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SCAFFOLDING IN THE CONSTRUCTION INDUSTRY: TRANSLATING TO SCAFFOLDING INSTRUCTIONAL STRATEGY IN EDUCATION

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ABSTRACT

The research explored the effectiveness of scaffolding, which has been an effective mechanism in the construction industry, and how it translates to a scaffolding instructional strategy in the classrooms. This was necessitated by the low performance of students in Biology, especially in Ecology concepts, as reported by West African Examinations Council chief examiner reports and as experienced by one of the authors, who was a biology teacher in the high school. A sample of 139 Grade Eleven students was drawn from a population of 3,092, and a mixed-methods approach was used. For the quantitative aspect, the research design was quasi-experimental, involving a pre-test, a post-test, and a post post-test. The validated instruments, tagged Ecology Performance Test (ECPT), were used for data collection. The experimental group's performance was compared with the control group, and the results indicated a significant difference, as the experimental group outperformed the control group in performance scores. In semi-structured interviews, which were audio recorded, a lot of excitement was captured in the voices of the experimental group regarding the scaffolding strategy. The scaffolding strategy showed strong potential for enhancing conceptual understanding of Ecology concepts, which positively impacted their performance.

SUBJECT/PROBLEM

To meet the needs of 21st-century learners, teaching strategies must be dynamic, student-centered, and integrate technology. Such strategies can create a more engaging, inclusive, and effective learning environment that prepares students for the challenges and opportunities of the digital age. To make biology teaching more joyful, there are many innovative teaching strategies, including scaffolding, which is an educational tool that can assist students in remembering and applying new information.

Scaffolding strategies have been found to boost students' learning. Although we hear more of this in construction (temporarily supporting structures) than in the classroom, It can also be used to support students so that they can better comprehend and build more complex skills. The support and assistance is then gradually withdrawn from the students as they move toward independence and have gained knowledge and competence. (Gonulal & Loewen, 2018). The part where the student is learning with assistance is called the Zone of Proximal Development. (ZPD) and the process from I can't (out of reach) to I can (with assistance, ZPD) to I can (unassisted) is represented as follows:

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Some researchers, however, have linked poor teaching strategies to memorization and poor performance among high school science students (Ogunsola-Bandele, 2002, Ketiku. 2019, Cimer 2004)). The West African Senior School Certificate Examination (WASSCE) results from 2020 to 2024 revealed important shifts in student performance. In fact, the performance of students has not been very encouraging in the sciences, especially in Biology. Specifically, from 2007, there have been reports of poor performance in Ecology, which is an aspect of biology, and this led to avoid such questions in examinations. More recently (2022–2023), questions on ecology have been left out. To support this, Michael et al. (2020) reported that students' difficulties learning some biology topics can again be attributed to poor teaching strategies. Other researchers (Ogunsola-Bandele & Kennepohl (2022), Igboegwu (2012), Djwantoro (2010) reported that the nature of science itself forces students to memorize facts rather than helping them to learn meaningfully and suggested a learner-centered instructional strategy that enhances cognitive gains. So, the concern in this research was to find out if scaffolding could be a useful alternative in enhancing students' performance in Biology.

The theoretical framework for the study hinged on the constructivist theory of social constructivism by Vygotsky (1978) and cognitive constructivism by Piaget (1964), which attempted to explain how students learn by constructing understanding themselves. In scaffolding, using Piaget's theory, teachers function as facilitators to help students develop their understanding and come to conclusions on their own. Also, teachers are continually, from a psychological point of view, within the Zone of Proximal Development (ZPD). Vygotsky suggests that when individuals work together, socio-cognitive conflicts occur, which stimulates equilibrium that leads to perspective thinking and the ability to reason, allowing students to learn at their levels. So, in relation to this research work, Vygotsky's theory encouraged social interaction with other students in the group in carrying out tasks or skills. The students had supporting materials such as partial solutions, questioning, explanations, examples, and hints, which were scaffolds to enable them to learn from each other, leading to better performance.

It also recognizes the More Knowledgeable Others (MKO); the students worked in groups while the MKO explained the task to others, thereby increasing their capacity to cooperate. So, the notion of scaffolding is increasingly being used to describe the support provided for students to learn successfully in classrooms (Janneke, Volman, Oort, and Beishuizen, 2015). Janneke et al. emphasized that learning occurs in a rich social context marked by interaction,

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negotiation, articulation, and collaboration. That is, the strategy promotes dialogue between the teacher and the student, providing the students with enough guidance and support to accomplish goals that could have been impossible without it.

The current research therefore investigated the effects of the scaffolding instructional strategy on the performance of some biology high school students.

DESIGN AND PROCEDURE

A sample of 139 biology high school students was drawn from a population of 3,092 in a high school in the northern part of Nigeria. This is specifically to answer the question of whether the academic performance of these high school students using scaffolding differs from those taught using the lecture method. Also, to find out the reaction of the sampled students taught using scaffolding. The instrument, tagged Ecology Performance Test (ECPT) was used for data collection and was adopted from the West African School Certificate Examination (WASCE) past question papers. The test consisted of 40 multiple-choice items with four response options (one correct and three distractors) for each item. The items meant to assess academic performance were based on the following concepts: basic ecological concepts, the functioning ecosystem, ecological management, and ecology of population. The reliability coefficient of ECPT was calculated to be 0.88

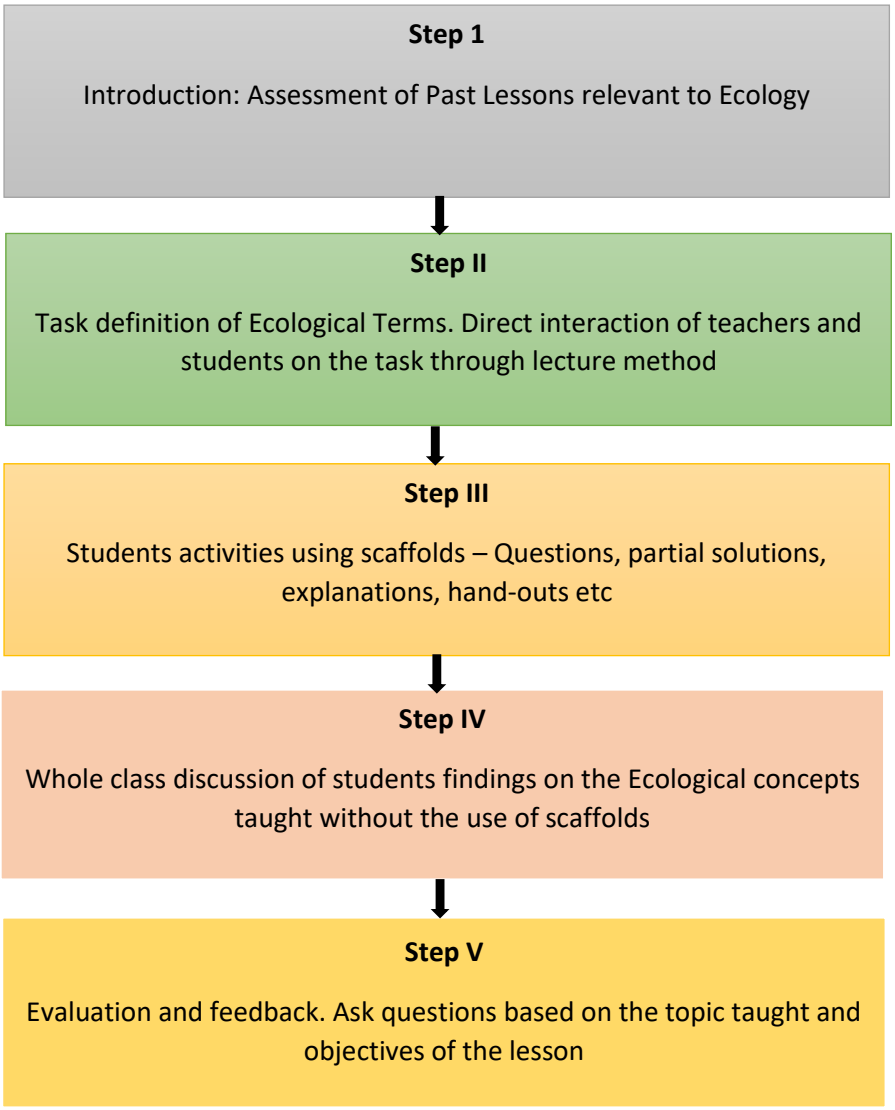
The research design for this study was a non-randomized quasi-experimental control group design described by Sambo (2008). The experimental group (EG) was taught using the scaffolding instructional strategy, and the control group (CG) using the lecture method, to see if there is a significant difference in their performance at the end of the 6-week treatment period. The lesson activities were designed in steps based on Djwantoro's (2010) model of scaffolding instructional strategy.

Fig. 1. A Flowchart of Scaffolding Instructional Strategy (Adapted from Djwantoro 2010)

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Result and Analyses: To find out the difference between the mean performance of the students taught Ecology using the Scaffolding Instructional Strategy and those taught using the Lecture Method, the performance scores of the students were subjected to descriptive statistics using the mean and standard deviation. The summary is presented in Table 1.

GROUP	N	Mean	SD	Mean diff.
Experimental	73	22.55	3.85	4.36
Control	66	18.19	3.19	

Table 1: Mean and Standard Deviation for Experimental and Control Groups

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Results in Table 1 indicate that the students exposed to the Scaffolding Instructional Strategy had a mean score of 22.55, while students taught using the Lecture Method had a mean score of 18.19. This implies that students exposed to the Scaffolding Instructional Strategy had a higher mean score and a mean gain of 4.36 over those taught using the Lecture Method. To determine whether the mean differences were significant, the mean scores were subjected to t-test statistical analysis.

Table 2 shows the summary of the analysis of the posttest mean performance scores of students taught Ecology using the Scaffolding Instructional Strategy and those taught using the Lecture Method, subjected to an independent t-test.

Table 2: Summary of Independent t-test Analysis of Experimental and Control Group

Group	N	Mean	SD	Df	t-cal	P-value	Remark
Experimental	73	22.55	3.85	137	6.43	0.001	Significant
Control	66	18.19	3.19				

P<0.05 level

The experimental group has a mean score of 22.55 and a standard deviation of 3.85, while the control group has a mean score of 18.19 and a standard deviation of 3.19. This indicates a significant difference between the mean performance scores of those students taught Ecology using the Scaffolding Instructional Strategy and those taught using the lecture method. This is because the P-value is less than the 0.05 level of significance at df 137. It was found that the Scaffolding Instructional Strategy enhances the performance of the students in ecology more than the Lecture Method.

But Keeffe & Andrew (2015) emphasized that students' voices have been a challenge to schools and researchers, so the need is to respond to the voices of these students in education and research. In view of this, 10 students (who were early arrivals on the last day) in the experimental group were interviewed, audio-recorded, and their voices captured using pseudonyms.

Aider: 'I couldn't believe I could find the ecosystem so easy'

Bider: 'What a good experience in ecology class today'

Cider: 'I have not only learned but socialized with those in my group'

Dider: 'Hmm. it's so satisfying helping others to learn'

Eider: 'The lesson took more time, but I didn't actually feel it'

Fider: 'I really enjoyed the class, and it is well organized. '

Gider: 'What a relaxing and exciting moment using scaffolding'

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Hider: 'Wow! Can ecology be this easy?'

Iider: 'So exciting to interact with others in the group to carry out the task'.

Jider: 'We worked and learned together. Learning from my classmates is even easier than learning from the teacher'

A lot of excitement was captured in the voices, especially from those who were initially hesitant about the topics. So, in conclusion for this study, the scaffolding teaching strategy has been found to be a useful addition to the strategies used for teaching in the ecology classroom.

Contributions to the Teaching and Learning of Science

Scaffolding has been found to enhance conceptual understanding of Ecology concepts, which has had a positive impact on performance. Its use should subsequently attract more students to attempt examination questions in ecology rather than avoid them.

Although the strategy increases the teachers' workload and adds complexity to classroom management, the social interactions that students and teachers have in the Scaffolding Instructional Strategy increase their pedagogical capacity to work together and enhance their academic performance. It indeed promotes a better teacher-learner relationship, accommodates diverse learners' needs, and allows learners to take responsibility for their learning. It promotes equity, respect, and values diversity in the classroom. It helps to establish "help stations where peers offer support to one another, to the extent that those struggling can learn from the more knowledgeable."

Impact to Science Teachers

The science teacher needs to continually learn and try out different innovative strategies like scaffolding tactics because of the diversity of learners possessing diverse abilities in the classrooms. However, extreme diversity poses significant challenges, making it difficult for teachers to provide equal opportunities for students. (Coristine, Russo, Fitzmoris, Beninato & Rivota 2022), This approach allows students to engage with the content in various ways, ensuring that every student, regardless of their ability level, can learn effectively (Tomlinson, 2023). It provides a framework for adapting curriculum and instructional methods to suit each student's specific learning profile, interests, and readiness levels (Woolcott, Marks, & Markopoulos, 2021). Even though scaffolding lessons may be lengthier in teaching time, everyone will benefit from a higher quality final output and a more fulfilling overall experience. Learning is facilitated by discourse, feedback, and shared accountability while using scaffolding. Teachers can help students develop into lifelong autonomous learners by providing them with the stimulating and demanding learning opportunities that come from thoughtfully designed scaffolded learning. This could help teachers in professional tasks such as revision and curriculum evaluation. Again, this strategy promotes better teacher-learner relationships and accommodates diverse learners' needs in the classroom setting. Since research is a continuous process, the use of this strategy for teaching ecology concepts would have added information to the existing literature and serve as a foundation for future studies.

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