

The Use of Scaffolded Activities in Developing Students Scientific Reasoning and Higher-Order Thinking Skills

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Abstract—This study aimed to determine the effectiveness of Scaffolded Activities in Developing Students' Scientific Reasoning and Higher-Order Thinking Skills. It focused on assessing the extent of use of scaffolded activities, the level of students' scientific reasoning and higher order thinking skills in science. Also to find out significant relationship between these variables. The study utilized a descriptive-experimental research design employing a one-shot test approach. The respondents of the study were 105 Grade 9 students who were purposively chosen. Scaffolded activities were implemented during the teaching of selected science topics, incorporating modeling, guided practice, gradual release, independent practice and reflection. Questionnaire for scaffolded activities and a researcher-made assessment tool was used to measure students' scientific reasoning and higher-order thinking skills after the intervention. The collected data were analyzed using mean and standard deviation, Pearson-r correlation and regression analysis. The extent use of scaffolded activities was very high across all dimensions. Finding also revealed that students demonstrated a very high level of scientific reasoning. As to students' higher order thinking skills were very satisfactory except applying which was interpreted as outstanding. The structured and gradual support provided through scaffolding enabled students to better understand scientific concepts, analyze problems, and apply knowledge in more complex situations. The approach also promoted active participation, critical thinking, and independent learning among students. However, no significant relationship was between the extent of use of scaffolded activities on students' scientific reasoning as well as effect on higher order thinking skills. These concludes that although scaffolded activities create structured and supportive learning environment, no significant relationship was found on students' scientific reasoning as well as significant effect on higher order thinking skills, thus accepting the hypotheses. Based on the results, it is recommended that teachers incorporate scaffolded activities in science instruction to enhance students' cognitive skills. Educators are encouraged to design lessons that provide appropriate support and gradually release responsibility to learners. Furthermore, schools may conduct training and workshops to equip teachers with effective scaffolded teaching strategies. Future studies may consider using comparative or experimental designs with control groups to further validate the effectiveness of scaffolded instruction.

Keywords— Scaffolded activities, scientific reasoning, higher-order thinking skills, descriptive-experimental design, science education

I. INTRODUCTION

In today's science classrooms, the ability of students to reason scientifically and engage in higher-order thinking is increasingly recognized as essential for meaningful learning. From merely memorizing information, education has changed

to promoting problem solvers who can think critically and utilize knowledge in real-world situations (Brookhart, 2015). Teachers are now expected to design learning environments that nurture both cognitive and analytical skills, preparing learners for future challenges in a knowledge-driven society.

Scientific reasoning plays a crucial role in developing learners' capacity to make hypotheses, interpret data, and draw valid conclusions. Kuhn (2015) emphasized that scientific reasoning is not only about applying formulas but also about fostering the mindset to evaluate evidence logically. Without this skill, students often struggle with abstract scientific concepts, especially when required to explain or justify experimental outcomes cited by Zimmerman, (2017). Therefore, strengthening scientific reasoning is fundamental in shaping learners' scientific literacy.

Parallel to scientific reasoning is the development of higher-order thinking skills, which include analysis, evaluation, synthesis, and application. According to Heong et al. (2016), these skills allow learners to process information beyond surface-level understanding and to construct innovative solutions. In science education, higher-order thinking transforms students from passive recipients of information to active investigators of phenomena asserted by Anderson & Krathwohl, (2018). These competencies are aligned with 21st-century learning goals that encourage inquiry, creativity, and critical judgment.

To address the demand for deeper thinking, scaffolding has emerged as an effective instructional approach. Wood, Bruner, and Ross cited in Van de Pol et al., (2019) originally defined scaffolding as the structured support provided to learners until they achieve independence. Recent studies affirm that scaffolded activities such as modeling, prompting, and guided practice help learners tackle complex tasks they might otherwise find overwhelming mentioned by Belland, (2017). Scaffolding thus bridges the gap between what students can do alone and what they can achieve with guided support.

Empirical findings suggest that scaffolded activities directly enhance students' scientific reasoning. McNeill and Krajcik (2018) showed that structured prompts in science investigations help students articulate hypotheses and use evidence more effectively. Similarly, Lin et al. (2020) demonstrated that scaffolding improves learners' ability to control variables in experimental design. These findings suggest that scaffolding does not only guide learners but also

builds the foundation for logical, evidence-based reasoning in science.

In addition to reasoning, scaffolded activities also promote higher-order thinking skills by encouraging students to analyze, evaluate, and synthesize information. Kim and Hannafin (2016) found that scaffolding encourages learners to apply concepts creatively in problem-solving contexts. More recently, O'Donnell (2021) reported that scaffolded group tasks enhance collaborative critical thinking, enabling students to construct knowledge collectively. By gradually reducing support, scaffolding ensures that learners internalize cognitive strategies and achieve greater independence in thinking processes.

Despite growing evidence, many science classrooms still struggle to implement scaffolded activities effectively, leading to students' difficulties in reasoning and higher-order tasks mentioned by Nguyen et al., (2022). This study therefore aims to examine how scaffolded activities can be systematically used to enhance both domains, providing insights for teachers and curriculum developers in advancing science education.

1.1 Statement of the Problem

Problem/s which were addressed by the research

The study wants to determine the use of scaffolded activities in developing students scientific reasoning and higher-order thinking skills.

It seeks answers in the following questions.

1. What is the level of use of scaffolded activities in terms of:
 - 1.1 modeling activities;
 - 1.2 guided practice;
 - 1.3 gradual release;
 - 1.4 in dependent practice; and
 - 1.5 reflection?
2. What is the level of students' scientific reasoning in Science in terms of:
 - 2.1 observation;
 - 2.2 questioning;
 - 2.3 logical thinking;
 - 2.4 data analysis; and
 - 2.5 interpretation?
3. What is the level of Students' Higher-Order Thinking Skill in Science in terms of
 - 3.1 applying;
 - 3.2 evaluating;
 - 3.3 synthesizing; and
 - 3.4 problem solving?
4. Is there a significant relationship between the use of scaffolded activities and student's scientific reasoning in Science?
5. Is there a significant effect between the use of scaffolded activities to the students higher-order thinking skills in Science?

II. METHODOLOGY

The study utilized a descriptive-experimental research design employing a one-shot test approach. The respondents of the study were 105 Grade 9 students who were purposively chosen. Scaffolded activities were implemented during the

teaching of selected science topics, incorporating modeling, guided practice, gradual release, independent practice and reflection. Questionnaire for scaffolded activities and a researcher-made assessment tool was used to measure students' scientific reasoning and higher-order thinking skills after the intervention. The collected data were analyzed using mean and standard deviation, Pearson-r correlation and regression analysis.

III. RESULTS AND DISCUSSION

This part deals with the presentation, analysis, and interpretation of data gathered to answer the sub-problem relative to the main problem of this study. This part discusses the findings of the study based on the questions. It also provides explanations and insights derived from the results to support the conclusions of the study.

Level of Using Scaffolded Activities

In this study, the level of Using Scaffolded Activities refers to Modeling Activities; Guided Practice; Gradual Release; Independent Practice; and Reflection. These dimensions represent the structured instructional strategies used to support and enhance students' engagement, understanding, and learning outcomes in science.

The level of Using Scaffolded Activities is revealed in the following table, which shows the statement, mean, standard deviation, remarks, and verbal interpretation. This table provides a clear overview of how each activity dimension was implemented and its perceived effectiveness in enhancing students' learning. This also serves as the basis for identifying the strengths and areas for improvement in the use of scaffolded activities.

Table 1 presents the level of using scaffolded activities in terms of modeling activities. It shows how modeling strategies were implemented in the teaching process and the extent to which they supported students' learning. The data indicate the effectiveness of modeling activities in guiding students to understand scientific concepts and processes.

Table 1. Level of Using Scaffolded Activities in terms of Modeling Activities

Statement	Mean	SD	Remarks
Through the use of scaffolded Activities in our lesson, I...			
...understand concepts better when my teacher demonstrates step-by-step how to solve a problem before I try it on my own.	4.94	0.23	Strongly Agree
...feel more confident in answering science questions when I see clear examples provided during class discussions.	4.93	0.25	Strongly Agree
...connect scientific theories to real-life applications when my teacher models how to analyze data or solve problems.	4.93	0.25	Strongly Agree
...visualize the correct way to approach similar problems when my teacher provides detailed explanations.	4.91	0.28	Strongly Agree
...learn more effectively when I observe demonstrations before working on tasks on my own.	4.92	0.27	Strongly Agree
Weighted Mean	4.93		
SD	0.26		
Verbal Interpretation			Very High

Table 1 shows the level of using scaffolded activities as perceived by students in terms of modeling activities.

Respondents strongly agree that they understand concepts better when their teacher demonstrates step-by-step procedures before allowing them to work independently.

The level of using scaffolded activities in terms of modeling activities attained a weighted mean of 4.93 with a standard deviation of 0.26, verbally interpreted as Very High. This indicates that teachers are highly effective in utilizing modeling strategies to support students' understanding, skill development, and confidence in science learning. The low standard deviation further suggests that students have consistent perceptions regarding the effectiveness of these scaffolded activities.

In summary, the findings imply that modeling activities are a vital component of scaffolded instruction. Through clear demonstrations, guided explanations, and practical examples, students better comprehend concepts, apply knowledge to real-life situations, and develop confidence in academic tasks. Moreover, modeling activities provide structured support that gradually enhances independent learning abilities and improves their engagement.

Table 2 presents the level of using scaffolded activities in terms of guided practice. It highlights how students perceive the support provided by teachers during structured learning activities. This indicates the importance of continuous teacher guidance.

Table 2. Level of Using Scaffolded Activities in terms of Guided Practice

Statement	Mean	SD	Remarks
Through the use of scaffolded Activities in our lesson, I...			
...feel supported when I practice new skills with my teacher's guidance before doing it alone.	4.92	0.27	Strongly Agree
...gain more confidence in science when I receive prompts and clues from my teacher during activities.	4.92	0.27	Strongly Agree
...understand lessons more deeply when I am given time to work with assistance before independent tasks.	4.91	0.28	Strongly Agree
...benefit from immediate feedback while I am still learning how to solve science problems.	4.92	0.27	Strongly Agree
...improve my learning when I can ask questions and receive guidance during practice activities.	4.92	0.27	Strongly Agree
Weighted Mean	4.92		
SD	0.27		
Verbal Interpretation			Very High

Table 2 shows the level of using scaffolded activities as perceived by students in terms of guided practice.

Respondents strongly agree that they feel supported when practicing new skills with their teacher's guidance before working independently. They also strongly agree that receiving prompts and clues during activities helps increase their confidence in science. Moreover, students strongly agree that they understand lessons more deeply when given time to work with assistance prior to independent tasks. They further agree that immediate feedback while learning enhances their ability to solve science problems, and that being able to ask

questions and receive guidance during practice improves their overall learning.

The level of using scaffolded activities in terms of guided practice attained a weighted mean of 4.92 with a standard deviation of 0.27, verbally interpreted as Very High. This indicates that teachers are highly effective in providing guided practice that supports students' learning, builds confidence, and strengthens their problem-solving skills in science. The low standard deviation also suggests that students have consistent perceptions regarding the effectiveness of guided practice.

In summary, the findings imply that guided practice is an essential component of scaffolded instruction. Through continuous support, timely feedback, and opportunities for guided engagement, students are able to deepen their understanding, enhance their confidence, and gradually develop independence in learning.

Table 3 presents the level of using scaffolded activities in terms of gradual release. It illustrates students' perceptions of the move from teacher-led education to autonomous learning, which allows them to gain proficiency and command of the concepts over time.

Table 3. Level of Using Scaffolded Activities in terms of Gradual Release

Statement	Mean	SD	Remarks
Through the use of scaffolded Activities in our lesson, I...			
...receive full guidance and then gradually allows me to take more responsibility in learning.	4.95	0.21	Strongly Agree
...feel prepared for independent tasks when lessons move step by step from teacher instruction to self-practice.	4.94	0.23	Strongly Agree
...develop confidence when responsibilities are shared before I work completely on my own.	4.93	0.25	Strongly Agree
...learn more effectively when teacher support is reduced gradually rather than removed all at once.	4.94	0.23	Strongly Agree
...manage new science concepts better when independence is introduced slowly.	4.94	0.23	Strongly Agree
Weighted Mean	4.94		
SD	0.23		
Verbal Interpretation			Very High

Table 3 shows the level of using scaffolded activities as perceived by students in terms of gradual release.

Respondents strongly agree that they receive full guidance at the beginning of the lesson, which is gradually reduced as they take more responsibility in their learning. They also strongly agree that they feel prepared for independent tasks when lessons are presented step by step, moving from teacher instruction to self-practice. In addition, students strongly agree that their confidence develops when responsibilities are shared before they work completely on their own. Furthermore, they agree that learning becomes more effective when teacher support is reduced gradually rather than removed abruptly, and that they are able to manage new science concepts better when independence is introduced slowly.

The level of using scaffolded activities in terms of gradual release attained a weighted mean of 4.94 with a standard deviation of 0.23, verbally interpreted as Very High. This

indicates that teachers are highly effective in applying the gradual release strategy, enabling students to transition smoothly from guided learning to independent performance. The low standard deviation further suggests consistency in students' responses regarding the effectiveness of this approach.

In summary, the findings imply that gradual release is a crucial component of scaffolded instruction. By systematically shifting responsibility from teacher to student, learners are able to build confidence, strengthen understanding, and develop independence in mastering science concepts and skills.

Table 4 presents the level of using scaffolded activities in terms of independent practice. It shows how students perceive their ability to apply learned concepts and skills on their own, demonstrating increased confidence and understanding with minimal teacher support.

Table 4. Level of Using Scaffolded Activities in terms of Independent Practice

Statement	Mean	SD	Remarks
Through the use of scaffolded Activities in our lesson, I...			
...apply what I have learned when I am given the chance to practice without my teacher's help.	4.95	0.21	Strongly Agree
...feel motivated to test my skills by working independently after guided learning activities.	4.95	0.21	Strongly Agree
...become more confident in science when I solve problems on my own after receiving support from my teacher.	4.95	0.21	Strongly Agree
...like working independently because it shows me how much I truly understand the lesson.	4.95	0.21	Strongly Agree
...learn responsibility and discipline when I practice tasks without assistance.	4.95	0.21	Strongly Agree
Weighted Mean	4.95		
SD	0.21		
Verbal Interpretation			Very High

Table 4 shows the level of using scaffolded activities as perceived by students in terms of independent practice.

Respondents strongly agree that they are able to apply what they have learned when given the opportunity to practice without their teacher's help. They also strongly agree that they feel motivated to test their skills through independent work after engaging in guided learning activities. Moreover, students strongly agree that solving problems on their own after receiving support increases their confidence in science. They further agree that working independently allows them to assess their true understanding of the lesson, and that practicing tasks without assistance helps them develop responsibility and discipline.

The level of using scaffolded activities in terms of independent practice attained a weighted mean of 4.95 with a standard deviation of 0.21, verbally interpreted as Very High. This indicates that teachers are highly effective in facilitating independent practice, allowing students to apply knowledge, strengthen skills, and build confidence in science learning. The low standard deviation also suggests that students have consistent perceptions regarding the effectiveness of independent learning tasks.

In summary, the findings imply that independent practice is a vital component of scaffolded instruction. After receiving

enough guidance, students can improve their comprehension, acquire self-confidence, and foster responsibility and discipline in learning by giving them the chance to work independently.

Table 5 presents the level of using scaffolded activities in terms of reflection. It illustrates how students perceive the opportunities to think critically about their learning, to help them evaluate their understanding, and for them to make meaningful connections for them to improve their skills and their performance.

Table 5. Level of Using Scaffolded Activities in terms of Reflection

Statement	Mean	SD	Remarks
Through the use of scaffolded Activities in our lesson, I...			
...learn more when I take time to think about how I solved a science problem.	4.94	0.23	Strongly Agree
...improve my learning when I reflect on my mistakes and identify how to correct them.	4.93	0.25	Strongly Agree
...evaluate which strategies worked and which did not after completing an activity.	4.93	0.25	Strongly Agree
...connect current lessons to future learning when I reflect on my classroom experiences.	4.93	0.25	Strongly Agree
...monitor my learning progress when I regularly reflect on my performance in class.	4.93	0.25	Strongly Agree
Weighted Mean	4.94		
SD	0.25		
Verbal Interpretation			Very High

Table 5 shows the level of using scaffolded activities as perceived by students in terms of reflection.

Respondents strongly agree that they learn more when they take time to think about how they solved a science problem. They also strongly agree that reflecting on their mistakes and identifying ways to correct them improves their learning. Moreover, students strongly agree that they are able to evaluate which strategies are effective after completing an activity. They further agree that reflection helps them connect current lessons to future learning and allows them to monitor their progress in class.

The level of using scaffolded activities in terms of reflection attained a weighted mean of 4.94 with a standard deviation of 0.25, verbally interpreted as Very High. This indicates that teachers are highly effective in integrating reflective practices that enhance students' critical thinking, self-awareness, and learning improvement in science. The low standard deviation also implies consistency in students' perceptions regarding the effectiveness of reflection as part of scaffolded instruction.

In summary, the findings suggest that reflection is an essential component of scaffolded learning. Through continuous evaluation of their own understanding, strategies, and performance, students are able to deepen learning, correct misconceptions, and become more responsible and independent learners.

Level of Students' Scientific Reasoning in Science

In this study, the level of Students' Scientific Reasoning in Science refers to observation, questioning, logical thinking, data analysis, and interpretation.

The level of Students' Scientific Reasoning in Science is revealed in the following table, which shows the statement, mean, standard deviation, remarks, and verbal interpretation.

Table 6 presents the level of students' scientific reasoning in science in terms of observation. It highlights how students perceive their ability and skills to carefully gather, analyze and describe information using their senses, in which this serves as a foundation for developing deeper scientific understanding.

Table 6. Level of Students' Scientific Reasoning in Science in terms of Observation

Statement	Mean	SD	Remarks
As a student I conduct observations to;			
...carefully observe details in experiments because it helps me understand the science concept better.	4.96	0.19	Strongly Agree
...recognize patterns and changes during science activities.	4.95	0.21	Strongly Agree
...examine experimental results carefully to understand the ideas they represent.	4.95	0.21	Strongly Agree
...relate observed details to what I have learned in class.	4.95	0.21	Strongly Agree
...increase my confidence in answering science questions through accurate observations.	4.95	0.21	Strongly Agree
Weighted Mean	4.95		
SD	0.21		
Verbal Interpretation			Very High

Table 6 shows the level of students' scientific reasoning in science as perceived in terms of observation.

Respondents strongly agree that they carefully observe details in experiments because it helps them better understand science concepts. They also strongly agree that they are able to recognize patterns and changes during science activities. Moreover, students strongly agree that examining experimental results carefully allows them to grasp the ideas being presented. They further agree that they can relate observed details to prior knowledge, and that accurate observations increase their confidence in answering science-related questions.

The level of students' scientific reasoning in terms of observation attained a weighted mean of 4.95 with a standard deviation of 0.21, verbally interpreted as Very High. This indicates that students demonstrate a very high level of observational skills, which is a fundamental component of scientific reasoning. The minimal standard deviation also points to the uniformity of students' responses about their ability to see well throughout science activities.

In summary, the findings suggest that observation is a strong aspect of students' scientific reasoning. Through careful examination, pattern recognition, and connection of observations to prior knowledge, students are able to develop deeper understanding, enhance analytical thinking, and build confidence in learning science. These results imply that strengthening observational skills can further support students in conducting investigations and making evidence-based conclusions.

Table 7 presents the level of students' scientific reasoning in science in terms of questioning. It reflects how students perceive their ability to formulate relevant and meaningful

questions, which is essential in deepening understanding and guiding scientific inquiry.

Table 7. Level of Students' Scientific Reasoning in Science in terms of Questioning

Statement	Mean	SD	Remarks
As a student, I formulate questions to;			
...help me clarify the things I do not fully understand.	4.95	0.21	Strongly Agree
...develop curiosity by asking "why" and "how" questions during science lessons.	4.94	0.23	Strongly Agree
...explore topics more deeply and discover new ideas.	4.94	0.23	Strongly Agree
...participate actively in class discussions through meaningful questions.	4.95	0.21	Strongly Agree
...gain knowledge by confidently asking questions, even when topics are challenging.	4.95	0.21	Strongly Agree
Weighted Mean	4.95		
SD	0.22		
Verbal Interpretation			Very High

Table 7 shows the level of students' scientific reasoning in science as perceived in terms of questioning.

Respondents strongly agree that they formulate questions to clarify concepts they do not fully understand. They also strongly agree that asking "why" and "how" questions help develop their curiosity during science lessons. Moreover, students strongly agree that questioning allows them to explore topics more deeply and discover new ideas. They further agree that asking meaningful questions enables them to participate actively in class discussions, and that confidently asking questions, even in challenging topics, helps them gain more knowledge.

The level of students' scientific reasoning in terms of questioning attained a weighted mean of 4.95 with a standard deviation of 0.22, verbally interpreted as Very High. This indicates that students demonstrate a high level of engagement in using questioning as a strategy for scientific reasoning. The low standard deviation also suggests consistency in students' responses regarding their ability to ask relevant and meaningful questions during science learning.

In summary, the findings imply that questioning is a key component of students' scientific reasoning. Through active inquiry, curiosity, and meaningful participation, students are able to deepen their understanding, enhance critical thinking, and become more engaged in the learning process. It also helps students develop problem-solving skills and confidence in expressing their ideas and to their ability to ask relevant and meaningful questions during science learning. It also helps students develop problem-solving skills and confidence in expressing their ideas.

Table 8 presents the level of students' scientific reasoning in Science in

terms of logical thinking. It highlights how students perceive their ability to analyze information, make connections, and draw sound conclusions based on evidence and reasoning. The table also reflects the extent to which logical thinking helps students solve problems and understand scientific concepts effectively.

Table 8. Level of Students' Scientific Reasoning in Science in terms of Logical Thinking

Statement	Mean	SD	Remarks
As a student, I apply logical thinking to:			
...use facts and evidence to support my answers because it makes my reasoning stronger.	4.93	0.25	Strongly Agree
...analyze problems carefully by following logical steps before choosing a solution.	4.92	0.27	Strongly Agree
...explain my answers clearly using reasoning rather than guessing.	4.92	0.27	Strongly Agree
...express my ideas confidently and logically during science activities.	4.92	0.27	Strongly Agree
...solve problems effectively by making logical connections.	4.92	0.27	Strongly Agree
Weighted Mean	4.93		
SD	0.26		
Verbal Interpretation	Very High		

Table 8 shows the level of students' scientific reasoning in science as perceived in terms of logical thinking.

Respondents strongly agree that they use facts and evidence to support their answers, making their reasoning stronger. They also strongly agree that they analyze problems carefully by following logical steps before selecting a solution. Moreover, students strongly agree that they are able to explain their answers clearly using reasoning rather than guessing. They further agree that they can express their ideas confidently and logically during science activities, and that they are able to solve problems effectively by making logical connections.

The level of students' scientific reasoning in terms of logical thinking attained a weighted mean of 4.93 with a standard deviation of 0.26, verbally interpreted as Very High. This indicates that students demonstrate a high level of engagement in applying logical thinking as part of their scientific reasoning skills. The low standard deviation also suggests consistency in students' responses regarding their ability to think logically and systematically during science learning.

In summary, the findings imply that logical thinking is a vital component of students' scientific reasoning. Through the use of evidence, step-by-step analysis, and clear explanation of ideas, students are able to enhance their problem-solving skills, strengthen their reasoning abilities, and actively engage in meaningful science learning. It also helps students make sound conclusions and apply scientific concepts effectively in real-life situations.

Table 9 presents the level of students' scientific reasoning in science in terms of data analysis. It highlights how students perceive their ability to interpret, organize, and evaluate data to draw meaningful conclusions and support scientific explanations. The table also shows the extent to which data analysis skills enable students to solve problems and make evidence-based decisions in science learning.

Table 9 shows the level of students' scientific reasoning in science as perceived in terms of data analysis.

Respondents strongly agree that they enjoy analyzing data from experiments because it helps them understand results more clearly. They also strongly agree that they are able to organize and compare data to identify patterns and

relationships. Moreover, students strongly agree that they can draw accurate conclusions based on careful analysis of data.

Table 9. Level of Students' Scientific Reasoning in Science in terms of Data Analysis

Statement	Mean	SD	Remarks
As a student, I perform data analysis to:			
...enjoy analyzing data from experiments because it helps me understand the results more clearly.	4.94	0.23	Strongly Agree
...organize and compare data to identify patterns and relationships.	4.93	0.25	Strongly Agree
...draw accurate conclusions based on careful analysis of data.	4.92	0.27	Strongly Agree
...avoid errors by examining data critically.	4.92	0.27	Strongly Agree
...gain deeper insights by interpreting experimental data thoughtfully.	4.93	0.25	Strongly Agree
Weighted Mean	4.93		
SD	0.25		
Verbal Interpretation	Very High		

The level of scientific reasoning in terms of data analysis attained a weighted mean of 4.93 with a standard deviation of 0.25, verbally interpreted as Very High. This indicates that students demonstrate a high level of engagement in applying data analysis as part of their scientific reasoning skills. The low standard deviation also suggests consistency in students' responses regarding their ability to analyze and interpret data effectively.

In summary, the findings imply that data analysis is a significant component of students' scientific reasoning. Through organizing, interpreting, and evaluating data, students are able to enhance their analytical skills, draw meaningful conclusions, and engage more deeply in science learning.

Table 10 presents the level of students' scientific reasoning in science in terms of interpretation.

Table 10. Level of Students' Scientific Reasoning in Science in terms of Interpretation

Statement	Mean	SD	Remarks
As a student, I reflect on interpretation to:			
...learn better and explain the meaning of the results from my activities in class.	4.94	0.23	Strongly Agree
...demonstrate my understanding of lessons through accurate interpretation of data.	4.94	0.23	Strongly Agree
...relate scientific findings to real-life situations.	4.93	0.25	Strongly Agree
...understand graphs, tables, and other scientific representations.	4.93	0.25	Strongly Agree
...appreciate science more when I can clearly explain what observations and data mean.	4.95	0.21	Strongly Agree
Weighted Mean	4.94		
SD	0.24		
Verbal Interpretation	Very High		

Table 10 shows the level of students' scientific reasoning in science as perceived in terms of interpretation.

Respondents strongly agree that reflecting on their interpretations helps them learn better and explain the meaning of results from classroom activities. They also strongly agree that accurately interpreting data demonstrates their understanding of lessons. Moreover, students strongly agree that they can relate scientific findings to real-life situations. They further agree that interpreting graphs, tables,

and other scientific representations enhances their comprehension, and that being able to explain observations and data clearly increases their appreciation of science.

The level of students' scientific reasoning in terms of interpretation attained a weighted mean of 4.94 with a standard deviation of 0.24, verbally interpreted as Very High. This indicates that students actively engage in interpreting scientific data, reflecting a strong ability to understand, relate, and communicate scientific concepts. The low standard deviation also suggests consistency in students' perceptions regarding the importance and effectiveness of interpretation in their learning.

In summary, the findings imply that interpretation is a key aspect of scientific reasoning. By reflecting on and explaining data, students deepen their understanding, connect concepts to real-world applications, and develop critical thinking and communication skills in science learning.

Level of Students' Higher-Order Thinking Skills

In this study, the level of Students' Higher-Order Thinking Skills refers to Applying; Evaluating; Synthesizing; and Problem Solving. These skills represent essential cognitive processes that enable students to think critically and perform complex intellectual tasks.

The level of Students' Higher-Order Thinking Skills is revealed in the following table, which shows the raw score, frequency, percentage, mean, standard deviation, and verbal interpretation. This table provides a comprehensive view of students' performance and the distribution of their scores across different levels of higher-order thinking skills.

Table 11 presents the level of students' higher-order thinking skills in terms of applying. It highlights how students perceive their ability to use learned concepts, principles, and procedures in new or real-life situations. Furthermore, it reflects their capacity to transfer knowledge from classroom learning to practical problem-solving tasks. This also indicates how effectively students can apply scientific ideas to different contexts with minimal guidance.

Table 11. Level of Students' Higher-Order Thinking Skills in terms of Applying

Raw Score	Frequency (f)	Percentage (%)	Descriptive Equivalent
13-15	90	85.71	Outstanding
10-12	15	14.29	Very Satisfactory
7-9	0	0.00	Satisfactory
4-6	0	0.00	Fair
1-3	0	0.00	Needs Improvement
	105	100	Outstanding
Mean	=	14.29	
SD	=	1.28	
VI	=	O	

Table 11 presents the level of students' higher-order thinking skills (HOTS) in terms of applying.

The majority of students (85.71%) scored within the 13–15 range, verbally interpreted as Outstanding, while 14.29% scored 10–12, interpreted as Very Satisfactory. No students scored in the lower categories of Satisfactory, Fair, or Needs Improvement, indicating a high level of performance in applying skills.

The overall mean score is 14.29 with a standard deviation of 1.28, verbally interpreted as Outstanding. This indicates that students are highly proficient in applying learned concepts to new situations, demonstrating the ability to transfer knowledge effectively. The low standard deviation suggests that students' performance in applying knowledge is consistent across the group.

In summary, the findings suggest that students excel in applying their learning, reflecting strong problem-solving skills and the capacity to use scientific concepts in practical and meaningful contexts. Furthermore, this indicates that students can demonstrate confidence in transferring classroom knowledge to real-life situations. It also shows that their learning experiences effectively support the development of higher-order thinking skills.

Table 12 presents the level of students' higher-order thinking skills in terms of evaluation. It highlights how students assess information, make judgments, and determine the value or credibility of ideas based on set criteria. Furthermore, it reflects their ability to justify decisions using logical reasoning and evidence. This also indicates how effectively students can critique concepts and compare different solutions in problem-solving situations.

Table 12. Level of Students' Higher-Order Thinking Skills in terms of Evaluating

Raw Score	Frequency (f)	Percentage (%)	Descriptive Equivalent
13-15	57	54.29	Outstanding
10-12	12	11.43	Very Satisfactory
7-9	0	0.00	Satisfactory
4-6	36	34.29	Fair
1-3	0	0.00	Needs Improvement
	105	100	Very Satisfactory
Mean	=	10.22	
SD	=	4.37	
VI	=	VS	

Table 12 presents the level of students' higher-order thinking skills (HOTS) in terms of evaluation.

The data show that 54.29% of students scored 13–15, which is verbally interpreted as Outstanding, while 11.43% scored 10–12 (Very Satisfactory). Notably, 34.29% scored 4–6, interpreted as Fair, and no students scored in the Satisfactory or Needs Improvement categories.

The overall mean score is 10.22 with a standard deviation of 4.37, verbally interpreted as Very Satisfactory. This indicates good evaluative skills among students, though the high standard deviation shows varied performance and that some may need additional support.

In summary, the findings imply that students are moderately strong in evaluating, with more than half performing at outstanding levels, but targeted interventions may be necessary to improve consistency and ensure all learners develop critical evaluative skills effectively. Furthermore, this suggests that while many students can make sound judgments and decisions, some still need additional support in applying evaluative thinking consistently. It also indicates the importance of strengthening instructional strategies that promote critical analysis and evidence-based reasoning among all learners.

Table 13 presents the level of students' higher-order thinking skills in terms of synthesizing. It highlights how students perceive their ability to combine different ideas, concepts, and information to form new and meaningful understanding. Furthermore, it reflects their capacity to integrate knowledge from various sources to create coherent explanations or solutions.

Table 13. Level of Students' Higher-Order Thinking Skills in terms of Synthesizing

Raw Score	Frequency (f)	Percentage (%)	Descriptive Equivalent
13-15	51	48.57	Outstanding
10-12	11	10.48	Very Satisfactory
7-9	0	0.00	Satisfactory
4-6	38	36.19	Fair
1-3	5	4.76	Needs Improvement
	105	100	Very Satisfactory
Mean	= 10.08		
SD	= 4.52		
VI	= VS		

Table 13 presents the level of students' higher-order thinking skills (HOTS) in terms of synthesizing.

The data show that 48.57% of students scored 13–15, verbally interpreted as Outstanding, while 10.48% scored 10–12, interpreted as Very Satisfactory. Meanwhile, 36.19% scored 4–6 (Fair) and 4.76% scored 1–3 (Needs Improvement), with no students in the Satisfactory category.

The overall mean score is 10.08 with a standard deviation of 4.52, verbally interpreted as Very Satisfactory. This indicates that, on average, students demonstrate a fairly strong ability to synthesize information, integrating ideas and concepts to form new understandings. However, the relatively high standard deviation suggests a wide variation in students' performance, with some excelling while others require additional guidance to effectively synthesize knowledge.

In summary, the findings imply that synthesizing is a moderate strength among students. While nearly half perform at outstanding levels, targeted support is needed to improve consistency and ensure that all students can integrate and connect ideas effectively in their learning. Furthermore, this suggests that students still need more opportunities to practice organizing and combining information in meaningful ways. It also indicates the importance of instructional strategies that promote creativity and deeper conceptual integration.

Table 14 presents the level of students' higher-order thinking skills in terms of problem solving. It highlights how students perceive their ability to identify problems, analyze possible solutions, and select appropriate strategies to address given situations. Furthermore, it reflects their capacity to think critically and apply learned concepts in resolving real-life and academic challenges.

Table 14 presents the level of students' higher-order thinking skills (HOTS) in terms of problem solving.

The data indicate that 59.05% of students scored 13–15, verbally interpreted as Outstanding, while 10.48% scored 10–12, interpreted as Very Satisfactory. A small portion, 0.95%, scored 7–9 (Satisfactory), and 29.52% scored 4–6 (Fair), with no students in the Needs Improvement category.

Table 14. Level of Students' Higher-Order Thinking Skills in terms of Problem Solving

Raw Score	Frequency (f)	Percentage (%)	Descriptive Equivalent
13-15	62	59.05	Outstanding
10-12	11	10.48	Very Satisfactory
7-9	1	0.95	Satisfactory
4-6	31	29.52	Fair
1-3	0	0.00	Needs Improvement
	105	100	Very Satisfactory
Mean	= 11.16		
SD	= 4.16		
VI	= VS		

The overall mean score is 11.16 with a standard deviation of 4.16, verbally interpreted as Very Satisfactory. This suggests that, on average, students demonstrate a good level of problem-solving skills, effectively applying knowledge to address challenges. The standard deviation reflects moderate variability in performance, showing that while many students excel, a notable portion still requires additional support to consistently solve problems effectively.

In summary, the findings imply that problem solving is a strength for most students, with over half performing at outstanding levels. Nevertheless, targeted interventions may be necessary to support those who are less confident in applying their knowledge to solve problems and to ensure more uniform proficiency across the class. Furthermore, this indicates that while many students can effectively analyze and resolve tasks, some still require additional scaffolding to strengthen their problem-solving abilities.

Significant Relationship between Using the Scaffolded Activities and the Students' Scientific Reasoning in Science

In this study, the level of Using the Scaffolded Activities refers to Modeling Activities; Guided Practice; Gradual Release; Independent Practice; and Reflection while the Students' Scientific Reasoning in Science refers to Observation; Questioning; Logical Thinking; Data Analysis; and Interpretation.

The Significant Relationship between Using the Scaffolded Activities and the Students' Scientific Reasoning in Science is revealed in the following table, which shows the Multiple Regression Analysis using Pearson Product Moment Correlation Coefficient.

Table 15 shows the Significant Relationship between Using the Scaffolded Activities and the Students' Scientific Reasoning in Science.

Table 15 presents the test of significant relationship between the use of scaffolded activities and students' scientific reasoning in science across five dimensions. Using Pearson Product-Moment Correlation with 105 respondents, the analysis examined whether the use of scaffolded activities modeling, guided practice, gradual release, independent practice, and reflection are significantly associated with students' performance in observation, questioning, logical thinking, data analysis, and interpretation.

The results reveal that most scaffolded activities modeling, guided practice, gradual release, and independent practice do not show statistically significant relationships with any dimensions of scientific reasoning, with p-values greater than 0.05. Only reflection shows a statistically significant positive

relationship with logical thinking ($r = 0.210, p = 0.032$), suggesting that students who engage in reflective practices tend to demonstrate stronger logical reasoning skills. The low to moderate correlation indicates that while most scaffolded activities are perceived as highly effective, their direct impact on measurable scientific reasoning skills is limited, with reflection emerging as the most influential component.

These findings imply that scaffolded activities, when implemented collectively, support students' learning experiences but only reflection has a measurable association with enhancing a specific aspect of scientific reasoning.

Reflection encourages students to think critically, evaluate their problem-solving processes, and make logical connections, which may strengthen their reasoning capabilities.

In summary, the results demonstrate that scaffolded activities generally provide a supportive and structured learning environment, yet their contribution to students' scientific reasoning is significant only in the context of reflective practice. Emphasizing reflection within scaffolded instruction may therefore be key to developing higher-order thinking and logical reasoning skills in science learning.

Table 15. Significant Relationship between Using the Scaffolded Activities and the Students' Scientific Reasoning in Science

Using the Scaffolded Activities	Students' Scientific Reasoning in Science					
		Observation	Questioning	Logical Thinking	Data Analysis	Interpretation
Modeling Activities	Pearson Correlation	0.069	0.081	0.086	0.084	0.101
	Sig. (2-tailed)	0.483	0.410	0.385	0.395	0.303
	N	105	105	105	105	105
Guided Practice	Pearson Correlation	0.068	0.073	0.084	0.085	0.083
	Sig. (2-tailed)	0.490	0.462	0.393	0.388	0.402
	N	105	105	105	105	105
Gradual Release	Pearson Correlation	0.060	0.143	0.074	0.075	0.068
	Sig. (2-tailed)	0.543	0.145	0.451	0.447	0.489
	N	105	105	105	105	105
Independent Practice	Pearson Correlation	0.129	0.116	0.064	0.065	0.059
	Sig. (2-tailed)	0.189	0.237	0.516	0.512	0.551
	N	105	105	105	105	105
Reflection	Pearson Correlation	0.036	0.070	0.210*	0.047	0.112
	Sig. (2-tailed)	0.716	0.475	0.032	0.633	0.255
	N	105	105	105	105	105

Significant Effect between Using the Scaffolded Activities on the Students' Higher-Order Thinking Skills in Science

In this study, the level of Using the Scaffolded Activities refers to Modeling Activities; Guided Practice; Gradual Release; Independent Practice; and Reflection while the Students' Scientific Reasoning in Science refers to Observation; Questioning; Logical Thinking; Data Analysis; and Interpretation. while the Students' Higher-Order Thinking Skills refers to Applying; Evaluating; Synthesizing; and Problem Solving.

The Significant Effect between Using the Scaffolded Activities on the Students' Higher-Order Thinking Skills in Science is revealed in the following table, which shows the use of t-Test, with the computed t-value (t-cal), p-value, number of observations or respondents, and critical t-value (t-crit) or constant.

The Table 16 shows the Significant Effect between Using the Scaffolded Activities on the Students' Higher-Order Thinking Skills in Science.

Table 16 presents the test of significant effect of using scaffolded activities on students' higher-order thinking skills (HOTS) in science across four domains: applying, evaluating, synthesizing, and problem solving. Using t-tests with 105 respondents, the analysis examined whether the implementation of scaffolded activities modeling, guided

practice, gradual release, independent practice, and reflection has a statistically significant effect on students' demonstration of HOTS.

The results reveal that none of the dimensions of scaffolded activities show a statistically significant effect on any of the measured HOTS domains, with all p-values exceeding 0.05. The t-values range from -1.228 to 0.812, indicating no substantial differences in students' abilities to apply, evaluate, synthesize, or solve problems as a result of the individual scaffolded activities. Reflection, modeling, guided practice, gradual release, and independent practice all produced t-values that were not significant, suggesting that while these activities are perceived as highly effective in supporting learning, they do not independently generate measurable improvements in HOTS. The constant value of 1.98 represents the baseline performance level of students in the absence of the scaffolded activities.

These findings imply that although scaffolded activities create a structured and supportive learning environment, they alone do not significantly influence higher-order thinking skills. Development of HOTS may require a combination of scaffolded strategies, cumulative practice, and additional instructional interventions that actively challenge students to think critically, integrate knowledge, and solve complex problems.

Table 16. Significant Effect between Using the Scaffolded Activities on the Students' Higher-Order Thinking Skills in Science

Using the Scaffolded Activities		Students' Higher-Order Thinking Skills in Science			
		Applying	Evaluating	Synthesizing	Problem Solving
Modeling Activities	t-value	-0.067	-0.494	-1.001	-0.514
	Sig. (2-tailed)	0.947	0.622	0.319	0.609
	N	105	105	105	105
Guided Practice	t-value	-1.228	0.166	-0.079	0.470
	Sig. (2-tailed)	0.222	0.868	0.937	0.639
	N	105	105	105	105
Gradual Release	t-value	-1.081	0.301	-0.025	0.244
	Sig. (2-tailed)	0.282	0.764	0.980	0.808
	N	105	105	105	105
Independent Practice	t-value	-0.930	-0.566	-1.199	-0.357
	Sig. (2-tailed)	0.354	0.572	0.233	0.722
	N	105	105	105	105
Reflection	t-value	0.035	-0.612	-0.917	0.812
	Sig. (2-tailed)	0.972	0.542	0.361	0.418
	N	105	105	105	105

In summary, the findings demonstrate that the use of scaffolded activities does not produce a statistically significant effect on students' higher-order thinking skills in science. To enhance students' ability to apply, evaluate, synthesize, and solve problems effectively, educators may need to integrate scaffolded practices with complementary strategies that encourage independent thinking, problem-solving, and creative reasoning in authentic learning contexts.

IV. CONCLUSION AND RECOMMENDATIONS

Among the indicator of scaffolded activities only reflection shows significant relationship on students scientific reasoning in terms of logical thinking. Leading to acceptance of the null hypothesis. This suggests that the scaffolded activities used in the study did not significantly influence students' ability to analyze, reason, and make sound scientific decisions.

There's no significant effect among all the indicator of scaffolded activities and students higher order thinking skills. Leading to acceptance of the null hypothesis. The results show that scaffolded activities did not produce a significant effect on students' abilities in applying, evaluating, synthesizing, and problem-solving. This implies that while scaffolded activities may support learning, they are not sufficient on their own to significantly develop higher-order thinking skills without additional instructional strategies.

Based on the drawn conclusions resulted to the following recommendations:

It is recommended that teachers continue implementing all dimensions of scaffolded activities modeling, guided practice, gradual release, independent practice, and reflection to support understanding, confidence, independence, and reflective thinking in science.

Students are encouraged to actively engage in scaffolded activities, especially reflection, to develop logical thinking, observation, questioning, data analysis, and interpretation skills.

Future researchers are encouraged to explore combined instructional strategies beyond scaffolded activities to improve higher-order thinking, since scaffolded activities alone did not

produce significant measurable effects in applying, evaluating, synthesizing, or problem-solving.

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