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# Developing Problem-Solving Skills in Students through Instructional Scaffolding

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## *Abstract*

The study examined the use of Instructional Scaffolding in developing problem-solving skills among junior secondary school students in Lagos State, Nigeria. The study employed a quasi-experimental design of pre-test post-test, non-equivalent control group. A multistage sampling technique was first used to sample three schools from the population of all public Junior Secondary Schools students in Lagos State. These three schools had three intact classes of students who were purposively selected as sample for the study which resulted in a sample size of 108 students. Data were then collected using a problem-solving Achievement Test labeled "Junior Secondary School Students Problem-Solving Achievement Test (JSSSPSAT)" and a perception Questionnaire labeled "Junior Secondary School Students Scaffolding Perception Questionnaire (JSSSSPQ)". The reliabilities of the instruments were computed using Cronbach's alpha technique, with reliabilities of 0.71 and 0.78 for the JSSSPSAT and JSSSSPQ respectively. The study utilized frequency count, mean, and standard deviation for descriptive analysis and an independent t-test with Two-way ANOVA to test significance at a 0.05 alpha level. The findings revealed that JSS students taught with Teacher-Led-Think-Aloud scaffolding technique were found to significantly perform better than those taught with Reciprocal-Think-Aloud scaffolding ($t_{(106)}$ =13.55, p <0.05). The findings also show that generally, scaffolding strategy is significantly better than conventional teaching method (modified lecture) as students taught under the strategy outperformed those taught under conventional teaching methods ($t_{(66)}$ =4.47, p <0.05), but no significant interaction effect was found between gender and the techniques used [F (2,102) =0.244; p>0.05]. Based on the findings of the study, it was recommended among others that curriculum planners should ensure scaffolding techniques are incorporated into the Junior Secondary School curriculum and whenever a teacher is confronted with the choice of scaffolding technique, Teacher-led-Think-Aloud should be considered over Reciprocal-Think-Aloud scaffolding and gender factors should not be considered when planning and delivering scaffolding strategy lessons.

***Keywords:*** *Conventional teaching methods, Problem-solving skills, Scaffolding Instructional Strategies (Teacher-led Think-Aloud and Reciprocal-Think-Aloud)*

## INTRODUCTION

There is so much concern in the alignment between the knowledge and skills students are expected to acquire in the classroom, their learning outcome and the demand of the society. As future professionals and engaged citizens, students are expected to be equipped with useful and productive skills to excel in their academics and also live sustainably in their society. Among these skills, as pointed out by Yakubu et al. (2024), is the skill of problem solving. They posited that improved problem-solving skills were not only found out to have positive correlation with better academic performance but also with increased

classroom engagement and success outside the classroom. People who have better problem-solving abilities are generally observed to solve the problems of higher complexity faster than more intelligent people (Agnihotri, 2015).

Teachers also need to start thinking out of the box as the future of working environment which they are training the students to function in requires a lot of variation in skills and practices. According to James et al. (2024), the adoption of new structures and processes ultimately require a cultural change of continuous learning and adaptability among employees. Conversely, Adeoye et al. (2023) observed that Nigerian school curriculum have been found not to adequately addresses critical skills and competencies needed by the 21st-century workforce, such as critical thinking, creativity, digital literacy and more importantly, problem-solving. This coincide with observations of United Nations that schools in Nigeria are not equipping young ones with the skills they need to live sustainably in the world around them (UNESCO, 2019).This problem is believed to stem out from the poor development of students meta-cognitive abilities which is made worse by the emphases placed on theoretical knowledge at the expense of practical skills (Adeoye et al, 2023). According to the UNESCO (2017), students need not to just learn, but to learn how to learn. Emphasis on memorization leaves students ill-equipped with the knowledge and skills of analysis and decision making which every child needs to be able to cope with the reality of life. Realizing the importance of this position, the 2013 National Policy on Education calls for the need to equip every child with 21st century skills of creative and critical thinking, collaboration and more importantly the skills of problem solving (Federal Republic of Nigeria (FRN), 2013). These skills are not only catalyst to any successful learning outcomes but are also instrumental to the learners' ability to cope in today's complex world. Learners need to be taught to be critical thinkers and problem solvers. When solutions to the problems are correctly deciphered students can apply them in solving problems and this could result in enhanced achievement (Ekoyo & Ngwu, 2023). Achieving this will mean that teachers would need to centre their teaching away from traditional memorization and recall to higher order meta-cognitive activities that would task the learners intelligence to analyze situations, make informed decisions and engage meaningfully with the world around them (Alanazi et al., 2024).

Problem-solving entails guiding the students through the process of analyzing and resolving a problem (Anyafulude, 2014). Bransford and Stein (1984) describes the problem-solving process as consisting of stages that begin with identifying the problem, defining the problem, exploring possible strategies, acting on those strategies, and looking back and evaluating the process. All these stages coincidentally fall within the realm of Bloom (1956) higher levels of Educational Objectives (application, analysis, synthesis and judgment). These are the levels of cognition at which problem-solving is believed to operate. Learners should therefore be well-groomed with activities that characterized these levels for a better learning outcome and for the learners to be able to survive within and outside the four-wall of classrooms. Developing problem-solving skills is vital for students as they face academic challenges and cultivate the critical thinking abilities needed for real-world situations. According to Resnick (1987), good problem solvers do not only understand material, but are also able to use it in different situations. As students move forward in their education at the Junior Secondary School level, they encounter more complex, open-ended problems, making it essential to develop these skills. Research shows that problem-solving skills are transferable and can be taught (Johnstone, 2001). However, numerous innovative learning strategies have been highlighted to enhance problem-solving abilities of students most especially at the lower level of schooling. A typical example of these strategies is scaffolding which has proven to be one of the active learning strategy. In this context, a comparative analysis of scaffolding and traditional methods of instruction can provide insights into the relative effectiveness of these instructional approaches in fostering problem-solving skills of Junior Secondary School students.

Even though educators and policymakers have begun to realize the significance of problem-solving skills in the 21st century, many classrooms are still characterized by traditional instructional methods which predominantly employ rote memorization. However, these classroom settings have failed to equip the learners with the problem-solving skills of critical thinking and adaptive reasoning that are needed to solve real-life problems. Evidently, findings have proven scaffolding to be one of the strategies that can be used to bolster students' problem-solving skills, but, the power of scaffolding to better the problem-solving skills of students in our environment particularly, Lagos State, is yet to be fully explored. There is a paucity of empirical research specifically focusing on Junior Secondary School education in Lagos State. Without well-structured empirical investigations, teachers may lack

the understanding of how to adopt scaffolding effectively in their classrooms, limiting the potential benefits for students to develop their problem-solving abilities.

Therefore, this study aims to investigate the effectiveness of instructional scaffolding in developing problem-solving abilities of Junior Secondary school students in Lagos State, in order to provide critical insights into instructional strategies that promote effective learning and address the existing gaps in student problem-solving skills towards preparing them for a better tomorrow. In doing this, the study examines, if there is a difference in problem-solving skills between students taught under scaffolding strategies and those who received traditional methods of teaching; if the teaching methods of theTeacher-Led and Student-Led-Think-Alouds yield differences in the levels of problem-solving skills amongst students; whether gender has an influence on the effectiveness of the scaffolding procedure. Finally, the research tries to determine how students view the effectiveness of scaffolding strategies to enhance their problem-solving abilities.

## LITERATURE REVIEW

This study is anchored on the Vygotsky's socio-cultural theory of learning, particularly Zone of Proximal Development (ZPD). The Russian psychologist Lev Vygotsky introduced the Zone of Proximal Development, in the early 20th century and since then the concept has been used widely in education and instructional design. ZPD refers to the range of tasks or skills that a learner can perform with the assistance of a More Knowledgeable Other (e.g., Teachers, Parents, Peers) but not yet independently (Vygosky, 1978). It refers to the area that sits between the regions of what learners can do alone and the learner can do with assistance. Simply put, it describes that additional space where students can learn, practice, and accomplish more than they would normally do without additional support and guidance (Office of Curriculum, Assessment and Teaching Transformation, 2020). According to the theory, less learning would occur when pupils are taught only below the ZPD because it will be mere repetition or review of what they already know and practice what they are already proficient at. Similarly, teaching learners only the concepts above their ZPD i.e. things they don't understand would results in failure and frustration, which further restricts learning. The relevance of scaffolding in this situation is to bridge the gap between these two extreme zones. According to the Office of Curriculum, Assessment and Teaching Transformation (2020), although some degree of uncertainty and initial failure are common during the learning process, scaffolding is used to reduce needless challenges and assist student achievement. Zone of Proximal Development emphasizes the importance of support and social interaction in the learning process which scaffolding provides as illustrated in Figure 1.

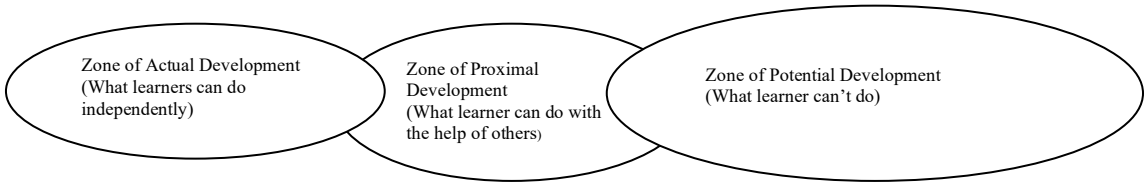


**Figure 1** Zone of proximal development

1. The Concept of Instructional Scaffolding

The term scaffolding was first used in the construction industry. It describes a makeshift framework that holds up a building while it is being built and it is gradually removed once it is sturdy enough (Olarewaju, 2023). This concept has been viewed and applied differently using this paradigm. Iroko and Olaoye (2022) provide a description of instructional scaffolding to be the temporary, structured, and decreasing support offered by teachers to assist students in reaching a higher level of understanding and skill development that they may not be capable of attaining independently. Wood et al. (1976) also see scaffolding as a temporary support and guidance given to students as they learn new concepts and

skills, gradually releasing responsibility to the learner as they become more proficient. This strategy is a crucial pedagogical tool used in education to help students develop new concepts and skills through higher-order thinking ability. Lowe (2012) points out that scaffolding is an appropriate approach used to help children learn more skills and solving problems independently. It is a concept that describes a strategy or collection of methods used in the learning process to enhance achievement, comprehension, and performance with the aim of meeting educational goals (Aditi, 2017).In their own words, Michell and Sharpe (2005) explain that instructional scaffolding entails teachers making both conscious and unconscious choices regarding the kind of assistance they think students require in order to succeed. The practice of scaffolding is used to reduce the difficulty of the learning process and simultaneously allow students to focus on high-order thinking activities to construct new knowledge (Ghanizadeh et al., 2020). All these definitions put scaffolding decision in the hands of the teacher who acts as facilitator, guidance and director during scaffolding process. Scaffolding is never permanent, as the knowledge of students develops, it can be changed, reduced or removed over time. The process of starting to the end of scaffolding is what Van de Pol et al., (2010) identify as contingency, fading, and transfer of responsibility. While contingency involves provision of support for the children and ensures they are not left alone when struggling, fading involves gradual removal of the support, which would lead to another key aspect which is the transfer of responsibility (skills) from the teacher to the pupils.

Several forms of scaffolding exist in literature. Think-Aloud Scaffolding technique is a typical example that researchers found to be effective and have the propensity to develop problem-solving skills of students. The Think-Aloud method is a cognitive and meta-cognitive teaching technique meant to get students talking about their thought processes while solving problem or during learning tasks. Think-Aloud is a teaching strategy that is "used to demonstrate what a thought process is." According to Raihan (2011), in Teacher-led-Think-Aloud, teachers explain their thoughts as they complete a task, read a passage, or work through an issue so that students can hear the conclusions and decisions they are making. This strategy allows teachers to model the way to approach a task or solve a problem by explicitly verbalizing their thoughts (Raihan, 2011). Teacher can also pair students and in-turn they play the role of a verbalizer. This is what is termed “Student-Led-Think-Aloud or Reciprocal-Think-Aloud”. Students work together in pairs, Think-Aloud, while they read a difficult text or hypothesize in science, or compare opposing viewpoints (Raihan, 2011). It involves students verbalizing their thoughts during Think-Aloud process while reading, solving problems or responding to questions (Chin and Ghani, 2021). Think-Aloud, makes the reasoning apparent and therefore fosters deeper understanding and strategic thinking. Students will learn to monitor their own thinking and develop self-regulation skills that can help them improve their learning outcomes. It has been used to influence the promotion of students' engagement, comprehension, and critical thinking skills with students make reading an active and social experience (Wilhelm, 2001).

The Teacher-Led and Student-Led-Think-Alouds have their advantages and disadvantages in the learning environment. A particularly good way to introduce complex concepts and set up foundational understanding is with Teacher-Led Think-Alouds. Yet student led approaches may not as much support student engagement or foster a sense of ownership in learning as these approaches. On the other hand, Student-Led-Think-Alouds support independence and verbalization of thought processes, but they typically need more initial support and structure to be effective (Rosenshine, 2012). It is found that combining both approaches can result in optimal outcomes. As an example, teachers can first demonstrate strategies in think alouds and then allow students to think aloud, both in terms of comprehension and active engagement (Raihan, 2011). Often known as the gradual release of responsibility, this method allows students to learn effective thinking strategies, get more confident, and more autonomous (Dede & Sochacki). In the end, teacher- and student-led think alouds can increase productivity and enhance deeper learning. To carryout Teacher-led Think-Aloud technique, the teacher is expected to:

i. give the intended topic to the students and provide them the intended learning outcomes
ii. share materials to the students most especially the contents to be taught
iii. explain to the students some important problem-solving skills to guide them in answering questions during the lesson. Such skills include that of predicting, connecting, visualizing, questioning, summarizing, and monitoring comprehension are given out to students.

iv. model his thinking as he reads. He explicitly articulates his thinking process by using phrases like "I'm thinking," "I wonder," or "This makes me think of…" Teacher does this at most points when reading or teaching seems to look confusing to students.
v. Teacher reads the materials shared to the students using Think-Aloud method as the students read the same text silently. At certain point, teacher stops and Think-Aloud the answers to some preselected questions.
vi. Teacher shares another material, leads the Think-Aloud process then leaves the students to offer answers to the questions.
vii. He thereafter asks students to read on their own and answer questions using Think-Aloud method.

Reciprocal-Think-Aloud shares same procedure with the Teacher-led-Think-Aloud technique but from step 6 where, teacher shares another material and leads the Think-Aloud process, students work together in pairs, Think-Aloud, while they read and offer answers to the questions. Afterward, one student thinks-aloud, the other writes down what is said, then roles are changed, students reflect on the process and write about the findings (Raihan, 2011).

2. Scaffolding Strategy, Traditional methods and Development of Problem-solving skills in Students

The concept of scaffolding is grounded in the socio-cultural theory of learning, which emphasizes the importance of social interaction and collaboration in the learning process (Vygotsky, 1978) in contrast to traditional methods that adopt a more didactic approach, where students are expected to follow instructions and the teacher provides direct instruction (Hativa, 2019).Traditional teaching methods, such as textbooks, lectures, and memorization, have been questioned for their effectiveness in promoting positive learning outcomes and developing problem-solving skills despite their long-standing use and proven effectiveness in transmitting knowledge (Hafeez et al., 2021). Hafeez (2021) asserts that traditional method is only recommended when knowledge transfer is the only purpose which supports many other researchers positions that traditional methods are poor methods when it comes to the development of critical thinking, a crucial element in problem solving(Carter et al., 2016; Dehghanzadeh & Jafaraghaee, 2018).

According to Northern Illinois University Center for Innovative Teaching and Learning (2012) scaffolding enhances problem-solving skills by providing support through strategies like modeling, prompting, and feedback, transitioning students from rote memorization of traditional instruction to deeper cognitive processing (Alanazi et al., 2024). Although conventional approaches can offer fundamental knowledge, they frequently fail to foster problem-solving abilities. Students who get just traditional instruction may rely largely on memorization without fully comprehending subjects (Wang, 2022). This rudimentary comprehension may make it more difficult for them to address challenging and real-world issues. The scaffolding approach encourages students to become independent and self-directed, improving problem-solving skills. It involves recruitment, reduction of freedom, direction maintenance, and feedback (Wood et al., 1976: Arifin et al., 2020), which can be adjusted to suit individual learning needs, making it a flexible and dynamic teaching strategy which are grossly absent in traditional method of instruction. Hafeez (2021) added more to these attributes of scaffolding by positing that scaffolding facilitates higher-order thinking, enhances meta-cognitive awareness, and as such has the propensity to improve students' problem-solving abilities. Ekoyo and Ngwu (2023) assert that problem-solving strategy has been seen to engage students more fruitfully and reduces rote learning as is common with conventional teaching methods. Similarly, according to Frederick (2014), students who received scaffolding instructions were discovered to more likely reflect on their methods and work with peers, which increased the frequency of successful problem-solving techniques. On the other hand, kids in traditional classroom environments showed a decreased ability to try new things and take chances while addressing problems. They are more suited for lower order cognitive skills and less effective for developing critical thinking and problem-solving skills which are essential (Hafeez, 2021).

3. Scaffolding Strategy and Gender of Students

Studies have been carried out to examine how different scaffolding techniques affect male and female

students differently, offering insights into efficient teaching techniques to advance educational parity. In a study conducted by Obafemi (2023) the findings revealed that both genders benefited from scaffolding methods; however, there were notable differences in how each group responded to these teaching approaches. The study indicated that female students exhibited a higher degree of engagement and improved problem-solving skills when participating in collaborative activities and group discussions, which are common elements in scaffolding techniques. This supports the findings of Kwon (2025) that girls tend to benefit more from collaborative learning environment while boys tend to thrive in competitive settings. In a related finding, a longitudinal study reveals that gender differences in self-regulated learning often relate to the effectiveness of scaffolding strategies. Koch (2002) presented that creating and employing stereotypes around the gender attributes of students' roles in class, known as gender-sensitive educational approaches, leads to undesirable and inequitable outcomes. At the same time, their study emphasizes the importance of implementing gender-neutral practices in a classroom so as not to deprive any of the students of opportunities to learn in an optimal environment. Ariyibi et al. (2025) however, subscribed to this assertion with their finding of no positive effect of gender on the academic performances of students exposed to computer/hypermedia-based learning. According to Angeli and Georgiou (2023), who examined the effects of scaffolding and gender in developing young children's sequencing and decomposition, significant gender effects was found on children's sequencing and decomposition skills, with boys outperforming girls, indicating the existence of gender effects in computational thinking development a much deviation from Ariyibi et al. (2025).

## METHODS

The study adopted a quasi-experimental design of the pre-test and post-test, non-equivalent control group design. The design involved intact classes without randomization in the selection of the subjects. The population of the study was all students enrolled in public Junior Secondary Schools in Lagos State, which has a total population of 374,717 across 353 schools (Lagos Bureau of Statistics, 2022).The treatment was applied to students in Junior Secondary School (JSS) II classes only. A sample size of 108 students was selected, comprising of 52 males and 56 females. While the Experimental Group one had 15 male, 21 female; Experimental Group two had 18 male, 14 female and Control Group had 21 male and 19 female. Hence, Experimental Group had 68 respondents while Control Group had 40 respondents.

Multi-stage sampling procedure was used to select the sample. Lagos State has six Education District (Districts I-VI) and in the first stage of the selection process, Education District V was selected using purposive sampling. The next stage involved the selection of three public Junior Secondary Schools from the district through random sampling technique. From each of these three schools, one Junior Secondary School Two class was selected to make three classes. The first class was tagged as Experimental the Group 1, the second as Experimental Group 2 while the third school was named Control Group. The three groups were attached to treatments, thus: Experimental Group 1 to Teacher-Led-Think-Aloud scaffolding Technique, Experimental Group 2 to Reciprocal-Think-Aloud Scaffolding Technique and Control Group to Conventional teaching Methods. Students in the three groups (classes) were left intact without any randomization.

A self-designed Achievement Test titled: "Junior Secondary School Students Problem-solving Achievement Test (JSSSPSAT)" which was made up of ten short essay questions and "Junior Secondary School Students Scaffolding Perception Questionnaire(JSSSSPQ)" made up of "Yes" or "No" responses with ten items were used to collect data. The test and questionnaire were validated using content and face validity and subjected to Cronbach's alpha to estimate their internal consistency. While JSSSPSAT yielded an alpha value of 0.71, JSSSSPQ gave 0.78. Descriptive statistics (frequency counts, means, and standard deviations) and inferential statistics (independent t-tests and ANOVA) were used to address the first four objectives. The fifth objective was analyzed using only descriptive statistics.

Treatment Procedure: A pre-test was administered to all the students in all groups using the JSSPSAT. Afterward, the students in each group were taught four lessons of 40 minutes per contact period. Students in the Experimental group 1 were taught using Teacher-led–Think-Aloud scaffolding

technique, Experimental group 2 were taught with "Reciprocal Think-Aloud scaffolding technique while those under control group were taught with conventional teaching methods. At the end of the third lesson, JSSSPSAT and JSSSSPQ were administered to the students. The test and questionnaire were collected immediately after their response, later marked and scored. The scores from each group were used for the analysis.

## RESULTS

1. Difference in problem-solving skills between students taught under scaffolding strategies and those who receive traditional/conventional methods of teaching.

From Table 1, students taught with scaffolding method had a higher mean score of 27.31 with standard deviation of 3.17 in the problem-solving Achievement Test than students taught with the use of conventional teaching method who had mean score of18.42 and standard deviation of 3.49. It can therefore be concluded that the use of scaffolding made students performed better than the use of conventional teaching methods with a mean gain of 8.89. However, to determine whether the observed difference is significant, the data was analyzed using t-test (Table 2). From the analysis (Table 2), t-value yielded 13.55 with p-value of 0.00 at 0.05 level of significant and 106 degree of freedom ($t_{(106)}$=13.55, p <0.05). Hence, it can be said that there is a significant difference in the problem-solving skills of Junior Secondary School students taught using scaffolding method and those taught using conventional teaching methods.

**Table 1** Descriptive statistics of junior secondary school students taught problem- solving skills using scaffolding strategies and conventional teaching methods

| Strategies | Mean | Std. Deviation | Frequency |
|---|---|---|---|
| Scaffolding | 27.31 | 3.17 | 68 |
| Conventional teaching methods | 18.42 | 3.49 | 40 |
| Mean Difference | 8.89 | | |

**Table 2** Test of significant difference between junior secondary school students taught problem- solving skills using scaffolding strategies and conventional teaching methods

| Strategy | X | SD | N | DF | T-value | p-value | Sig. level |
|---|---|---|---|---|---|---|---|
| Scaffolding | 27.31 | 3.17 | 68 | 106 | 13.55 | 0.000 | 0.05 |
| Conventional | 18.42 | 3.49 | 40 | | | | |

2. Difference in the problem-solving skills of Junior Secondary School students taught using Teacher Led-Think-Aloud and Reciprocal-Think-Aloud scaffolding techniques

Table 3 shows that students taught with Teacher-Led-Think-Aloud had higher mean score (Mean = 28.75, SD = 1.78) than those taught with Reciprocal-Think-Aloud scaffolding (Mean = 25.69, SD = 3.65) in the problem-solving achievement test. What this implies is that the Teacher-Led-Think-Aloud technique made students performed better than the Reciprocal-Think-Aloud scaffolding with a mean gain of 3.06. To verify if the observed difference in Table 2a was significant, the data was analyzed using t-test (Table 4). Table 2b shows the t-value of 4.47, p-value of 0.00 at 0.05 level of significant and 66 degree of freedom ($t_{(66)}$=4.47, p <0.05). This indicates that there is a significant difference in the mean problem-solving skills of Junior Secondary School students taught using the Teacher-Led Think-Aloud and Reciprocal Think-Aloud scaffolding techniques.

**Table 3** Descriptive statistics of junior secondary school students taught problem- solving skills using teacher-led-think-aloud and reciprocal-think-aloud techniques

| Scaffolding Technique | Mean | Std. Deviation | Frequency |
|---|---|---|---|
| Teacher-Led-Think-Aloud | 28.75 | 1.779 | 36 |
| Reciprocal-Think-Aloud | 25.69 | 3.649 | 32 |
| Mean Difference | 3.06 | | |

**Table 4** Test of significant difference in the problem-solving skills of junior secondary school students when taught using teacher led-think-aloud and reciprocal-think-aloud scaffolding techniques

| Scaffolding Technique | X | SD | N | DF | T-value | p-value | Sig. level |
|---|---|---|---|---|---|---|---|
| Teacher-Led- Think-Aloud | 28.75 | 1.78 | 36 | 66 | 4.47 | 0.000 | 0.05 |
| Reciprocal-Think- Aloud | 25.69 | 3.65 | 32 | | | | |

3. Difference in the problem-solving skills of Junior Secondary School students taught using scaffolding methods based on gender

Table 5 shows that female students taught with the use of scaffolding had a higher mean score of 15.36 with a standard deviation of 2.21 in problem-solving Achievement Test than their male counterparts who had a mean score of 15.11 and standard deviation of 3.14. It can therefore be said that female students taught with the use of scaffolding performed better than male with a mean difference of 0.25.

**Table 5** Descriptive statistics of male and female junior secondary school students taught using scaffolding method

| Gender | Mean | Std. Deviation | Frequency |
|---|---|---|---|
| Male | 15.11 | 3.14 | 31 |
| Female | 15.36 | 2.21 | 37 |
| Mean Difference | 0.25 | | |

4. Interaction Effect between Gender and the Techniques

While there is difference between the performance of male and female students taught through scaffolding method, the study moves further to determine if significant interaction effect exists between gender and the techniques. To achieve this, the analysis was done using Two-way ANOVA (Table 6). The result of the analysis in Table 6 shows that there is no significant interaction effect of gender and the techniques on the problem-solving abilities of JSS students [F (2,102) =0.244; p>0.05]. This indicates that the effects of teaching techniques on problem-solving scores do not differ by gender.

**Table 6** Test of interaction effects of gender and techniques on the problem-solving skills of junior secondary school students

| Source | Type III Sum of Square | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 2153.449[a] | 5 | 430.690 | 44.262 | 0.000 |
| Intercept | 62261.095 | 1 | 62261.095 | 6398.534 | 0.000 |
| Technique | 2117.384 | 2 | 1058.692 | 108.801 | 0.000 |
| Technique* gender | 4.743 | 2 | 2.372 | 0.244 | 0.784 |
| Error | 992.514 | 102 | 9.731 | | |
| Total | 65450.000 | 108 | | | |
| Corrected Total | 3145.963 | 107 | | | |

$R^2$= 0.685 (Adjusted $R^2$= 0.669)

5. Perception of students about the effectiveness of scaffolding strategies on problem-solving abilities

Responses of students to items in the questionnaire were used determine perception of students about the effectiveness of scaffolding strategies on problem-solving abilities. The analysis in Table 7 shows that 74.9% of the respondents claimed that the scaffolding methods were better than the methods their teachers were using to teach them while 25.1% believed otherwise. From the analysis, it can be inferred that since about three-quarter of the respondents consented to the fact that scaffolding method is better therefore we can conclude that the method is better than conventional teaching methods being adopted by teachers.

**Table 7** Perception of students about the effectiveness of scaffolding strategies on problem-solving abilities

| Item | Statement | Response | | Total |
|---|---|---|---|---|
| | | Yes | No | |
| 1. | The methods made me to understand everything taught | 56 | 12 | 68 |
| 2. | The methods can make a dull student to start performing well | 47 | 21 | 68 |
| 3. | The methods assisted me to think critically before answering question | 50 | 18 | 68 |
| 4. | The methods made lessons interesting | 49 | 19 | 68 |
| 5. | The methods made me to connect my experiences to the topics being taught | 45 | 23 | 68 |
| 6. | The methods gave me opportunity to actively participate in class activities. | 56 | 12 | 68 |
| 7. | The methods gave us (students) a better opportunity to interact with class members. | 44 | 24 | 68 |
| 8. | The methods enabled us (students) to arrive at correct answers to most of our questions without teacher's intervention. | 53 | 15 | 68 |
| 9. | The methods showed that there is no difference between what is taught in school and what we do at home | 56 | 12 | 68 |
| 10. | I will want our teacher to always use this methods in class | 53 | 15 | 68 |
| | Total | 509 | 171 | 680 |
| | % | 74.9 | 25.1 | 100 |

## DISCUSSION

Research question one sought for the difference in the problem-solving skills of Junior Secondary School students taught using scaffolding method compared to those taught using conventional teaching methods and discovered that students taught with the use of scaffolding outperformed their counterparts taught with conventional teaching methods with mean difference of 8.89. This difference is however significant at 0.05 level of significant ($t_{(106)}$ =13.55, p <0.05). The finding is not first of its series. Ekoyo and Ngwu (2023) discovered the productivity of scaffolding over traditional teaching practices and thus urged teachers to introduce the former into their classrooms. This brighter performance that students under scaffolding displayed in problem-solving than those under conventional teaching methods can be as a result of some overriding advantages such as effective interaction and coordinated guidance which conventional teaching methods often lack.

The difference in performance between students taught with Teacher-Led-Think-Aloud strategy and Reciprocal-Think-Aloud scaffolding is evident in this study with a mean gain of 3.06 in favour of Teacher-Led-Think-Aloud strategy and a considerable statistically significant difference between them ($t_{(66)}$ =4.47, p<0.05). The finding supports Rosenshine (2012) who asserts that direct instruction such as teacher modelling aids acquisition of new skills in comprehending difficult concepts. According to Rosenshine (2012), good teachers model how to go about tasks and this corresponds to the implications of TLTA which suggests that when students see a good model, they perform better. The findings also corroborate the fact that TLTA facilitates and improves students' meta-cognitive awareness and strategies. As Thu and Vien (2022) state, when teachers Think-Aloud, they not only assist students with content knowledge, but they also encourage students to verbalise their

own learning. The results of Henjes (2007) research, carried out among young learners', also illustrated a better performance, regarding the problem-solving skills, after teachers used Think-Aloud methods, reporting a similar mean gain of 3.06 in our study. As reported by 2015 Programme for International Student Assessment (PISA), students with higher levels of teacher-directed instruction achieved significantly better results than those on students-led instruction (Organization for Economic Co-operation and Development (OECD, 2016). The study showed how focused sessions led by a teacher outperformed less organized sessions led by the children with a difference that was in line with the significance presented. Nevertheless, as demonstrated by Burhansyah (2022) and Raihan (2011)'s study, by combining both approaches can result in optimal outcomes. As an example, teachers can first demonstrate strategies in think alouds and then allow students to think aloud, both in terms of comprehension and active engagement.

The result got from the analysis of gender difference reveals that female students taught with the use of scaffolding performed better than their male counterparts with a mean difference of 0.25. When the interaction effect of gender and the techniques was tested the result got was not significant at alpha level of 0.05 [F (2.102) =0.244; p>0.05]. A more thorough examination of the results showed that during a period of scaffolding, both male and female students' problem-solving abilities considerably improved. These results corroborate the study by Obafemi (2023), who shows that both genders were able to improve their problem-solving skills through scaffolding approaches offered. Their improvements, however, varied in kind and were in line with Kwon et al. (2025) assertion that males could perform better on activities requiring independent reasoning and analytical techniques, while females made more noticeable improvement on challenges involving collaborative problem-solving.

The finding from the study further shows that majority of the respondents (74.9%) consented to the fact that scaffolding is better than conventional teaching methods used by their teachers (25.1%).According to this findings, students believed scaffolding learning to be a more efficient and interesting method than traditional teaching techniques. Scaffolding also enhances understanding and retention of information by addressing learning needs, enhancing interest, and promoting collaboration amongst learners. As educational institutions evolve scaffolding techniques could provide answers to the challenges of conventional teaching that limit critical thinking and problem solving. This finding corresponds with that of Van de Pol et al. (2010), who remarked that students believed scaffolding provided them with support to construct meaning from complex subject matter and enhanced their problem-solving skills. The authors also investigated the contrast between traditional methods, in which their absence often resulted in students being overwhelmed by content material.

## CONCLUSION

Scaffolding techniques significantly improves problem-solving skills in Junior Secondary School students. Unlike conventional teaching methods, scaffolding encourages students' involvement, comprehension, and retention of information. Teacher-led Think-Aloud is more productive than Reciprocal-Think-Aloud, and regardless of gender, scaffolding is an engaging strategy. Students have a positive perception of scaffolding. In all, students like the scaffolding techniques. This is because scaffolding fosters individual learning requirements, increasing motivation, and encouraging teamwork, scaffolding improves comprehension and memory of information

Based on the findings of this study, it is recommended that the Ministry of Education and policymakers should incorporate scaffolding techniques into lower secondary education teaching methods to improve student learning outcomes. Teachers should also prioritize Teacher-led Think-Aloud over Reciprocal Think-Aloud, as research indicates it is more effective. In addition, it is recommended that schools should hold seminars and professional development activities to equip teachers with these strategies, promote hands-on techniques, and conduct regular assessments to evaluate the effectiveness of scaffolding interventions. This will help make informed decisions for future changes and improvements in teaching methods.

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## DATA AVAILABILITY STATEMENT

The data used and presented in this study are available on request from the corresponding authors.

## CONFLICT OF INTEREST

The authors declare that they have no known conflicting interests that could have appeared to influence the work reported in this paper.

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