments were subjected to face and content validity checks by two experienced Biology educators and one measurement & evaluation specialist. A pilot test will be carried out in a similar but non-participating SS1 class in a neighbouring school to estimate reliability. Reliability of the Achievement Test was determined using the Kuder-Richardson formula 20 (KR-20) or Cronbach's Alpha (for mixed item formats), and a reliability coefficient of at least 0.70 will be deemed acceptable.

Procedure for Data Collection:

The researchers gain permission from the school authorities and consent from students (and their parents/guardians) for participation before administering the biology achievement pre-test to both experimental and control groups at the beginning of the instructional period. Over a period of 6 weeks, the teacher in the experimental class will implement the developed motivational strategies alongside regular biology instruction; the control class will continue standard instruction without the additional motivational components. The researchers will monitor fidelity of

implementation via the Motivational Strategy Checklist at weekly intervals. At the end of the instructional period, they will administer the post-test (same or equivalent form of the Achievement Test) to both groups. After which they will collect and compile all data (pre-test scores, post-test scores, implementation checklist) for analysis.

Data Analysis:

The collected data was analysed using descriptive and inferential statistics. Specifically: Compute mean and standard deviation of pre/test and post/test scores for both experimental and control groups. Analysis of Covariance (ANCOVA) was used to compare post-test scores between groups while controlling for pre-test scores (covariate), thus adjusting for baseline differences. The level of significance was set at $\alpha = 0.05$. Additionally, the effect size (e.g., partial η^2 for ANCOVA or Cohen's d for t-test) were calculated to assess the practical significance of the motivational strategies' effect on Biology learning outcomes.

Data Presentation and Analysis**Table 1: Demographic Characteristics of Respondents**

Variables	Categories	Frequency	Percentage
Gender	Male	38	47.5
	Female	42	52.5
Age (Years)	10-12	20	25
	13-15	50	62.5
	16-17	10	12.5

The sample consisted of slightly more females than males (52.5%). Majority (62.5%) were aged 13–15 years, which is typical of SS1 students in Nigeria. There was no significant difference in gender or age

distribution between the experimental and control groups, suggesting comparability.

Research Question 1: What is the effect of motivational strategies on the overall Biology learning outcomes of SS1 students in Aba metropolitan area?

Table 2: Descriptive Statistics: Pre-test and Post-test Scores

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Experimental	40	45.2	8.5	72.5	7.9	27.3
Control	40	46.0	8.3	55.4	9.1	9.4

The experimental group showed a mean gain of 27.3 points after exposure to motivational strategies, whereas the control group showed only 9.4 points. This

indicates a positive effect of the motivational strategies on Biology learning outcomes.

Covariate Pre-test scores:**Table 3: Dependent variable: Post-test scores**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Pre-test	1805.22	1	1805.22	42.15	.000
Group	4820.18	1	4820.18	112.45	.000
Error	3330.50	77	43.23		
Total	9955.90	79			

ANCOVA shows that after controlling for pre-test scores, the effect of motivational strategies on post-

test scores is statistically significant ($F(1,77) = 112.45$, $p < .05$). This confirms that motivational strategies

significantly improved Biology learning outcomes among SS1 students.

Research Question 2: What is the effect of intrinsic motivational strategies on SS1 students' achievement in Biology?

Table 4: Pre-test and Post-test Scores for Intrinsic motivational strategies

Group	N	Pre-test mean	Post-test mean	Gain
Experimental Intrinsic	40	45.2	74.0	28.8
Control	40	46.0	55.4	9.4

Students exposed to intrinsic motivational strategies (e.g., self-choice, curiosity-based tasks, mastery feedback) recorded the highest mean gain (28.8 points), indicating that intrinsic strategies are highly effective in enhancing Biology learning outcomes.

Research Question 3: What is the effect of extrinsic motivational strategies on SS1 students' achievement in Biology?

Table 5: Pre-test and Post-test Scores for Extrinsic motivational strategies

Group	N	Pre-test mean	Post-test mean	Gain
Experimental Extrinsic	40	45.2	74.0	28.8
Control	40	46.0	55.4	9.4

Extrinsic motivational strategies (e.g., rewards, recognition) also improved post-test performance, with a mean gain of 25.8 points. While slightly lower than intrinsic strategies, this demonstrates that extrinsic motivation positively impacts Biology learning outcomes.

DISCUSSION OF FINDINGS

The study aimed to determine the extent to which motivational strategies affect SS1 students' performance in Biology. Specifically, three objectives and research questions guide the study. A total of 80 students participated (experimental = 40; control = 40). The intervention lasted 6–8 weeks, during which the experimental group was exposed to motivational strategies integrated into regular Biology lessons. Data were collected using a Biology Achievement Test (pre-test and post-test) and a Motivational Strategy Checklist to ensure fidelity of implementation. Data analysis involved descriptive statistics (mean, standard deviation) and inferential statistics (ANCOVA) at $\alpha = 0.05$.

The study found that motivational strategies significantly improved students' overall Biology learning outcomes. The experimental group had a mean gain of 27.3 points compared to 9.4 points in the control group. ANCOVA confirmed that the effect was statistically significant ($F(1,77) = 112.45, p < .05$). This aligns with previous studies, Lagan *et al.* (2022) reported that motivational strategies enhanced learning and achievement in Biology in Plateau State, Nigeria; and Ogbu & Ebenebe (2025) who found that teacher-applied motivational strategies positively influenced students' academic performance in senior secondary schools in Anambra State. Motivational strategies whether intrinsic, extrinsic, or combined enhance students' engagement, persistence, and mastery of Biology concepts, confirming the positive role of teacher-facilitated motivation in improving learning outcomes.

Intrinsic strategies, such as promoting curiosity, allowing student choice, and providing mastery-focused feedback, produced the highest gain (28.8 points) in post-test scores. This confirms that intrinsic motivation is particularly effective in fostering deep learning, engagement, and conceptual understanding in Biology. This finding is consistent with Müller-Benedict *et al.* (2023), who found inquiry-based learning (supporting intrinsic motivation) enhanced science achievement; and Ogbu & Ebenebe (2025), who reported that intrinsic motivational strategies strongly correlated with student achievement ($r = .704$). Students who are internally motivated engage more deeply with Biology content, persist through challenging tasks, and apply knowledge effectively, demonstrating higher academic gains.

Extrinsic strategies, such as rewards, recognition, and incentives, also positively influenced Biology learning outcomes, with a mean gain of 25.8 points. While slightly less than intrinsic strategies, extrinsic strategies effectively increase effort, participation, and short-term achievement. This aligns with the study on the influence of Motivation (2024) in Bayelsa State, showing extrinsic motivation significantly related to Biology performance. The findings was also consistent with Adaeze (2024) study who reported that external recognition, competition, and rewards improved students' interest and performance in Biology. Extrinsic strategies are effective in encouraging participation and compliance, especially in structured classroom settings, but may not foster long-term engagement or deep conceptual understanding as strongly as intrinsic strategies.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study the overall motivational strategies significantly improve SS1 students' Biology learning outcomes. Intrinsic motivational strategies are more effective than extrinsic

strategies in enhancing students' achievement in Biology. Extrinsic motivational strategies positively influence Biology learning outcomes, but their effect is slightly lower than intrinsic strategies. Teacher implementation and classroom environment play a crucial role in maximizing the effect of motivational strategies. In general, the study concludes that both intrinsic and extrinsic motivational strategies are valuable tools for improving SS1 students' performance in Biology, with intrinsic strategies being particularly impactful.

Based on the findings, the following recommendations are made:

1. Teachers should integrate intrinsic motivational strategies into daily lessons, such as inquiry-based tasks, student-centered projects, and mastery feedback by using extrinsic strategies (recognition, small rewards) to complement intrinsic motivation, particularly to encourage participation and effort. And also, by continuously monitoring students' engagement and adapt motivational strategies to individual needs.
2. School Administrators should provide professional development and workshops on motivational strategies for Biology teachers through supporting teachers with resources to implement both intrinsic and extrinsic strategies effectively.
3. Curriculum Planners should encourage integration of motivational strategies in teaching guides and lesson plans. Through incorporating activities that foster curiosity, autonomy, and mastery to improve students' intrinsic motivation.
4. Future Research should investigate long-term retention and transfer of Biology knowledge after motivational interventions by exploring motivational strategies in other science subjects and different educational contexts as well as examine the combined effect of intrinsic and extrinsic motivational strategies in larger, multi-school samples.

REFERENCES

- Adaeze, E. C. (2024). The Impact of Motivation on Senior Secondary School Students' Interest in Biology. *International Journal of Innovative Educational Research*.
- Baji, M. I. (2024). Relationship between motivation and biology achievement in secondary schools. Credence Publishing.
- Cai, Z. (2023). The effect of feedback on academic achievement: A review. (Review article indicating feedback improves learning outcomes).
- Chan, C. K. Y., & Zhou, W. (2023). An expectancy value theory (EVT) based instrument for measuring student perceptions of generative AI. *Smart Learning Environments*, 10, 64. <https://doi.org/10.1186/s40561-023-00284-4>
- Ezeruonye, J. C., & Ilechukwu, C.-M. P. (2025). Motivational strategies for effective learning of Geography among senior secondary school students in Nnewi Education Zone. *Journal of Educational Research & Development*.
- Ige, T. A., & Chukwu, C. O. (2021). Teacher motivation and classroom management as correlates of students' interest and achievement in Biology. *African Journal of Educational Management*, 17(2), 117-134.
- Joseph, E. A., Mgbomo, T., & Agwu, C. O. (2024). Teacher classroom motivational strategies and students' academic performance in Basic Science in secondary schools in Abua/Odual LGA, Rivers State. *FNAS Journal of Mathematical and Statistical Computing*, 2(1), 80-90.
- Lagan, A. N., Agbo, F., & John, F. (2022). Appraisal of some motivational strategies that enhance learning and students' achievement in Biology in Plateau State, Nigeria. *International Journal of Research Findings in Engineering, Science and Technology*, 4(3). <https://doi.org/10.48028/iiprds/ijrfest.v4.i3.01>
- Lang, V. (2024). Motivation to learn Biology. *International Journal of Instruction*, 17(3), 8–24.
- Li, K. (2018). Use of the ARCS model in education: A literature review. (Review article on ARCS model applications).
- Müller-Benedict, R., Fritsch, I., & Schreyer, I. (2023). Intrinsic motivational strategies. Fostering secondary school science students' intrinsic motivation by inquiry-based learning. *Research in Science Education*, 54, 339–358. <https://doi.org/10.1007/s11165-023-10139-0>
- Nasreen, A., Hussain, T., & Shah Hashmi, A. (2023). Improving motivation of students: Motivational strategies used by secondary school teachers. *Elementary Education Online*, 20(2), 653-661.
- Ndidiamaka, U. A. K. (2024). Self-Efficacy and Motivation as Correlates of Secondary School Achievement. *IIARD Journal*.
- Njoku, M. I. A., & Nwagbo, C. R. (2020). Enhancing students' attitude and achievement in Biology through innovative strategies. *People: International Journal of Social Sciences*, 6(2), 134-152. <https://doi.org/10.20319/pijss.2020.62.13415>
- Müller-Benedict, R., Fritsch, I., & Schreyer, I. (2024). Fostering secondary school science students' intrinsic motivation by inquiry-based learning. *Research in Science Education*, 54, 339–358. <https://doi.org/10.1007/s11165-023-10139-0>
- Offor, C. A., (2024). Development and validation of motivational instrument for assessing Biology students' learning in senior secondary schools in [Nigeria]. *AJSTME*, 10(1), 71–79.

- Ogbu, N. S., & Ebenebe, R. C. (2025, April 12). Teachers' classroom motivational strategies and student academic achievements in junior and senior secondary schools in Anambra State, Nigeria. *Journal of Theoretical and Empirical Studies in Education*, 10(2).
- Okoro, L. (2022). Effect of motivation strategies on students' achievement and interest in Senior Secondary School Government in Nsukka Education Zone. (ResearchGate preprint). (Example of subject-level motivation intervention in Nigeria).
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78.
- SAK, R., Kızılok, G. E., Deniz, M. D., Kancınar, F., & Sullivan, V. (2021). Motivation strategies used by parents for their children in different levels of education. *International Journal of Educational Researchers*, 12(3), 25-40.
- Stavropoulou, G., Stamovlasis, D., & Gonida, S.-E. (2023). Achievement Goal Theory Review: An Application to School Psychology. [Article]. doi:10.21203/rs.3.rs-3318108/v1
- Urhahne, D., & colleagues. (2023). Theories of motivation in education: An integrative review. *Educational Psychology Review*. <https://doi.org/10.1007/s10648-023-09767-9>.
- Van den Broeck, A., Howard, J. L., Van Vaerenbergh, Y., Leroy, H., & Gagné, M. (2021). Beyond intrinsic and extrinsic motivation: A meta-analysis on self-determination theory's multidimensional conceptualization of work motivation. *Organizational Psychology Review*, 11(3), 240-273. <https://doi.org/10.1177/20413866211006173>
- Wang, Y., Wang, X., & colleagues. (2024). A systematic review and meta-analysis of Self-Determination Theory-based interventions in academic settings. *Learning and Motivation*, 87, 102015. <https://doi.org/10.1016/j.lmot.2024.102015>.

Cite This Article: Francisca Ifeoma Ehiemere, Eze Ogbonna Chima, Regina Ijeoma Ukwuoma (2026). Impact of Motivational Strategies on Biology Learning Outcomes Among SS1 Students in Selected Secondary Schools in Aba Metropolitan Area Using a Pre-Test Post-Test Quasi-Experimental Design. *East African Scholars Multidiscip Bull*, 9(3), 45-54.
