

EFFECTS OF SCAFFOLDING ON BIOLOGY STUDENTS' ACHIEVEMENTS AND MOTIVATIONS IN SECONDARY SCHOOLS IN DELTA CENTRAL SENATORIAL DISTRICT

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Abstract

This study investigated the effects of scaffolding instructional strategy on Senior Secondary School Students' achievements and motivations in Biology. A quasi-experimental pretest-post-test control group design was adopted. The population comprised all Senior Secondary School II (SSS II) Biology students in Delta Central Senatorial District, Nigeria, with a target population of 28, 745 students from government owned schools. A sample of 162 students was selected using a combination of purposive and random sampling techniques. Two instruments were used for the data collection: Biology Achievement Test (BAT) and Biology Motivation Questionnaire (BMQ). The instruments were validated by experts, and reliability coefficients of 0.82 (KR-20) and 0.86 (Cronbach's Alpha) were obtained for BAT and BMQ, respectively. Mean and standard deviation were used to answer the research questions, while independent samples t-test was used to test the hypotheses at 0.05 level of significance.

Pre-test results established homogeneity of the experimental and control groups. Post-test results revealed that students taught Biology using scaffolding instructional strategy achieved significantly higher and were more motivated than those taught using the conventional lecture method. The study concluded that scaffolding instructional strategy is effective in enhancing students' achievements and motivations in Biology and recommended its adoption in secondary school classrooms.

Keywords: Scaffolding, Biology Achievement, Students' motivations, Secondary education, Instructional strategy.

Introduction:

Biology is a subject taught at the secondary school level to give students in-depth understanding of biological concepts, principles theories and laws. (Bello et.al, 2020). It encompasses the study of living organisms, from microscopic cellular molecules to the entire biosphere, including ecosystems and the Earth's surface. Biology has a significant global impact and plays vital roles in various fields; such as, Microbiology, Biotechnology, Genetics, Medicine, Botany, Zoology, and Bioinformatics (Kulak & Newton, 2015). Developing a comprehensive knowledge of biological concepts is crucial for students to comprehend the complexities of the living world. Through Biology, students can

explore diverse aspects; such as, organism structures and functions, ecosystem interactions, evolution, and practical application in health, agriculture, and the environment. A solid understanding of Biology empowers students to actively contribute to environmental sustainability, engage in scientific research, and make informed decisions in the increasingly complex biological realm (Neji & Ntibi, 2019b). However, due to its abstract nature and intricate relationships, Biology is often perceived as a challenging subject to teach and learn (Cimer, 2012). Effective presentation of science instructions at the secondary school should be able to enhance the students' mastery of the subject matter (achievement) and sustain their motivation

to learn. The increasingly educational needs and incessant requests for the 21st century skills have necessitated science teachers to advance from rote memorization to promoting learning abilities in students that can help them learn the concepts and skills in Biology. The effective teaching and learning of biological concepts largely depends on the instructional approaches adopted by the teachers.

Instructional strategies are meant to enhance students' achievements by engaging learner's diverse interest, and abilities for proper motivation to progressively learn biological concepts from the familiar to unfamiliar ones. They, however, act as tools for supporting teaching and learning practices. There are several instructional strategies that can help improve students' achievements in Biology. Some of which may include; generative learning, think-pair-share, computer-based, assisted inquiry based, instructional scaffolding etc. (Okafor, Agbala, et.al., 2022).

The term scaffolding in education was first coined by Wood, Brunner and Ross (1976), based on the Lev Vygotsky's Theory of Learning and the notion of the Zone of Proximal Development (ZPD). Scaffolding in education is a teaching strategy wherein the teacher provides temporary support to students while learning new skills or concepts and gradually fading away the support as the students become more independent. It is an instructional strategy that gives a support system to help students learn new concepts and skills by breaking them down into smaller, manageable parts. Much like a physical scaffold on a building, this framework provides support that is gradually removed as the students master the task, ultimately enabling them become independent and confident learners. The process allows teachers to model the desired skill or explain the concept first to the learners and then guide them through practice together.

Instructional scaffolding actually enables complex topics to be broken down into smaller digestible pieces that are easier for students to learn and build upon. There are varieties of scaffolding, which the teacher can actually adopt into the classroom instruction for effective learning. These may include; sensory, interactive, and graphic scaffolding, which make use of concrete objects, conversation and visual organizers to support learning, respectively. Other forms of scaffolding include; material/resource, instructional, student grouping, active prior learning, content scaffolding, modelling, think aloud, visuals, meta cognitive show and tell, and questioning.

The importance of scaffolding as a teaching strategy cannot be underplayed. Its significance ranges from encouraging the learners to actively participate in the learning process to deeper conceptual understanding and sustained motivation (Akinbobola & Folashade, 2022). It also enables students perform task, which they could not accomplish independently (Liu, et.al., 2020). Unfortunately, the traditional teacher centred method, most times, does not actively involve students in the classroom activities. The approach only ensures the coverage of large contents in a limited space and not giving consideration to the inquiry based learning. This is why students are made to memorize facts for the purpose of passing examinations; instead, of developing self-abilities and competence to analyze and synthesize knowledge (Okebukola, 2020). This study, therefore, seems to investigate the extent to which scaffolding instructional strategy can affect Biology students' achievements and motivation in the secondary schools.

Statement of Problem

Biology as a science subject taught in Nigeria senior secondary schools, plays central role in preparing students for different fields of endeavor. Careers; such as, Medicine, Agriculture, Biotechnology

and Environmental Science are offshoot of Biology. In spite of the innumerable importance of the subject, reports have it that students perform poorly in it (Okere & Ude, 2022). These poor achievements are traceable to so many factors, some of which are; lack of school facilities, qualified teachers, competencies on the wise and skillful use of instructional strategies as well as inadequate instructional approaches. The place of instructional strategies cannot be over-emphasized in relation to academic achievement and students' motivation.

Instructional strategies have a way of engaging students in a learning process by arousing their curiosity and sustaining their motivation to achieve higher academically. It also enables them develop critical thinking skills, keep students on task and sustain their interests in the class.

Despite the curriculum reforms and the emphasis on learner-centred methods, many Nigeria Biology classrooms still rely on rote memorization and lecture-based instruction (Nwosu & Obrekwe, 2019). This results in superficial learning and disengagement. One promising approach to address these challenges is instructional scaffolding, which provides structured support that gradually decreases as learners develop competence (Wood, Burner, & Ross, 1976). There is a limited empirical evidence on how scaffolding strategies influence both achievement and motivation of students in Nigerian Secondary Schools, therefore, creating a gap that this study seems to address.

Purpose of the Study

The purpose of this study was to determine the effect of scaffolding instructional strategy on students' achievements and motivations in Biology at the Senior Secondary School level. Specifically, the study sought to:

- (i) Determine the difference in pre-test achievement scores of students taught Biology using scaffolding

instructional strategy and those taught using the conventional method.

- (ii) Determine the difference in pre-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught using conventional method.
- (iii) Determine the difference in post-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught using the conventional method.
- (iv) Determine the difference in post-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught using the conventional method.

Research Questions

- (i) What is the difference in the pre-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method?
- (ii) What is the difference in the pre-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method?
- (iii) What is the difference in the post-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method?
- (iv) What is the difference in the post-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

- H₀₁:** There is no significant difference in the pre-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method.

H02: There is no significant difference in the pre-test motivation scores of students taught biology using scaffolding instructional strategy and those taught using the conventional method.

H03: There is no significant difference in the post-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught using the conventional method.

H04: There is no significant difference in the post-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught using the conventional method.

Significance of the Study

- The findings provided valuable insights to the effectiveness of scaffolding in improving students' motivation and achievements in Biology.
- The research informed the development of more effective instructional strategies for secondary school Biology teachers.
- The study contributed to a better understanding of the factors that influence students' learning and motivation in under-resourced educational settings.

Scope and Limitation of the Study

The study focused on the impact of scaffolding techniques on students' motivation and academic achievements in Biology among the senior secondary school students in Delta Central Senatorial District. However, limitations; such as, the small sample size of 162 students, reliance on self-reported data and standardized tests, time constraints, variability in teacher implementation, and external factors like socio-economic status, posed challenges to the generalizability and thoroughness of the findings.

Reviewed Literature

The study provided an overview of existing concepts of students' motivation and achievements in Biology at the secondary school level. The review highlighted the key theories, concepts, and findings from various studies, enabling deeper understanding of the effectiveness of scaffolding in promoting educational outcomes; thus, establishing a comprehensive context for the current study. The review will be done under the following sub-topics; concept of scaffolding, scaffolding and students' achievements, scaffolding and students' motivation, theoretical framework and appraisal of the review.

Concept of Scaffolding

Scaffolding is a meta cognitive approach to teaching that involves providing successive levels of temporary support that is adjusted to fit the students' needs as they gain independence in the learning process (Wood et.al, 1976). The process of scaffolding may take the form of modelling, guided questioning, feedback, prompting or collaborative learning until learners gain independence (Liu et.al, 2020).

Contemporary theorists have redefined it, emphasizing not just a support but also the fostering of independent learning. They distinguished between procedural scaffolding (guidance on problem solving steps), substantive scaffolding (content focused support), and Meta-cognitive scaffolding (promoting self-regulation and reflection). These facts of scaffolding are particularly relevant in Biology education, where complex concepts require incremental understanding.

Scaffolding is a crucial instructional strategy designed to support learners as they are introduced to new subjects and complex concepts. It is a form of targeted coaching and temporary support, carefully

tailored to the individual learner's needs, that is gradually withdrawn as competence develops. Jerome Brunner's work significantly shaped our understanding of scaffolding, describing it as a process where a learner is assisted to achieve a task they might not be able to do independently, ultimately empowering them to perform it on their own.

Scaffolding could also be viewed as a teaching strategy where the teacher or the gifted students lend academic support to the slow learners through discussion and interactions with the slow learners. It is a teaching learning process designed to promote a deeper level of learning as the teacher pairs up gifted and knowledgeable students with the slow learners or students during classroom instructions or activities. Several researchers have contributed to the understanding of scaffolding. Nzewi & Ibeneme (2011), described it as the help given to ensure maximum learning of new knowledge, temporary support to develop new understanding, skills, concepts and abilities. Bassiri (2012), emphasizes that the support, students build on acquired experience and skills reshape their knowledge, and improve their performance.

Scaffolding and Students' Achievements

Achievement is an action or reward for accomplishing a task. It is the feeling of getting things done as desired or getting the things that are expected. Thus, achievement in science education may not necessarily take place unless teachers form solid foundation for solid instruction through effective use of strategies that are students-centred and activity-oriented techniques.

Based on the premise, several research studies have shown that positive relationships exist between scaffolding strategies and students' academic achievements in science education. This assertion is true with the research findings of Akinbobola and Folashade (2022), who reported that scaffolding significantly improved Nigerian students' performance

in difficult Physics topics. Similarly, Alake and Ogunlaye (2020), reported improved retention in Biology when students received guided prompts and structured worksheets. Different research findings opined that when learners are guided, supported and provided with necessary attributes, students become more responsible, motivated and successful learners. Most notable is the fact that scaffolding makes students independent and self-regulating learners, and improving their problem-solving skills.

The use of scaffolding as a teaching strategy, helps in boosting the overall achievements of students in the class, aids meaningful learning of biological concepts and the average performance of students in the class. In the same vein, (Abidakun et.al, 2024), asserted that scaffolding significantly enhanced Biology students' performance with no gender or location effects. In another research finding conducted by Ufommadu & Okoli (2019), revealed that scaffolding improved achievements of students with the field-dependent and field-independent cognitive styles with greater gains for field-independent learners. Similarly, Amobi & Uche (2022), also gave their report, stating that scaffolding boosted achievement with slightly higher gains among female students in Anambra State.

Using scaffolding teaching strategy in Biology, teaching demands students' involvement in the teaching learning processes. By so doing, the students are not only observing but are directly involved in the process. The involvement in the process brings about increase in academic achievements of students, hand on practical and intelligibility in concepts learning. Furthermore, Zydney et.al. (2012), examined the impact of online scaffolding on student learning in an introductory Biology course and found out that students who received targeted feedback and support through online fora performed better on assessments and reported higher

levels of engagement. Belland et.al. (2017), in his exploration of the effects of different types of scaffolding (procedural, conceptual, strategic, and meta cognitive) on middle school students' science inquiry skills, reported that students taught using strategic scaffolding, which focused on helping students plan and monitor their inquiry process, had the most significant impact on their scientific reasoning abilities.

Scaffolding and Students' Motivation

Motivation is a key determinant of academic success. It is an act of willingness of action to do something. Motivation, the internal and external drive that propels students to engage in learning, is crucial for academic success. It encompasses both intrinsic factors (like curiosity and enjoyment) and extrinsic factors (like grades and rewards). Motivation is a dependent variable influenced by the education context, the subject area and the task to be performed. Moreover, it is an intra-personal factor that has an energizing stimulus; motivated students are more likely to actively participate, set goals, persist through challenges and maintain a positive attitude towards learning.

Research indicates that scaffolding enhances intrinsic motivation by giving learners autonomy, competence, and a sense of progress (Ryan & Deci, 2020). In a related study, Adeola (2021), observed that students in scaffolding classrooms reported higher interest and persistence compared to those taught traditionally.

Scaffolding plays crucial roles in fostering both motivation and achievement. By providing targeted support with the ZPD, scaffolding helps students experience success and build confidence. This success in turn, excites motivation, encouraging students to take on new challenges and strive for better achievement.

Scaffolding also promotes mastery of new skills and knowledge, which further strengthens intrinsic motivation as students

become more competent and self-directed learners. Furthermore, effective scaffolding enhances students' sense of belonging and makes them feel more comfortable taking risks, all of which, contribute to increased motivation. Other research works or findings in relation to scaffolding and students' motivation are the likes of; Linnenbrink – Garcia et al. (2011), who conducted a study on the effects of scaffolding on students' motivation and self-regulated learning in science found out that scaffolding particularly when it included elements of choice and autonomy, was associated with higher levels of intrinsic motivation and greater use of self-regulated learning strategies.

In the same vein, Lazarides & Buchholz (2019), investigated the relationship between teacher scaffolding and students' interest in Mathematics and science, and the result indicated that teachers who provided effective scaffolding, characterized by clear explanations and supportive feedback had students with higher levels of interest in these subjects. More so, Walker et.al. (2016), examined how different types of feedback (a form of scaffolding) impacted students' motivation and achievements in an on-line learning environment. They found out that personalized, specific and timely feedback were more effective in promoting students' engagement and learning compared to general feedback.

Furthermore, several motivational theories explain how scaffolding can impact students' motivation self-efficacy theory by Albert Berudera in 1977. They revealed that scaffolding can enhance students' self-efficacy by providing them with successful experiences. Also Usher & Payares (2008), explained that as students accomplish tasks with support, their belief in their ability to succeed increases, leading to greater motivation. Expectancy-value Theory (Eccles, 2021), opined that motivation is influenced by students'

expectations for success and the value they place on the task. Scaffolding can increase both motivation and achievement by making tasks more achievable and demonstrating the relevance of Biology to students' lives. Self-determination Theory (Ryan & Deci, 2017), posited that motivation is enhanced when students feel autonomous, competent and related to others. Scaffolding that supports these needs can lead to greater intrinsic motivation.

Theoretical Framework

This study is anchored on the Socio-cultural Learning Theory by Brunner and Lev Vygotsky in 1960 and 1978 respectively. The theory was introduced by Brunner (1960) and was directly influenced by Lev Vygotsky (1978). The theory posits that learners actively construct knowledge through interaction with others that are knowledgeable to enable them also become knowledgeable. The theory, however, emphasizes social learning culture where guided participation and scaffolding supports are given to students to enable them grasp concepts or skills, which are later withdrawn gradually as students can now practice independently. The concept is deeply rooted in Vygotsky's Theory of the Zone of Proximal Development (ZPD). The ZPD represents the space between the learners' current developmental level and their potential development with guidance. The ZPD according to Vygotsky, is the gap between what learners can do independently and what they can achieve with help of a more knowledgeable person (like a teacher or a peer). Vygotsky, however, believed that learning of concepts and skills are best acquired through interaction and collaboration with others. He argued that learners possess untapped potentials that can be unlocked through scaffolding provided by teachers, peers, or other intellectual individuals.

In essence, scaffolding is a practical application of Vygotsky's theory where the

instructor act as a temporary guide to help learners reach their full potentials within their ZPD. This theory influences instructions through scaffolding by providing supports within this zone, guiding students through activities that help learners build on their existing knowledge and skills to reach new levels of understanding. By implication, the theory helps in fostering collaborative learning environment where learners actively construct knowledge through interaction with others. It also advocates for teachers to assess students' ZPDs and provide just enough assistance to help them master new skills; rather, than leaving them to struggle along.

Appraisal of the Review

This review has explored the critical role of scaffolding in supporting student learning, particularly, in challenging subjects like Biology, etc. Scaffolding, grounded in Vygotsky's theory of the ZPD, provides temporary support that empowers learners to achieve more than they could have independently achieved. It emphasizes the gradual release of responsibility, fostering independent learning and problem-solving skills. The various definitions of scaffolding offered by researchers highlight its multifaceted nature, from providing targeted assistance to fostering deeper learning and promoting self-regulation.

Furthermore, this research has emphasized the crucial link between motivation and achievement, and how scaffolding acts as a bridge between these two essential elements. When students experience success through effective scaffolding, their motivation to learn is enhanced, leading to greater achievement. The decline in students' achievements in Biology underscores the need for effective teaching strategies.

Scaffolding, therefore, offers a valuable framework for improving students' outcomes in Biology by providing

tailored support within the ZPD, with a view to fostering a positive learning environment, and ultimately empowering students to develop a deeper understanding of complex biological concepts. If the potentials of scaffolding teaching or instructional strategy are fully and carefully utilized, the academic achievement of students in Biology could be improved and academic achievement in the discipline could be verified. Time constraints within the curriculum can also limit opportunities for meaningful scaffolding instructions. Future research could explore the specific types of scaffolding most effective in different Biology topics and investigate the long-term impact of scaffolding on student learning, motivation and achievement.

Methodology and Procedure

The study employed a quasi-experimental design, specifically the pretest-posttest and control group design. The population for this study comprised of all the Senior Secondary School Biology students in Delta Central Senatorial District. The target population consisted of 28,745 senior secondary school two (SSS2) Biology students from government owned schools within the district. The study population also included qualified Biology teachers responsible for teaching the subject in the selected schools.

The sample of the study consisted of senior secondary school II (SSS2) drawn from ten Government Secondary Schools in five (5) Local Government Areas of the study. A sample size of 162 Biology students was used for the study. A combination of purposive and random sampling techniques was employed to ensure both relevance and objectivity in the selection process. Two intact classes were used for the study, which were assigned to the experimental and the control groups using random sampling. Randomization was done by simple lottery method.

Two instrument were used for this study, and these were the Biology

Achievement Test (BAT) and the Biology Motivation Questionnaires (BMQ) structured by the researcher. The Biology Achievement Test (BAT) was a 30 item multiple choice test with options (A-D). The items covered two major content areas drawn from the Senior Secondary School Biology curriculum approved by the Federal Ministry of Education. The Biology Motivation Questionnaires (BMQ) were 20-item questionnaires designed to measure students' motivation towards learning Biology. The instrument was adopted from the existing motivation scales and modified to suit the context of the Secondary School Biology learning. The BMQ was structured on a four point Likert scales as follows: Strongly Agree (SA)= 4 point, Agree (A)= 3 points, Disagree (D)= 2 points, and Strongly Disagree (SD)= 1 point.

The validity of the instruments was done by three experts; they were in the Departments/Units of Science Education (Biology Unit), Educational Measurement and Evaluation, and Curriculum Studies, respectively. The BAT was validated for face and content validity; while the BMQ was subjected to face and construct validity. The feedbacks of their reviews were incorporated.

The reliability of the instruments was established by pilot testing. The BAT was administrated to 30 Senior Secondary School II Biology students from a school outside the main study area but with similar characteristics. The responses were analyzed using Kuder-Richardson formula 20 (KR-20). A reliability co-efficient of 0.82 was obtained indicating that the BAT has a high internal consistency and was reliable. Similarly, the Biology Motivation Questionnaires were also pilot tested on 30 students not included in the main study. The internal consistency of the item was determined using Cronbach's Alpha method, which yielded a coefficient of 0.86. Thus, the BMQ was considered reliable. Data collection processes of this study was carried out systematically in

three phases: pre-treatment (pre-test), treatment, and post-treatment (post-test) across the selected schools. The process spanned a period of six weeks, during which, the researcher implemented the scaffolding instructional strategy and administered the research instruments. The data collected were coded and analyzed using both descriptive and inferential statistical methods. Descriptive statistics; such as, mean (\bar{x}) and standard deviation (SD) were used to summarize the pre-test and post-test scores of students in both groups, while inferential statistics; such as, the independent sample t-test was used to compare the post-test mean scores of the experimental and control groups.

Results and Discussion

In order to establish the baseline equivalence of the experimental and control

groups before treatment, pre-test achievement and motivation scores were analysed using independent samples t-test. The analysis of pre-test achievement scores showed no significant difference between students assigned to the experimental and control groups at the 0.05 level of significance. Similarly, the analysis of pre-test motivation scores revealed no statistically significant difference between the two groups. These results indicate that the groups were homogeneous prior to the implementation of the scaffolding instructional strategy.

Research Question 1: What is the difference in the pre-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught using the conventional method?

Table 1: Showing mean and standard deviation of pre-test achievement scores of students.

Group	N	Mean	SD	Mean diff
Experimental	81	42.31	5.12	0.47
Control	81	41.84	5.09	

The results in table 1 show that the experimental group had a mean score of 42.31 (SD=5.12), while the control group had a mean score of 41.84 (SD=5.09), with a mean difference of 0.47 in favour of experimental group. This indicates that

both groups had closely comparable achievement levels prior to the treatment

Research Question 2: What is the difference in the pre-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method?

Table 2: Showing mean and standard deviation of pre-test motivation scores of students.

Group	N	Mean	SD	Mean diff
Experimental	81	58.42	6.01	0.38
Control	81	58.04	5.96	

Table 2 reveals that the experimental group had a mean motivation score of 58.42 (SD=5.96), resulting in a mean difference of 0.38. The small mean difference suggests similarity in the students' motivations before the intervention.

Research Question 3: What is the difference in the post-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method?

Table 3: Showing mean and standard deviation of post-test achievement scores of students.

Group	N	Mean	SD	Mean diff
Experimental	81	68.14	5.28	14.74
Control	81	53.40	5.30	

The result in table 3 shows that students in experimental group obtained a higher mean achievement score (68.14, SD=5.28) compared to control group (53.40, SD=5.30), with mean difference of 14.74. This suggests improved achievement

among students exposed to scaffolding instructional strategy.

Research Question 4: What is the difference in the post-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method?

Table 4: Showing mean and standard deviation of post-test motivation scores of students.

Group	N	Mean	SD	Mean diff
Experimental	81	80.51	6.23	18.92
Control	81	61.59	6.45	

Table 4 indicates that the experimental group recorded the higher mean motivation score (80.51, SD 6.45), with a mean difference 18.92. This suggests that scaffolding instructional strategy may have positively influenced students' motivation in Biology.

Hypotheses Testing

Hypothesis 1: There is no significant difference in the pre-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method.

Table 5: Independent samples t-test of pre-test achievement scores.

Group	N	Mean	SD	t	df	P-value	Decision
Experimental	81	42.31	5.12	0.62	160	0.536	Ho1 Not Rejected
Control	81	41.84	5.09				

Since $P > 0.05$, H_{o1} was not rejected. This indicated no significant difference in pre-test achievement scores of the two groups.

Hypothesis 2: There is no significant difference in the pre-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method.

Table 6: Independent samples t-test of pre-test motivation scores.

Group	N	Mean	SD	t	df	P-value	Decision
Experimental (Scaffolding)	81	58.42	6.01	0.51	160	0.611	Ho2 Not Rejected
Control (Conventional)	81	58.04	5.96				

Since $P > 0.05$, H_{o2} was not rejected, indicating homogeneity in motivation at pre-test.

Hypothesis 3: There is no significant difference in the post-test achievement scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method.

Table 7: Showing independent samples t-test of post-test achievement scores.

Group	N	Mean	SD	t	df	P-value	Decision
Experimental (Scaffolding)	81	68.14	5.28	17.21	160	0.000	Ho3 Rejected

Control (Conventional) 81 53.40 5.30

Since $P < 0.05$, H_{03} was rejected. This indicates a significant difference in post-test achievement scores in favour of the experimental group.

Hypothesis 4: There is no significant difference in the post-test motivation scores of students taught Biology using scaffolding instructional strategy and those taught with the conventional method.

Table 8: Showing independent samples t-test of post-test motivation scores.

Group	N	Mean	SD	t	df	P-value	Decision
Experimental (Scaffolding)	81	80.51	6.23	15.94	160	0.000	Ho4 Rejected
Control (Conventional)	81	61.59	6.45				

Since $P < 0.05$, H_{04} was rejected, indicating that scaffolding instructional strategy significantly enhanced students' motivations in Biology.

Discussion of Findings

The absence of significant differences in the pre-test achievement and motivation scores indicates that the experimental and control groups were comparable prior to the commencement of treatment. This finding confirms that both groups possessed similar academic and motivational characteristics at baseline. Consequently, the significant differences observed in the post-test achievement and motivation scores can reasonably be attributed to the effect of scaffolding intervention; rather, than pre-existing differences among the students.

The findings of this study, however, revealed that scaffolding instructional strategy significantly improved students' achievements in Biology.

The substantial mean difference observed in the post-test achievement scores suggests that scaffolding provides structured cognitive support that enhanced students' understanding and mastery of biological concepts. This finding aligns with Vygotsky's socio-cultural theory of learning, particularly the concept of the zone of proximal development, which emphasizes guided assistance in promoting effective learning.

In addition, the study found that students taught using scaffolding instructional strategy were significantly more motivated than those taught with the conventional lecture method.

The improved motivation levels indicate that scaffolding fostered learners' confidence, interest, and active participation in Biology lessons. This result supports motivational theories; such as self-determination theory and expectancy value theory, which posit that learners' motivation increases when instructional support enhances their sense of competence and likelihood of success.

Conclusion:

Based on the findings of this study, it was concluded that scaffolding instructional strategy has a significant positive effect on students' achievements and motivation in Biology. Students exposed to scaffolding strategies achieved better and were more motivated to learn biological concepts compared to those taught using conventional method.

Recommendations:

The following recommendations were made based on the research findings:

1. Biology teachers should employ scaffolding instructional strategies to enhance students' achievements and motivation.

2. Teachers education programmes should incorporate scaffolding pedagogy into their training modules.
3. School administrators should encourage innovative teaching methods by providing supportive teaching resources.
4. Further research should explore the long-term impact of scaffolding on students' retention and problem solving abilities.

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