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Effectiveness of Scaffolding Strategy in Enhancing Students Achievement and Retention in Basic Science and Technology.

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ABSTRACT

The study investigated the effectiveness of scaffolding strategy in enhancing students achievement and retention in Basic Science and Technology in Anambra state of Nigeria. A Quasi experimental, pretest postest, and non-randomized control group was adopted. The research was guided by two research questions and two null hypothesis. The population of the study consisted of 4,433 Junior Secondary School (JSS) 2 students in all 56 government owned secondary schools in Onitsha Education Zone of Anambra State. The sample of the population was 140 junior secondary school drawn from the population with simple random sampling technique. The Basic Science and Technology Achievement Test (BSTAT) developed by the researcher were used for data collection. Mean and standard deviation were used to answer research questions while analysis of co-varience (ANCOVA) was used to test the null hypothesis at .05 level of significant. The results revealed that students exposed to scaffolding strategy outperformed their counterpart taught with traditional method with significant improvement in retention rate. The study concluded that scaffolding is an effective teaching strategy that addresses the challenges of underachievement in Basic Science and Technology in Nigeria.

Keywords: Achievement, Retention, Basic Science and Technology

INTRODUCTION

Education is the foundation upon which the lives of individuals, communities, and nations is built. In recent changing world, the new development in scientific and technological knowledge and skills in science, technology, engineering and mathematics (STEMS) subjects specifically Basic Science and Technology (BST) is vital for students future careers and national advancement.

Basic Science and Technology is a popular and foundational subject in Nigerian junior secondary school aimed at preparing students who will take up science courses in higher level of education (university and other tertiary institution). However, many students encounter difficulties in learning basic science and technology concepts as most of the concepts are abstract and difficult to understand leading to poor performance of students in (BST exams), both internal and external examinations specifically in Basic Education Certification Examination (BECE), conducted by Nigerian schools, state and federal ministry of basic education (Uchegbu et.al 2020).

Research has shown that students lack of understanding of basic concepts, inadequate teaching methods and insufficient learning support are major factors contributing to this problem of under achievements of basic science and technology. To address this challenge of under achievements, researchers have employed different teaching strategies including scaffolding.

Scaffolding is a teaching technique/skill that provides temporary support and guidance to learners as they develop their skills and knowledge. Scaffolding is also a helpful interaction between a teacher and a learner which enables the learner comprehend what is being taught beyond their individual effort. In relation to learning, scaffolding strategy refers to different forms of support and assistance given by the teacher to any learning situation which geared towards helping the students achieve and retain stated learning objectives. Sawyer in Amobi (2021) defines scaffolding as the support given during learning processes which is tailored to the needs of students with the aim of helping students achieve learning goals. Scaffolding Strategy is based on Vygotsky's social cultural theory and his Zone of Proximal Development (ZPD), which is the range of knowledge and understanding that a learner can achieve with the assistance and help of a more knowledgeable other.

Achievements, Hence, is the measure of a learners level of knowledge, skills or performance. It is thus the extent of accomplishments or failure of goal in a particular content that the student has earlier been exposed to. Generally, achievement is used to determine how well an individual is able to assimilate, recall, communicate and retain knowledge on what has been learnt or taught.

Therefore, retention goes with achievements as it involves the amount of learning experience that is currently remembered at a later time by the learners, Ibe (2021). The ability of student retaining what they learnt for a long time will enhance their achievement in a subject like Basic Science and Technology, especially when the subject is taught with effective and meaningful strategy like scaffolding.

This study investigates the effectiveness of scaffolding strategy in enhancing students achievement and retention in Basic Science and Technology. Specifically it examines the impact of scaffolding on students understanding of BST concept and their retention of knowledge over the time.

SCOPE OF THE STUDY.

The study was based on the effectiveness of scaffolding strategy in enhancing students achievement and retention in Basic Science and Technology (BST). It covers Junior Secondary School II (JSS II) students in Onitsha Education Zone. The content area that were covered are: Energy and Force.

RESEARCH QUESTIONS.

1. What is the mean achievement scores of students taught Basic Science and Technology using scaffolding strategy and those taught with traditional method.
2. What is the mean retention scores of students taught Basic Science and Technology with scaffolding strategy and those taught with traditional method.

RESEARCH HYPOTHESIS.

1. There is no significant difference in the mean achievement scores of students taught Basic Science and Technology using scaffolding strategies and those taught with traditional method.
2. There is no significant difference in the retention scores of students taught Basic Science and Technology with scaffolding strategy and those taught with traditional methods.

Literature Review

Scaffolding is an instructural strategy anchored in Vygotsky's (1978) social-cultural theory of child development and concept of the Zone of Proximal Development (ZPD), it has gained significant attention as one of the effective approach in teaching and learning. It involves providing temporary, adjustable guidance/support to students in order to enhance or facilitate students learning and their academic achievement as they acquire new knowledge or skills, whilst gradually removing this support as learners gain independence. In the context of Basic Science and Technology education in Nigeria, scaffolding has been explored as a means to address persistent challenges in student achievement and retention. Okafor (2019) In her work examines the impact of environmental factors on science students' performance, providing a background for understanding how supportive environments, akin to scaffolding, enhance academic achievement.

Conceptual Framework

Scaffolding is a teaching strategy that involves providing temporary support and guidance to students as they learn new concepts and skills, Amobi (2021). The goal of scaffolding is to help students build their confidence and independence as learners, and to eventually take ownership of their learning. Tartenger, Enemarie, & Yusuf, (2024), indicated that students taught using scaffolding strategies outperformed those taught using traditional demonstration methods. Obafemi, Saadu, Yahaya, Obefemi, & Yakubu, (2023) also concluded that scaffolding strategies significantly enhanced pupils' performance compared to conventional teaching methods.

Types of Scaffolding

There are several types of scaffolding that can be used in the classroom. Alber, (2024) and Northern Illinois University, Center for Innovative Teaching and Learning. (n.d.) Outlined various scaffolding techniques, including:

- Modeling: The teacher demonstrates a task or skill, and then guides the students as they practice it.
- Coaching: The teacher provides feedback and guidance to students as they work on a task.
- Fading: The teacher gradually reduces the amount of support and guidance provided to students as they become more confident and independent.
- Peer scaffolding: Students work in pairs or small groups to support and guide each other as they learn.

Students' Achievement in Basic Science and Technology

Achievement in Basic Science and Technology refers to the extent to which students demonstrate an understanding of scientific concepts, principles, and processes. Numerous research has shown that scaffolding can have a positive impact on students' achievement in science, particularly when it is used to support students centered learning. Okafor, & Nzomiwu, (2021), Explores collaborative learning strategies, such as Think-Pair-Share, which share conceptual similarities with scaffolding, offering insights into fostering student achievement. Okeke, & Ugwuanyi, (2023), indicated that students

achievement in Basic Science and Technology is dependent on the teaching method, as students taught using scaffolding strategies outperformed those taught through traditional methods.

Factors Influencing Achievement

Scaffolding is an effective teaching method that enhances learning and achievement. Afolabi & Afolabi, (2022), highlighted that several factors can influence students' achievement in Basic Science and Technology, such as:

- Prior knowledge: Students' prior knowledge and experiences can affect their ability to learn new concepts.
- Motivation: Students' motivation and interest in science can impact their achievement.
- Teaching methods: The teaching methods used in the classroom can influence students' achievement, with scaffolding being one effective approach.

Students' Retention in Basic Science and Technology

Retention in Basic Science and Technology refers to the extent to which students remember and apply scientific concepts and principles over time. Research has shown that scaffolding can help improve students' retention of scientific concepts, particularly when it is used in conjunction with other teaching strategies such as formative assessment. Tartenger, Enemarie, & Yusuf, (2024), explored the effect of scaffolding teaching strategies on students' academic performance, which is closely linked to retention of knowledge in Basic Science. Akani, (2024), also investigated the role of instructional scaffolding in enhancing students' retention of chemistry concepts. The results showed improved retention among students who were taught using scaffolding techniques.

Factors Influencing Retention

Several factors can influence students' retention of scientific concepts, including:

1) Depth of processing: The depth to which students process information can affect their retention.
2) Repetition and practice: Repeating and practicing scientific concepts can help solidify them in students' long-term memory.
3) Contextual learning: Learning scientific concepts in context can help students remember them more effectively.

The effectiveness of scaffolding strategy in enhancing students' achievement and retention in Basic Science and Technology can be attributed to its ability to provide temporary support and guidance, promote inquiry-based learning, and help students build their confidence and independence as learners.

Scaffolding and Student Achievement

Research has consistently highlighted the positive impact of scaffolding on students' academic achievement. For example, Ibe and Nwosu (2021) examined the effectiveness of scaffolding in teaching Basic Science and Technology in Nigeria and found that students taught using scaffolding strategies outperformed those taught through traditional methods. The study attributed this improvement to scaffolding's ability to break down complex concepts into manageable parts, thus enhancing students' understanding and engagement.

Similarly, Okeke and Ugwuanyi (2019) reported that scaffolding increased students' interest and participation in Basic Science and Technology lessons. The stepwise guidance allowed students to build on prior knowledge, fostering a deeper understanding of scientific concepts and enhancing overall achievement.

Scaffolding and Retention

Retention is the ability to store, remember, recall and apply learned information over time, is another critical aspect of learning. Studies show that scaffolding positively influences retention by engaging students in active learning processes. Olorunfunmi et al. (2020) found that scaffolding strategies, such as the use of visual aids, guided discussions, and hands-on activities, significantly improved retention rates among Nigerian Basic Science and Technology students. The interactive nature of scaffolding helps learners internalize concepts, making them more likely to retain information. Olufunke, (2020) In her study found that students who were taught using scaffolding strategies exhibited better retention of scientific concepts compared to those in traditional lecture-based learning environments.

Furthermore, scaffolding encourages the development of metacognitive skills, helping students to regulate their understanding and apply learning strategies effectively. This is particularly important in Basic Science and Technology, where students are required to integrate theoretical and practical knowledge.

Theoretical Framework

The scaffolding instructural strategy is rooted in social constructivist theory of learning, which emphasizes learning as an interactive mediated process. Vygotsky also asserted that learners perform better with the assistance of a more knowledgeable individual, which may be a teacher or a peer. This aligns with the Nigerian Basic Science and Technology curriculum's aim to enhance critical thinking, problem-solving, and lifelong learning skills.

Vygotsky's Sociocultural Theory (Zone of Proximal Development)

Lev Vygotsky's Sociocultural Theory emphasizes the fundamental role of social interaction in cognitive development. Central to this theory is the concept of the Zone of Proximal Development (ZPD), which represents the difference between what a learner can do independently and what they can achieve with guidance from a more knowledgeable other (MKO).

Application to Scaffolding: Scaffolding is the practical application of ZPD. In an educational context, scaffolding refers to the support provided by teachers, peers, or tools to help students accomplish tasks they cannot perform independently. This support is gradually withdrawn as students gain competence, enabling them to eventually master the content on their own. For instance, in Basic Science and Technology, scaffolding might involve step-by-step demonstrations, guided questioning, or the use of visual aids to teach complex concepts like circuits or chemical reactions.

Relevance to Achievement and Retention: By operating within a student's ZPD, scaffolding ensures that learning experiences are challenging yet achievable. This balance motivates students, facilitates deeper understanding, and promotes long-term retention of knowledge. Vygotsky's theory highlights the importance of contextualized support in fostering academic success in science and technology education.

Constructivist Learning Theory (Jean Piaget)

Constructivist theory, pioneered by Jean Piaget, posits that learners actively construct their own understanding and knowledge of the world through experiences and reflection. Learning is seen as a process of building upon prior knowledge, with new information integrated into existing cognitive structures.

Application to Scaffolding: Scaffolding aligns with constructivism by emphasizing active learning. Teachers use scaffolding techniques to connect new scientific or technological concepts to students' prior knowledge, facilitating the construction of new understanding. For example, in teaching the laws of motion in Basic Science, teachers might begin with a familiar concept like pushing objects, gradually introducing more complex ideas such as inertia and force.

Relevance to Achievement and Retention: Constructivist theory suggests that students are more likely to retain information when they actively participate in their learning process. Scaffolding provides the structure and support necessary for students to engage meaningfully with content, fostering deeper comprehension and long-term retention.

METHODOLOGY.

Research Design

The research design adopted for the study was quasi experimental design specifically pre test, post test, non randomized control group. The study was carried out in Onitsha Education Zone, in Anambra, Nigeria. Onitsha Education Zone comprises of three (3) local governments: Onitsha North, Onitsha South and Ogbaru.

Population of the Study

The population of the study consists of 4,433 Junior Secondary School II students in Onitsha Education Zone in Anambra state. The sample size consist of 140 Junior Secondary School II Basic Science students drawn from two schools out of 56 Public secondary schools in Onitsha Education Zone which was drawn through multi stage simple random sampling technique (balloting without replacement).

Instrument for data Collection

The instrument for data collection was Basic Science and Technology Achievement Test (BSTAT) developed by the researcher. This instrument was validated by three expert and it's reliability was tested using Pearson Product Moment Correlation Coefficient (PPMCC). The reliability index obtained from the BSTAT was 0•82.

Data Analysis

The data collected was analysed with mean, standard deviation and analysis of co-varience (ANCOVA). Mean and standard deviation (SD) were used to answer research questions and analysis of co-varience was used to test the null hypothesis at 0•05 level of significance.

RESULTS.

The results of this study were presented in line with the research questions and hypothesis that guided the study.

Research Question 1:

What is the mean achievement scores of students taught Basic Science and Technology using scaffolding strategy and those taught with traditional method.

Table 1

- Pretest Achievement Scores / Postest Achievement Scores

METHOD	N	x̄	SD	n	x̄	SD	Adj x̄	x̄diff
Scaffolding Strategy	76	22•56	14•07	76	77•28	9•63	77•33	21•41
Traditional method	64	20•06	12•42	64	55•82	10•46	55•42	

The results in table 1 above showed that the pretest and postest mean achievement scores for Basic Science and Technology students taught BST concepts using scaffolding strategy were 22•56 and 77•28. While those students taught using traditional method had 20•06 and 55•82. The adjusted mean scores for the two groups were 77•33 and 55•92 respectively. The difference between the mean gained achievement score of the students in the groups is 20•41, In favor of the students who used scaffolding strategy. This indicates that the students who were taught with scaffolding strategies achieved higher than those taught with traditional method. Hence, scaffolding strategy is very effective in enhancing students academic achievement in Basic Science and Technology.

Research Question 2

What is the mean retention scores of students taught Basic Science and Technology with scaffolding strategy and those taught with traditional method.

Table 2

- Mean and Standard deviation scores on students retention.

METHOD	N	x̄	SD	Adjust x̄	x̄diff
Scaffolding Strategy	76	64•91	9•15	65•06	20•41
Traditional method	64	44•67	9•79	44•65	

From table 2 above, the result showed that the Basic Science and Technology students taught with scaffolding strategy had mean retention score of 64•91 and standard deviation of 9•15, while those students taught with traditional method had a mean retention score of 44•67 and the standard deviation of 9•79. The adjusted mean scores for the two groups were 65•06 and 44•65. This indicating the mean difference in retention scores between those taught with scaffolding strategy and those taught with traditional method as 20•41. This implied that the students taught with scaffolding strategy retained the concepts better than those taught with traditional method. Therefore, scaffolding strategy enhances students retention than the traditional method of teaching.

TEST OF HYPOTHESIS

1) Hypothesis One (Ho_1)

There is no significant difference in the mean achievement scores of students taught Basic Science and Technology using scaffolding strategy and those taught with traditional method.

Table 3

Analysis of co-varience on pretest—posttest achievement scores of students by teaching methods.

SOURCE	TYPE III SUM OF SQUARES	df	MEAN SQUARE	F	P-VALUE
Corrected model	16484•04[a]	5	3296•81	32•92	•000
Intercept	162615•20	1	162615•20	1623•60	•000
Postest	9•76	1	9•76	•10	•755
Teaching method	5807•88	1	5807•88	57•99	•000

Table 3 showed that there was a significant difference in the mean achievement scores of students taught Basic Science and Technology concept with scaffolding strategy than those taught with traditional method, where F(1•134)=57•99, P=•000. The null hypothesis was rejected. Also looking at the adjusted mean achievement score of students in Table 1, the students taught Basic Science and Technology concepts using scaffolding strategy had mean =77•33 which was significantly greater than those of the students taught with traditional method $\bar{x}$=55•92, thus, scaffolding strategy is considered more effective than the traditional method of teaching Basic Science and Technology.

i. Hypothesis 2 (Ho_2)

There is no significant difference in the mean retention scores of students taught Basic Science and Technology with scaffolding strategy and those taught with traditional method.

Table 4

Analysis of co-varience on the retention scores of students by teaching method.

SOURCE	TYPE III SUM OF SQUARES	df	MEAN SQUARE	F	P-VALUE
Corrected model	14630•275[a]	5	2926•06	32•45	•000
Intercept	117648.359	1	117648.36	1304•81	•000
Postest	102.474	1	102•48	1•14	•288
Teaching method	4457.532	1	4957•53	54•98	•000

The result in Table 4 above showed that there is a significant difference in mean retention scores of students taught Basic Science and Technology with scaffolding strategy than those taught with traditional method, F(1•134)=54•98, P= •000, therefore the null hypothesis (Ho) was rejected. This shows that the adjusted mean retention scores of students taught Basic Science and Technology with scaffolding strategy ($\bar{x}$=5•06) was significantly greater than the mean retention score of those taught with traditional method $\bar{x}$=44•65 in Table 2. Hence, scaffolding strategy is more effective than traditional method of teaching Basic Science and Technology.

DISCUSSIONS

The results of the study were discussed under the following subheadings

- Effectiveness of scaffolding strategy on students achievement in Basic Science and Technology concepts.
- Effectiveness of scaffolding strategy on students retention in Basic Science and Technology concepts.

Effectiveness of Scaffolding Strategy on Students Achievement in Basic Science and Technology Concepts

The finding of this study revealed that Basic Science and Technology students taught with scaffolding strategy scored higher in achievement than those taught with traditional method. This implies that the use of scaffolding strategy enhances students overall achievement in BST concepts taught than the use of traditional method. This was also noticed in the adjusted mean score of students taught with scaffolding strategy which is 77•33 and that of those taught with traditional method which is 55•92 as in Table 1. Hence, the difference was significant in favor of those taught with scaffolding strategy. The reason was because scaffolding strategy is activity and interactive oriented. These encouraged the scaffolded students to participate actively in the lesson, learn deeply and meaningfully, enjoy studying BST, and sustained their interest and attention. All these facilitates and enhance their achievement.

The outcome of the finding was in agreement with the findings of Ibeneme (2018); Azih and Nwosu (2020); Amobi and Uchegbu (2022). Who in their separate studies reported that the use of scaffolding strategy promotes and enhances students academic achievement.

Effectiveness of Scaffolding Strategy on Students Retention in Basic Science and Technology Concepts

The findings of the study showed that students taught Basic Science and Technology concepts using scaffolding strategy had higher retention than those taught with traditional method. These results showed a statistically significant difference in retention between the two groups in favor of scaffolding strategy. This implies that when the Basic Science and Technology concepts are taught using scaffolding strategy, students tend to assimilate, remember, recall, retain and be able to communicate what was taught. These helps them to be actively involved in the lesson, and there by encourages them to enjoy studying Basic Science and Technology and finally enhances their achievement in Basic Science and Technology.

The result of this work supports the findings of Tal et al(2020); Emeka and Okeke(2020) who in their studies found out that students who were taught with scaffolding achieved higher and retained better than those taught with traditional method.

CONCLUSION

The findings of the study provides evidence that the use of scaffolding strategy is an effective teaching strategy for enhancing and facilitating students achievement and retention in Basic Science and Technology by breaking down complex tasks and providing structured support, scaffolding addresses the diverse learning needs of students and promotes deeper understanding.

To maximize the benefits of scaffolding, it is essential to train teachers, provide adequate resources, and integrate technology into the classroom. Policymakers and educators should prioritize scaffolding in teaching practices to enhance the quality of basic science education in Nigeria.

RECOMMENDATION

Based on the findings, the following recommendations were made:

1. Teacher training: Teachers should undergo training on scaffolding strategy to enable them apply scaffolding in their teaching.
2. Curriculum Revision: The Basic Science and Technology curriculum should explicitly include scaffolding techniques and structured activities to foster better understanding and retention.
3. School administrator and curriculum planners should organize seminars, workshops and conferences to enlighten teachers on the use of scaffolding strategy.
4. Provision of Resources: Schools should be equipped with adequate teaching materials, such as science kits and visual aids, to support effective implementation of scaffolding strategies.
5. Integration of Technology: Incorporating digital tools such as virtual labs and interactive simulations can make scaffolding more engaging and accessible for students.

By implementing these recommendations, the benefits of scaffolding as an instructional strategy can be maximized, ultimately improving students' achievement and retention in basic science and other subjects.

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