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Research Paper

A Phenomenological Study on Teachers' Implementation of Think-Aloud Scaffolding Technique in Grade 4 Mathematics

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Abstract

This study explored the experiences of Grade Four mathematics teachers in implementing the Think-Aloud Scaffolding Technique (TAST), particularly in classrooms with Indigenous Peoples (IPs) students in the Bongabong District. Anchored on a phenomenological approach, the research examined how TAST influenced teaching strategies, student engagement, and mathematical comprehension. Semi-structured interviews with eight teachers were conducted, and data were thematically analyzed to identify recurring patterns and insights. Results revealed that TAST strengthened students' problem-solving and critical thinking skills through verbalized modeling and step-by-step reasoning. Teachers found the technique effective in bridging learning gaps and promoting inclusive participation among IP learners. However, challenges such as language differences and varying learning paces were noted. The findings highlight the importance of culturally responsive pedagogy, personalized scaffolding, and the integration of visual and contextual supports. Educationally, this study underscores how TAST can be adapted and scaled for broader STEM contexts to enhance inclusivity and comprehension. It provides valuable implications for teacher professional development, curriculum refinement, and policy-making aimed at improving mathematics instruction across diverse learning environments.

Keywords: Think-Aloud Scaffolding Technique, Indigenous Learners, Mathematics Education, Grade 4, Phenomenology, Inclusive Pedagogy, STEM Instruction.

INTRODUCTION

The growing demand for inclusive, learner-centered, and reflective teaching practices has increasingly motivated educators worldwide to explore innovative strategies aimed at deepening mathematical understanding, especially among diverse learners. This growing movement toward instructional innovation reflects the global effort to enhance STEM learning outcomes by promoting higher-order thinking, metacognitive awareness, and equitable participation in mathematics classrooms. This focus has become particularly relevant as classrooms continue to become more culturally and linguistically diverse, challenging traditional one-size-fits-all approaches to instruction.

In recent years, scaffolding techniques have been widely recognized as effective approaches for supporting learners' cognitive development, particularly within Mathematics instruction (Pratiwi & Noorani, 2022). These scaffolding methods provide structured support that gradually diminishes as learners gain independence, facilitating a more tailored and responsive educational experience. Among these strategies, the Think-Aloud Scaffolding Technique (TAST) has emerged as a promising and impactful method to enhance metacognitive skills, promote verbal reasoning, and systematically guide learners through complex problem-solving processes. While several studies have examined TAST in general or secondary education settings, its application in Indigenous and elementary contexts remains underexplored—representing a critical practice gap this study seeks to address.

By modeling how to approach tasks aloud, teachers make their cognitive processes visible and accessible, allowing students to internalize these strategies and thought patterns, which they

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can eventually apply independently across various mathematical challenges (Hidayat, 2023). This approach encourages learners to engage more meaningfully with mathematical problems as they gain insight into how experienced individuals analyze and deconstruct tasks, fostering a deeper understanding and strategic thinking.

In addition to enhancing metacognition, TAST aligns with global reforms emphasizing STEM integration, where students are encouraged to think critically, communicate reasoning, and connect abstract concepts with real-world applications. Globally, education systems are undergoing significant shifts towards instructional frameworks that prioritize process-based learning rather than rote memorization or procedural fluency alone. In Mathematics education, this shift means fostering not only procedural fluency but also a strong emphasis on conceptual understanding—enabling learners to grasp the "why" behind the procedures they use

Techniques like the Think-Aloud Scaffolding Technique are essential in promoting student autonomy and confidence by actively involving learners in the thinking process. The verbalization of problem-solving steps encourages learners to reflect on their choices, critically analyze their mistakes, and continuously refine their strategies for approaching mathematical problems

In the Philippine educational landscape, classrooms are often characterized by multilingualism and multiculturalism, presenting both rich opportunities and significant challenges for equitable learning. Despite the Department of Education's continued emphasis on inclusive and context-based teaching practices—articulated through frameworks such as the MATATAG curriculum—Indigenous learners still face persistent difficulties in Mathematics. These challenges arise from a complex interplay of language barriers, cultural disconnects between instructional content and learners' lived experiences, and existing instructional gaps (Cruz & Bernardo, 2021). In Bongabong District, Oriental Mindoro, where several elementary schools serve Indigenous Peoples (IPs) communities, these contextual factors underscore the need for adaptive and inclusive teaching strategies that bridge cultural and linguistic gaps.

The implementation of the Think-Aloud Scaffolding Technique in these settings offers promising potential to address these instructional gaps. By encouraging active learner participation and making the thinking process more transparent and relatable, TAST creates a learning environment where students feel supported in articulating their reasoning (Hidayat, 2023). Importantly, the technique's flexibility allows teachers to adapt it to local contexts through the use of culturally relevant examples and familiar language, thus fostering a stronger connection between learners' cultural identities and the mathematical concepts being taught (Gurung, 2024).

However, for many elementary teachers—particularly those working in Indigenous contexts—adopting new scaffolding techniques like TAST may present several challenges. These challenges include insufficient professional training, limited instructional time, and unfamiliarity with the method's implementation nuances (Cruz & Bernardo, 2021). Such realities highlight the need to explore not only how teachers apply TAST but also how they navigate contextual constraints to make it effective in Indigenous classrooms.

This study is grounded in two foundational theoretical frameworks that elucidate the role and importance of scaffolding in learning: Vygotsky's Zone of Proximal Development (1978) and Bandura's Social Learning Theory (1977). Vygotsky's concept of the Zone of Proximal Development emphasizes the importance of guided support in helping learners progress beyond their current independent abilities by assisting just beyond what they can do alone. This framework aligns closely with the scaffolding principles inherent in TAST, where teachers' verbal modeling and structured guidance help learners internalize complex problem-solving skills. Complementing this, Bandura's Social Learning Theory highlights the significance of modeling and observational learning as key mechanisms through which individuals acquire new skills and knowledge. The theory underscores the value of social interaction and imitation in learning, thereby providing a

robust foundation for understanding how the Think-Aloud Scaffolding Technique facilitates learning through social mediation. Together, these theories validate the use of TAST as an approach that not only supports academic achievement but also fosters learners' self-regulation, metacognitive awareness, and collaborative learning abilities.

Specifically, this study seeks to answer the following research questions:

1. How do Grade 4 Mathematics teachers implement the Think-Aloud Scaffolding Technique in classrooms with Indigenous learners?
2. What challenges do teachers encounter during the implementation of TAST?
3. What observable outcomes and instructional benefits arise from using TAST in Indigenous contexts?

This research explores the lived experiences of Grade 4 Mathematics teachers in the Bongabong District of Oriental Mindoro as they implement the Think-Aloud Scaffolding Technique among Indigenous learners. The study aims to identify the specific instructional strategies utilized by teachers, the challenges they face in integrating TAST into their teaching practices, and the positive outcomes they observe in their culturally diverse classrooms. By addressing this practice gap, the study contributes to both theory-building and practical improvement in mathematics instruction for diverse learners. Theoretically, it extends understanding of scaffolding and social learning within culturally responsive frameworks, while practically, it informs professional development and policy efforts to promote inclusive, effective STEM pedagogy in Indigenous education contexts.

LITERATURE REVIEW

Inclusive and Learner-Centered Mathematics Instruction

The global shift toward inclusive and reflective pedagogy has driven educators to reimagine instructional practices, particularly in Mathematics. Traditional, one-size-fits-all approaches have been found inadequate for addressing the diverse cultural, linguistic, and cognitive needs of contemporary learners. Instead, educators are adopting learner-centered strategies that emphasize active participation, reflection, and contextual relevance. Building on these inclusive approaches, recent frameworks such as the MATATAG Curriculum and DepEd's policy briefs on inclusive education reinforce the integration of localized, equity-driven practices in mathematics teaching. Such practices are critical in developing deeper mathematical understanding, especially in diverse classrooms where equity in learning opportunities must be ensured. However, some scholars caution that while learner-centered strategies foster engagement, their success depends on adequate teacher preparation and culturally responsive materials. This broader pedagogical trend provides fertile ground for the use of scaffolding techniques that adapt instruction to learners' varying levels of readiness.

Scaffolding in Mathematics Education

Expanding from these inclusive foundations, scaffolding has emerged as one of the most effective strategies for supporting student learning, particularly in complex domains such as Mathematics. Defined as the gradual release of structured support until learners can act independently, scaffolding has been widely recognized for promoting cognitive development and conceptual understanding (Pratiwi & Noorani, 2022). It allows teachers to intervene precisely at the learner's point of need, offering guidance that evolves as students build competence. Such an approach aligns with modern instructional priorities that value process-based learning and conceptual reasoning over rote memorization and procedural fluency. Nonetheless, researchers such as Gurung (2024) and Cruz & Bernardo (2021) note that without sufficient scaffolding training and contextual adaptation, teachers may struggle to sustain student independence or balance

support with autonomy.

The Promise of the Think-Aloud Scaffolding Technique (TAST)

Building upon the scaffolding framework, the Think-Aloud Scaffolding Technique (TAST) has gained attention for its unique capacity to make teachers' cognitive processes visible to learners. Salazar (2022) describes TAST as an effective method for enhancing metacognitive skills and guiding students through step-by-step problem-solving processes. By verbalizing their reasoning, teachers provide learners with a model for how to approach and deconstruct mathematical challenges. Learners, in turn, can internalize these strategies and transfer them across tasks, leading to more independent and reflective problem solving (Hidayat, 2023).

Research further shows that TAST fosters student autonomy, confidence, and critical reflection. Making thinking explicit promotes deeper engagement and self-regulation, while also encouraging collaborative dialogue in the classroom. Conversely, other studies caution that excessive modeling through TAST may lead to learner dependence if not balanced with gradual withdrawal of teacher support (Cruz & Bernardo, 2021). In this way, TAST not only strengthens mathematical proficiency but also cultivates essential metacognitive and analytical skills that are transferable to broader learning contexts.

Challenges and Contextual Realities in Philippine Classrooms

In line with these international perspectives, the Philippine education landscape reflects both opportunities and constraints in implementing inclusive strategies like TAST. The MATATAG Curriculum underscores the need for inclusive, culturally grounded, and technology- and strategy-enhanced instruction. However, multilingual and multicultural classrooms—particularly those with Indigenous learners—continue to face persistent challenges in Mathematics learning. These challenges stem from language barriers, limited cultural relevance of instructional materials, and systemic instructional gaps (Cruz & Bernardo, 2021).

The flexibility of TAST presents an opportunity to address these issues by enabling teachers to use culturally relevant examples and familiar language when modeling problem-solving (Gurung, 2024). Nonetheless, implementing TAST in such contexts is not without difficulty. Teachers often report limited training, lack of time to adapt scaffolding strategies, and uncertainty about how to integrate the method effectively (Cruz & Bernardo, 2021). Local teacher training programs and DepEd-led initiatives such as the National Educators Academy of the Philippines (NEAP) may provide essential frameworks for addressing these gaps, yet studies on their alignment with classroom realities remain scarce. This suggests that while the strategy is promising, its success depends on adequate professional development and institutional support tailored to local needs.

Theoretical Foundations of Scaffolding and TAST

The effectiveness of TAST is grounded in two major theoretical frameworks: Vygotsky's Zone of Proximal Development (ZPD) and Bandura's Social Learning Theory. Vygotsky (1978) emphasized that learners can achieve higher levels of competence through guided support, especially when assisted just beyond their independent capabilities. This principle directly aligns with scaffolding practices and the step-by-step guidance inherent in TAST.

Bandura's Social Learning Theory (1977), on the other hand, highlights modeling and observational learning as essential mechanisms of knowledge acquisition. By verbalizing their thought processes, teachers model expert reasoning strategies, which students then imitate, internalize, and adapt. In this study, ZPD serves as the analytical lens for interpreting teachers' support strategies, while Bandura's framework guides the understanding of modeling processes in TAST implementation. Together, these frameworks provide strong theoretical justification for

TAST as a method that not only supports academic development but also nurtures self-regulation, metacognition, and social learning.

Synthesis and Research Gap

The reviewed literature consistently highlights the importance of scaffolding, the promise of TAST in strengthening metacognition and mathematical reasoning, and the unique challenges in multicultural and Indigenous learning contexts. While international studies emphasize the cognitive and motivational benefits of think-aloud scaffolding, there is still limited research on its application in culturally and linguistically diverse Philippine classrooms. Some studies even point out that teacher-centered constraints, limited local resources, and policy-practice mismatches hinder full adoption of such reflective strategies. Moreover, little is known about the lived experiences of teachers who attempt to integrate TAST in contexts where resources, training, and time are limited.

Hence, this study not only bridges theoretical and practical insights but also grounds international perspectives within the Philippine STEM education landscape. This research therefore addresses a critical gap by exploring how Grade 4 Mathematics teachers in the Bongabong District of Oriental Mindoro implement TAST with Indigenous learners. By examining both the strategies employed and the challenges encountered, the study aims to contribute evidence-based insights for designing professional development programs that are not only effective but also culturally responsive.

RESEARCH METHOD

The study employed a qualitative research design using a phenomenological approach, aiming to explore the lived experiences of Grade 4 mathematics teachers in implementing the Think-Aloud Scaffolding Technique (TAST) within the context of Indigenous Peoples (IP) education in Bongabong District, Oriental Mindoro. This design was particularly appropriate for capturing the subjective experiences, instructional insights, and cultural considerations of teachers working with Indigenous learners. Following the descriptive phenomenological tradition, the approach emphasized understanding teachers' shared experiences and the meanings they attach to TAST implementation within their cultural and instructional contexts.

A phenomenological approach allowed the researcher to delve deeply into the realities of the participants, gathering rich descriptions of how they perceived, experienced, and responded to the use of TAST in their classrooms. This design enabled the researcher to uncover the meanings teachers assign to their instructional practices, challenges, and the broader cultural contexts that influence their teaching. Through this approach, the researcher was able to gain an in-depth understanding of how teachers applied TAST, navigated classroom challenges, and adapted their teaching to suit the diverse needs of their students. This study is exploratory in nature, aiming to uncover patterns of instructional behavior rather than test hypotheses, consistent with the interpretivist paradigm common in qualitative inquiry (Creswell, 2018).

The research was conducted in five selected public elementary schools in Bongabong District, namely: School A, School B, School C, School D, and School E. These schools were purposively selected due to their significant population of Indigenous learners, which provided a meaningful context for exploring multicultural and inclusive teaching practices. A total of eight Grade 4 mathematics teachers participated in the study. All participants had a minimum of one year of experience using TAST in their classrooms, which ensured that they could provide valuable and reflective insights into the practical application of the technique. The sample size was deemed sufficient for achieving data saturation, following Creswell (2018) guidelines suggesting that six to ten participants are adequate for phenomenological studies. The selection process employed

purposive sampling to ensure that the participants possessed firsthand experience relevant to the research objectives. The varied backgrounds of the teachers in terms of teaching experience, age, and familiarity with Indigenous culture also contributed to the depth and richness of the data collected.

Data were gathered through semi-structured, face-to-face interviews using an interview guide developed by the researcher. This guide contained open-ended questions designed to encourage detailed and thoughtful responses from participants. An example question included: "How do you integrate TAST into your daily mathematics instruction?" This question aligned directly with the study's objective of exploring practical classroom implementation and reflective experiences. Questions focused on areas such as the integration of TAST into daily instruction, specific challenges encountered in classrooms with Indigenous learners, cultural adaptation of the technique, and their perceptions of its effectiveness. Each interview session lasted approximately 10 to 15 minutes and was conducted in a quiet, private space within the school to ensure the comfort and openness of participants. While the main interviews were concise, follow-up conversations were conducted for clarification and deeper probing when necessary to ensure comprehensive data collection. With the participants' informed consent, all interviews were audio-recorded and later transcribed verbatim. Translations from the local dialect to English were made when necessary to preserve accuracy and authenticity during the analysis.

The data were analyzed using thematic analysis. Six-phase framework for thematic analysis, the researcher systematically coded significant statements, grouped them into patterns, and developed overarching themes. The researcher read and reread the transcripts to identify recurring ideas and significant statements. These were coded and clustered into themes that captured the essence of the teachers' lived experiences. The choice of thematic analysis complemented the phenomenological approach by allowing themes to emerge inductively from the participants' narratives, ensuring that the findings authentically reflected their experiences. To ensure the credibility of the findings, member checking was conducted by sharing the thematic summaries with participants to confirm accuracy and resonance with their perspectives. Triangulation was also employed by comparing and contrasting the responses of different teachers to identify consistent patterns.

In addition to these strategies, reflexivity was practiced throughout the research process. The researcher maintained a reflective journal to monitor assumptions, biases, and interpretations, ensuring that personal perspectives did not overshadow participants' authentic voices. Ethical practices were carefully observed throughout the study. Participants were fully informed about the study's purpose, their rights, and the voluntary nature of their involvement. Their identities were kept confidential through the use of assigned code names, and all collected data were securely stored and used solely for research purposes. The researcher ensured transparency, honesty, and respect during the entire process to maintain the integrity and trustworthiness of the research. A procedural flowchart was also included to visualize the sequence of methodological steps—from participant selection to data analysis—enhancing clarity and transparency.

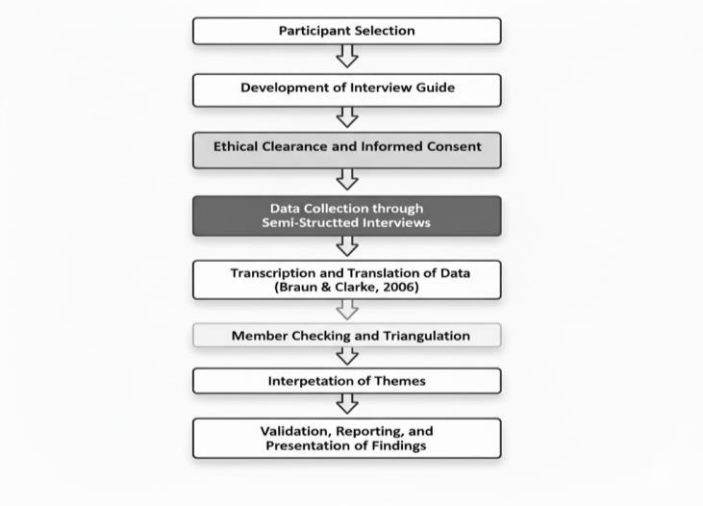

Figure 1. Research Process Flowchart

FINDINGS AND DISCUSSION

Participant Demographics

The study involved eight Grade 4 mathematics teachers (coded as P1–P8) from Bongabong District, Oriental Mindoro. They represented both male and female educators with 3–20 years of teaching experience. All participants had experience teaching Indigenous learners, and most reported minimal formal training in metacognitive or scaffolding strategies.

Table 1. Thematic Matrix of Grade 4 Mathematics Teachers' Experiences with the Think-Aloud Scaffolding Technique (TAST)

Themes	Subthemes	Supporting Participant Quotes
Instructional Strategies	Modeling Thinking Processes	"Iniimplement ko yung Think-Aloud... kase pag PowerPoint lang hindi nila magegets." – P1
Instructional Strategies	Cultural Contextualization	"Ginagamit ko ang local practices nila kasi mas nakaka-relate sila." – P2
Instructional Strategies	Repetition and Simplification	"Madalas kong inuulit yung explanation sa iba't ibang paraan para mas madaling maintindihan." – P5
Challenges	Language Barriers	"Sometimes, while I explain, I have to pause to translate..." – P2
Perceived Effectiveness	Enhanced Engagement	"They are now more confident to answer because they know their ideas are listened to." – P1

1. What instructional strategies do Grade 4 mathematics teachers use when implementing the Think-Aloud Scaffolding Technique in their classrooms?

The study found that Grade 4 mathematics teachers used various instructional strategies when implementing the Think-Aloud Scaffolding Technique (TAST). such as modeling thought processes, cultural contextualization, simplification, verbalization, and visual aids. These approaches helped Indigenous learners in Bongabong District better understand and engage with math lessons.

Modeling Thinking Processes

This emerged as one of the most frequently used and highly emphasized instructional strategies (Tricot & Sweller, 2023). Teachers verbalized their cognitive steps aloud while solving mathematical problems in front of the class, providing students with a clear and concrete example of how to approach and reason through similar tasks independently. This method offered learners a step-by-step demonstration of problem-solving strategies, transforming abstract mathematical procedures into more accessible and less intimidating experiences.

By explicitly sharing their internal thought patterns, teachers made visible the types of questions students should ask themselves, the decisions they need to consider, and the logical progression necessary to reach accurate solutions. This transparency in thinking allowed students to internalize effective problem-solving methods (Tricot & Sweller, 2023). It empowered them to replicate these strategies independently, thereby building their confidence to face and solve mathematical challenges on their own.

P1 illustrated this approach by stating, "*Iniimplement ko yung Think-Aloud Scaffolding Technique sa aking Grade 4 mathematics class by demonstration and by modeling... habang nagtuturo ako ahh gumagamit ako ng chalk... kase pag PowerPoint lang hindi nila magegets*" (I implement the Think-Aloud Scaffolding Technique in my Grade 4 mathematics class through demonstration and modeling. While I'm teaching, I use chalk because if I only use PowerPoint, they don't understand the lesson). This shows that Participant 1 relies on hands-on and visual tools like chalk to make abstract math concepts more concrete, as learners tend to struggle with static and digital-only formats.

P4 added, *"Mas naiintindihan nila kapag nakikita nila mismo paano ko sinusolve ang problem habang ini-explain ko"* (They understand better when they can actually see how I solve the problem while I explain it). This indicates that real-time problem-solving fosters better comprehension because learners can connect verbal explanations with actual steps as they happen.

P5 shared, *"Kapag sinasabi ko ang bawat hakbang habang sinusulat ko sa pisara, mas engaged sila, lalo na yung mga nahihirapan sa math*" (When I say each step out loud while writing it on the board, they become more engaged, especially those who struggle with math). This emphasizes that verbalizing each step while writing it on the board keeps students attentive and supports those who find math particularly challenging.

Supporting this instructional practice, researchers argue that teacher modeling serves as an important mechanism to reduce students' cognitive load by breaking down complex processes and providing them with cognitive strategies that they can imitate (Tricot & Sweller, 2023). By observing an expert's thought process, students develop their own reasoning skills and build confidence in problem-solving through guided examples.

This scaffolding method aligns strongly with Vygotsky's concept of the Zone of Proximal Development (ZPD), where learners move from needing assisted performance toward achieving independent mastery with the guidance of a knowledgeable other.

Cultural Contextualization

This emerged as a key instructional strategy identified by Grade 4 mathematics teachers implementing the Think-Aloud Scaffolding Technique (TAST). Teachers incorporated culturally relevant and real-life examples when teaching mathematical concepts, a practice particularly beneficial for Indigenous learners (Ladson-Billings, 2021). By connecting abstract mathematical ideas to familiar aspects of students' daily lives, they fostered deeper understanding and engagement.

For example, lessons involved local cultural practices such as farming, beading, and planting, linking mathematical operations to these everyday activities. P6 shared, *"When teaching multiplication by repeated addition using the context of planting root crops, I verbalize each step and*

relate it to how the crops are grouped and counted" (When teaching multiplication by repeated addition using the context of planting root crops, I verbalize each step and relate it to how the crops are grouped and counted. This helps learners connect the concept to a real-life situation they are familiar with). This illustrates how contextualizing math in familiar agricultural practices helps learners grasp abstract operations like multiplication through real-life grouping scenarios.

P2 supported this by stating, *"Ginagamit ko ang local practices nila kasi mas nakaka-relate sila at mas nagiging interesado sila sa math"* (I use their local practices because they can relate more, and it makes them more interested in math). This response emphasizes that incorporating learners' cultural backgrounds makes math more engaging and relevant, increasing their motivation to participate.

P7 added, "*Kapag halimbawa ay ginamit ko ang paghahati ng ani sa pag-introduce ng division, mas nagiging meaningful sa kanila ang lesson" (For example, when I use the sharing of harvest to introduce division, the lesson becomes more meaningful to them).* This highlights how relating division to local harvest-sharing practices enhances the lesson's meaning and supports deeper conceptual understanding.

Culturally responsive teaching acts as a vital scaffold that bridges Indigenous learners' lived experiences with academic knowledge. It promotes equity and inclusion by recognizing and validating students' cultural identities within the learning process (Ladson-Billings, 2021). This validation supports not only academic success but also personal growth and identity affirmation. When learners see their cultural backgrounds acknowledged and respected in the classroom, they tend to feel more valued and motivated to participate actively. His strategy strongly resonates with a culturally relevant pedagogy framework. When students see their identities reflected in what they learn, they are more likely to engage meaningfully and achieve academically (Ladson-Billings, 2021).

Repetition and Simplification

This refers to deliberate instructional strategies commonly observed and purposefully employed to support learners struggling with complex mathematical concepts (Milazoni et al., 2022). Teachers intentionally repeated key points during lessons and systematically broke down challenging problems into smaller, more manageable parts. Simplifying language and explanations ensured that learners with varying proficiency levels could understand and keep up with the material being presented (Tomlinson, 2021). This form of scaffolding gave students multiple opportunities to engage with and process core mathematical ideas, facilitating mastery over time.

P1 remarked on this practice, referring to it as "*Yung paghihimay-himay nung problema"* (Breaking down the problem into smaller parts). This indicates that breaking down problems into smaller, manageable parts helps learners follow the process step by step, reducing cognitive overload.

P5 added, *"Madalas kong inuulit yung explanation sa iba't ibang paraan para mas madaling maintindihan"* (I often repeat the explanation in different ways to make it easier to understand). This highlights the role of varied repetition in helping students with different learning styles understand complex math concepts more clearly.

P3 emphasized, "*Kapag paulit-ulit naming tinatalakay ang konsepto gamit ang simple at konkretong halimbawa, mas natututo ang mga bata*" (When we repeatedly discuss the concept using simple and concrete examples, the children learn better). This demonstrates that consistent use of simple and concrete examples reinforces understanding and supports long-term retention of math concepts.

Research supports the effectiveness of repetition and simplification in scaffolding learning by providing necessary reinforcement and clarity, especially for diverse classrooms where differentiated support is essential (Milazoni et al., 2022). These instructional strategies allow students to build mastery incrementally, reducing cognitive overload and frustration (Tomlinson, 2021).

This approach also aligns with the Universal Design for Learning framework, which advocates for multiple means of representation to ensure accessibility and accommodate diverse learners' needs. By revisiting essential concepts multiple times and presenting them using clear, simplified language, teachers create a supportive environment where all students can succeed regardless of their initial proficiency levels (Tomlinson, 2021).

Verbalization

A defining feature of the Think-Aloud Scaffolding Technique is which encourages learners themselves to verbalize their thought processes during problem-solving activities (Khan et al., 2022). This strategy promotes active student participation, helping learners become more aware of their reasoning and facilitating deeper conceptual understanding of mathematical.

P8 described this practice by explaining, *"After modeling, I ask students to try similar problems while verbalizing their thought process in pairs, so they can practice the strategy"* (After modeling, I ask students to work on similar problems in pairs while verbalizing their thought process, so they can practice the strategy). This shows how paired verbalization allows learners to actively practice and internalize metacognitive strategies by articulating their reasoning aloud.

P7 shared, *"Pag sila mismo ang nagsasalita habang nagso-solve, mas natatandaan nila yung steps."* (When they speak aloud while solving, they remember the steps better). This highlights that verbalizing problem-solving steps improves memory retention and helps students sequence their thinking clearly.

P4 added, *"Mas confident sila kapag pinapractice namin yung pagsasalita habang nag-iisip ng sagot. Natututo silang iproseso ang kanilang ideas."* (They become more confident when we practice speaking aloud while thinking of the answers. They learn to process their ideas). This emphasizes that regular practice in verbalizing thoughts builds learners' confidence and ability to process and organize their ideas effectively.

Moreover, paired or small-group verbalization fosters collaboration among students. Learners benefit from hearing one another's reasoning processes, receive peer feedback, and are exposed to different perspectives and approaches to solving mathematical problems. This social interaction enriches cognitive growth by broadening students' understanding and encouraging them to consider alternative strategies.

Collaborative think-aloud sessions also create a supportive classroom environment where learners feel safe and motivated to share their ideas without fear of judgment, thus enhancing overall classroom dynamics and fostering a positive learning atmosphere. This aspect is essential for building learner confidence and social skills, which in turn contribute to academic success.

Lastly, the use of visual aids and demonstrations emerged as a widely adopted and effective strategy to scaffold mathematical learning. Teachers utilized charts, drawings, number lines, manipulatives, and other visual tools to help students conceptualize abstract mathematical ideas (Tricot & Sweller, 2023).

These visual representations provided concrete anchors for abstract reasoning, making it easier for students to follow the lesson and internalize key concepts. P3 noted, *"Pag may visual aids, makaka-adapt sila... Real-world context, structured prompts, and peer interaction... mas inclusive ang learning environment" (*When there are visual aids, they can adapt more easily. Real-world context, structured prompts, and peer interaction make the learning environment more inclusive). This shows that visual aids combined with contextual and interactive elements create a more inclusive space where learners can better connect with the material.

P6 emphasized, *"Kapag ginagamit ko ang mga bagay na nakikita nila araw-araw, mas mabilis nilang naiintindihan ang lesson" (*When I use things they see every day, they understand the lesson more quickly). This highlights that incorporating everyday objects into lessons accelerates

comprehension by linking learning to familiar experiences.

P2 shared, "Sa paggamit ko ng mga larawan at diagram, mas naging maliwanag sa kanila ang proseso ng pagsosolve" (By using pictures and diagrams, the problem-solving process becomes clearer to them). This indicates that visuals such as pictures and diagrams clarify problem-solving steps, helping students grasp processes more clearly.

Visual tools also accommodate diverse learning preferences by offering alternative ways to understand mathematical ideas (Tricot & Sweller, 2023). When combined with verbal explanations and peer collaboration, these visual aids help create an inclusive and dynamic learning environment that supports multiple entry points to learning.

2. What challenges do teachers face in incorporating the Think-Aloud Scaffolding Technique in teaching mathematics?

Despite its benefits, teachers faced challenges in implementing the Think-Aloud Scaffolding Technique (TAST) in Grade 4 math classes. These included language barriers, time constraints, lack of materials, limited training, and learner-related issues, especially in the diverse context of Bongabong District.

Language difficulties

Which emerged as a significant obstacle in implementing the Think-Aloud Scaffolding Technique (TAST) in classrooms with Indigenous learners who often speak local dialects as their first language, limiting their proficiency in Filipino or English, the dominant languages of instruction (Hidayat, 2023). This challenge is heightened by the nature of TAST, which requires students to verbalize their cognitive processes, making it sensitive to linguistic capacity, and without sufficient language understanding, students struggle to articulate their mathematical thinking, thereby reducing the effectiveness of the strategy.

P2 remarked, *"Sometimes while I explain, I have to pause to translate to their language because they look blank when I speak in Filipino"* (Sometimes, while I'm explaining, I have to pause and translate into their language because they look confused when I speak in Filipino). This suggests that using the standard language of instruction creates barriers to comprehension, prompting the teacher to translate in real time to ensure students remain engaged.

This concern was echoed by P6, *"If I really can't explain in Filipino so they understand, I use words they use daily—like 'several trees' or 'several bundles' to give them an idea of multiplication*" (If I really can't explain it in Filipino in a way they understand, I use words they hear every day—like 'several trees' or 'several bundles'—to help them grasp the idea of multiplication). This shows the teacher's adaptive strategy of using culturally familiar vocabulary to represent mathematical ideas, helping bridge linguistic gaps.

These responses reveal a linguistic disconnect between instruction and learner comprehension, causing teachers to frequently resort to code-switching or translating mathematical terms into local contexts to bridge understanding (Hidayat, 2023). This practice highlights the need for a language-responsive pedagogy that respects learners' linguistic backgrounds. Similarly, integrating culturally familiar vocabulary into instruction reduces learners' cognitive load when engaging with abstract concepts, making mathematical thinking more accessible and meaningful.

However, this added linguistic responsibility increased teachers' cognitive demands, as they had to simplify complex concepts or spontaneously create culturally relevant examples during instruction. They emphasize that such linguistic mediation is essential for facilitating conceptual understanding in multilingual classrooms (Ahmad et al. 2021). Yet, without institutional support or readily available resources in native dialects, teachers face an additional burden.

Time Limitations

It is another major challenge identified by teachers was the time-consuming nature of the Think-Aloud Scaffolding Technique (TAST), as it requires deliberate verbalization, modeling, and guided reflection, which—while pedagogically sound—often extends beyond the time allocated per lesson, limiting how much content can be covered (Tricot & Sweller, 2023). Consequently, teachers found it difficult to balance the depth of understanding that TAST fosters with the broad range of topics required by the curriculum, creating tension between promoting deep learning and meeting syllabus demands.

P5 shared, *"When I use the think-aloud throughout the lesson, time is really insufficient. Sometimes we don't finish the topics"* (When I use the think-aloud throughout the lesson, time is really insufficient. Sometimes, we don't get to finish the topics). This highlights the challenge of implementing time-intensive strategies like think-aloud while still meeting curriculum demands within limited class hours.

P1 also noted, "*I only use TAST at the beginning for modeling, then I speed up the lesson because we have many topics to cover"* (I only use the Think-Aloud Scaffolding Technique at the beginning for modeling, then I speed up the lesson because we have many topics to cover). This indicates a practical compromise, where the teacher limits TAST use to introductory phases to manage time and ensure syllabus completion.

This problem shows how teachers struggle to balance helping students understand deeply and finishing all the topics in the syllabus, which can be hard to manage during class time (Tricot & Sweller, 2023). When teachers spend too much time explaining or guiding students without changing the lesson schedule, it can become too difficult for both teachers and students to keep up, causing stress and confusion in the learning process.

Moreover, time limits often made teachers shorten or change the think-aloud process, using it only at the start of lessons or for hard problems, which lessened the repeated practice needed for TAST to work well. At the same time, teachers feel pressured to quickly finish the curriculum because of tests and year-end goals, even though ongoing learning is more helpful for students. This conflict highlights the need for systemic adjustments, such as integrating TAST into macro-level lesson planning, adjusting pacing guides, and allocating time for deep conceptual instruction, especially in linguistically diverse contexts.

Lack of Instructional Materials

This emphasizes that the success of using TAST heavily depends on having teaching resources that are culturally relevant and suited to learners' needs. However, teachers often reported a shortage of pictures and examples that connect with Indigenous learners (Putri et al., 2022). Since TAST relies on clear and relatable examples to help students articulate their thinking, the absence of such materials made it more difficult for learners to engage with and understand the lessons (Milazoni et al., 2022).

P3 shared, "There aren't enough visual aids, so I sometimes create my own, but it's hard with many classes" (There aren't enough visual aids, so I sometimes create my own, but it's challenging because I handle many classes). This shows the teacher's effort to compensate for the lack of materials, although preparing customized visuals for multiple classes becomes a heavy workload.

P7 added, "For examples like beading or planting, I want to show real things or pictures, but we don't have them" (For examples like beading or planting, I want to show real objects or pictures, but we don't have them available). This reflects the challenge of making math lessons culturally relevant when the necessary resources to illustrate familiar practices are unavailable.

The need for teaching materials that relate to learners' own culture is very important, especially when students don't understand abstract or city-focused examples in their textbooks

(Putri et al., 2022). Visual aids that connect to local culture help students understand hard math ideas better by linking them to their real-life experiences, making it easier for them to think aloud during lessons (Milazoni et al., 2022).

Limited Professional Training

This highlights insufficient professional development as a major barrier to effectively implementing TAST. Many teachers reported never receiving formal training and instead learned primarily through peer observation, which led to uncertainty and a lack of confidence (Tomlinson, 2021). This lack of structured training resulted in inconsistent application and uneven outcomes across classrooms.

P7 remarked, "*Wala kaming training tungkol sa estratehiyang ito; natutunan ko lang ito sa panonood sa ibang guro*" (We didn't get training on this strategy; I only learned by watching another teacher.

This reveals the lack of formal professional development, leading teachers to rely on informal observation rather than structured learning.

P4 admitted, "*Minsan, hindi ko alam kung tama ba ang approach ko. Trial and error lang"* (Sometimes I don't know if my approach is right. It's trial and error). This suggests uncertainty in implementing the strategy correctly, highlighting the need for clearer guidance and support in instructional practices.

Effective scaffolding techniques require intentional professional development, including opportunities for modeling, coaching, and reflection, to ensure instructional fidelity (Tomlinson, 2021). Teachers also need ongoing training to integrate metacognitive practices like think-alouds into daily instruction that aligns with learners' developmental stages and cultural contexts.

Continuous professional development is essential for teachers to effectively apply scaffolding strategies like TAST, as it builds their instructional skills and confidence. Likewise, ongoing training programs help educators address the diverse learning needs of Indigenous students, ensuring culturally responsive teaching practices.

Learner-Related Challenges

Student-related factors such as shyness and low confidence often prevented learners from fully engaging in the Think-Aloud Scaffolding Technique, as many hesitated to verbalize their thought processes during lessons. Uneven learning paces and language insecurities further challenged participation, as some learners felt unsure about expressing their mathematical reasoning aloud, which affected the overall effectiveness of the technique (Khan et al., 2022).

P4 observed, "*Talagang mahiyain silang magsalita, lalo na kapag alam nilang mahina sila sa Tagalog, kaya nananahimik na lang sila."* (They are really shy to speak, especially when they know their Filipino is weak, so they just stay quiet). This highlights how language insecurity affects student participation, leading to silence and disengagement during think-aloud activities.

P8 explained, "*May ilang estudyante na mabilis matuto, pero may iba naman na kailangan ng paulit-ulit na gabay. Hindi agad-agad nangyayari ang kanilang pag-unawa*" (Some students are fast learners, but others need repeated guidance. Their understanding doesn't happen all at once). This emphasizes the varied pace of student learning and the importance of patience and emotional support when implementing scaffolded strategies like TAST.

Emotional safety is essential in classrooms using metacognitive strategies like TAST, as students who fear making mistakes or being mocked tend to withdraw from participation. Teachers must create a classroom environment that encourages risk-taking and normalizes errors as part of the learning process.

These findings echo Vygotsky's Sociocultural Theory and the Zone of Proximal Development

(ZPD), which argue that learning occurs best when scaffolded through interaction within a supportive social environment. According to this theory, the teacher plays a critical mediating role, helping learners stretch beyond their current level through guided participation and modeling.

3. How do teachers use TAST to support pupil engagement, mathematical understanding, and culturally responsive instruction?

Despite the challenges, teachers reported positive outcomes from using the Think-Aloud Scaffolding Technique (TAST) in Grade 4 math, especially with Indigenous learners in Bongabong District. Key outcomes included increased participation, deeper understanding, independent thinking, and integration of local culture into lessons.

Promoting Active Participation

It is a significant and recurring benefit that teachers reported when using the Think-Aloud Scaffolding Technique (TAST) was the marked increase in student active participation during mathematics lessons, as modeling thinking processes aloud helped previously passive students become more attentive and motivated to reason on their own (Pratiwi & Noorani, 2022). This process also normalized thinking aloud as a learning tool, helping students understand that making mistakes and encountering uncertainty are natural parts of learning new concepts.

P1 stated, "*Kapag nagti-think aloud ako sa paglutas ng problema, nakikita ng mga bata kung paano ko iniisip ang mga hakbang. Kaya mas nagiging bukas sila na subukan kahit hindi agad tama ang sagot*" (When I think aloud while solving a problem, the children see how I think through the steps. This makes them more open to trying, even if their answers aren't immediately correct). This verbal modeling reduces students' fear of failure and promotes a growth mindset by providing a clear problem-solving framework and encouraging open idea-sharing without pressure for immediate accuracy (Pratiwi & Noorani, 2022).

These factors build learners' confidence, help them view problem-solving as a continuous process, and, through think-aloud protocols during group work, stimulate curiosity and peer collaboration by encouraging students to question their own and others' reasoning.

P7 remarked, *"Kahanga-hanga kasi dati, kakaunti lang ang nagsasalita sa klase, pero ngayon halos lahat ay gustong magbahagi ng kanilang mga sagot. May ilan pa nga na nagtatanong, 'Ma'am, tama ba ang hakbang ko?'"* (It's amazing because before, only a few students spoke up in class, but now almost everyone wants to share their answers. Some even ask, "Ma'am, is my step correct?). The shift from silence to active verbal participation fosters a classroom culture that views mistakes as learning opportunities and promotes student involvement and ownership of learning, aligning with Vygotsky's (1978) social constructivist theory.

Promoting active participation aligns with the Department of Education's goal to develop critical thinkers and effective communicators by encouraging students to articulate their thought processes, supporting both communication and cognitive skills development while building learners' self-efficacy, a key factor in motivation and persistence.

Enhancing Conceptual Understanding

Teachers consistently reported that the Think-Aloud Scaffolding Technique (TAST) significantly deepened students' conceptual understanding of mathematical ideas, which is essential for meaningful learning (Milazoni et al., 2022). Conceptual understanding enables learners to transfer knowledge to new and complex problems, making it a fundamental goal in mathematics education. By verbalizing each procedural step and explaining their reasoning, students were able to break down abstract mathematical concepts into manageable and comprehensible parts (Pratiwi & Noorani, 2022). This approach helped learners understand not

only the 'how' but also the 'why' behind mathematical procedures, leading to stronger retention and application of knowledge.

P4 explained, *"Sa think-aloud, paulit-ulit kong sinasabi kung bakit ko ginagawa ang isang hakbang. Naiintindihan nila ang konsepto, hindi lang ang formula"*(With think-aloud, I repeatedly explain why I'm doing each step. They understand the concept, not just the formula). Explicitly explaining the logic behind each operation helps students to internalize mathematical principles more effectively than rote memorization.

Teachers observed that students, especially those struggling with multiplication, division, and word problems, showed improved accuracy and confidence in applying their knowledge (Milazoni et al., 2022). This increased understanding was not fleeting; many teachers reported that students retained the concepts longer and demonstrated better recall in subsequent lessons.

P5 added, *"Kapag pinapagawa kong ulitin at himayin ang mga hakbang, mas tumatagal ang kanilang pag-alala. Kahit sa susunod na aralin, naaalala pa rin nila"* (When I have them repeat and break down the steps, their memory lasts longer. They still remember it even in the next lessons). This practice of repetition and scaffolding aligns with cognitive load theory, which suggests that learning is enhanced when information is broken down and processed step-by-step to avoid overwhelming working memory. The Think-Aloud Scaffolding Technique acts as an external cognitive aid, helping learners organize and encode information effectively.

Furthermore, the Philippine Basic Education Curriculum explicitly supports mastery learning, which emphasizes comprehensive understanding over superficial memorization, and the Think-Aloud Scaffolding Technique (TAST) aligns with this framework by encouraging learners to build foundational understanding necessary for advanced mathematical thinking.

Encouraging Independent Thinking

Another important outcome of implementing the Think-Aloud Scaffolding Technique was the promotion of independent thinking and metacognitive awareness. Metacognition—thinking about one's thinking—is crucial for developing autonomous learners who can plan, monitor, and evaluate their problem-solving approaches (Khan et al., 2022). Teachers observed that as students practiced verbalizing their thought processes, they gradually learned to self-monitor and self-correct more effectively (Tomlinson, 2021).

P 3 described, *"Dahil sanay na silang magsalita tungkol sa kanilang ginagawa, natututo silang mag-isip bago sumagot. Minsan, sila pa mismo ang nagpapaliwanag kung bakit mali ang kanilang unang sagot"* (Because they're used to talking about what they're doing, they learn to think before answering. Sometimes, they even explain themselves why their first answer was wrong). This internal dialogue is a powerful tool for fostering reflective thinking habits, which help learners to become more deliberate and mindful problem solvers. It reduces their dependence on teacher validation and encourages them to develop confidence in their reasoning (Khan et al., 2022).

P6 added, *"May mga estudyante na ngayon ang nagsisimulang mag-solve at mag-explore ng sarili nilang paraan nang hindi na kailangan ng gabay ko"* (Some students now start to solve and explore their own methods without needing my guidance anymore). This progression from guided to independent thinking reflects constructivist learning theories emphasizing active knowledge construction and the benefits of self-directed inquiry, and the shift toward autonomy empowers learners, fostering intellectual curiosity and adaptable problem-solving skills.

Additionally, fostering metacognition supports inclusive education by providing diverse learners with strategies to manage their own learning challenges, and in the context of Indigenous learners, promoting independent thinking through TAST can help bridge gaps caused by limited resources or differentiated instruction.

Integrating Local Culture

It is one of the most culturally affirming outcomes of the Think-Aloud Scaffolding Technique was its ability to integrate students' local culture into mathematics instruction, as teachers often incorporated Indigenous knowledge and everyday practices into their think-aloud examples, making lessons more meaningful and relevant to students' lives (Putri et al., 2022). This culturally responsive approach fosters both deeper comprehension and affirmation of learners' identities.

P2 shared, *"Ginagamit ko ang kanilang pang-araw-araw na gawain tulad ng pagsasaka o pagbibilang ng ani sa pagtuturo ng problema. Kapag nakikita nila ang koneksyon sa kanilang buhay, mas nagiging interesado sila"* (I use their daily activities, like farming or counting the harvest, when teaching problems. When they see the connection to their lives, they become more interested). By contextualizing math problems in familiar cultural experiences such as fishing, farming, or traditional crafts, teachers helped students bridge academic concepts with real-life applications.

P8 explained, *"Mas nagiging proud sila sa kanilang kultura at dahil dito, mas aktibo sila sa klase."* (They become more proud of their culture, and because of this, they are more active in class). Culturally responsive pedagogy increases learner motivation by honoring students' identities and prior knowledge, enriching classroom discourse and strengthening teacher-student relationships, while also helping to combat the educational marginalization experienced by Indigenous learners (Putri et al., 2022).

Teachers reported effective use of culturally relevant examples to explain abstract math ideas—for instance, using beading patterns to teach symmetry or crop yields to illustrate multiplication (Putri et al., 2022). These real-world applications enhance retention and understanding by linking mathematics to tangible, valued cultural practices.

The integration of local culture through TAST aligns with the Philippines' Indigenous Peoples' Education framework, which advocates respect for Indigenous knowledge and its incorporation into formal education, supporting inclusive education goals and contributing to holistic learner development by fostering cultural pride alongside academic achievement.

Reflective Synthesis

Across all themes, the Think-Aloud Scaffolding Technique (TAST) demonstrated adaptability and effectiveness in promoting inclusive mathematics learning. Modeling, contextualization, and repetition collectively strengthened scaffolding practices under inclusive STEM frameworks. However, variations in teacher success were linked to contextual factors such as class size, availability of culturally relevant materials, and learners' linguistic backgrounds. Unexpectedly, teachers with more years of experience displayed greater improvisation in adapting TAST to multilingual classrooms. Recent studies (e.g., Tricot & Sweller, 2023) reaffirm that metacognitive scaffolding enhances student reasoning, self-regulation, and confidence in mathematics. These insights align with current trends emphasizing inclusive, reflective, and culturally responsive mathematics education.

CONCLUSIONS

The use of the Think-Aloud Scaffolding Technique (TAST) in Grade 4 mathematics effectively addressed the study's research questions by demonstrating (1) the instructional strategies teachers employed, (2) the challenges they encountered, and (3) the outcomes observed among Indigenous learners. Teachers primarily used modeling, demonstration, verbalization, and culturally contextualized examples to make abstract mathematical concepts more concrete and relatable. These strategies enhanced pupils' comprehension, participation, and confidence during lessons. However, challenges emerged, including language barriers, limited materials, and varying levels of learner readiness, which sometimes hindered consistent application.

Theoretically, the findings reinforce Vygotsky's Zone of Proximal Development (ZPD) and Social Learning Theory by showing how scaffolding through think-alouds bridges learners' current understanding with new concepts through guided interaction. This study contributes to scaffolding theory by emphasizing how think-aloud techniques function effectively within multilingual and multicultural classrooms, extending existing frameworks to more inclusive and linguistically diverse STEM settings.

Practically, the study provides several actionable recommendations for improving classroom instruction and teacher preparation:

1. Provide regular professional training for teachers on implementing TAST effectively in culturally diverse and multilingual mathematics classrooms.
2. Develop bilingual and visual teaching aids that align with local cultural contexts to enhance comprehension and engagement.
3. Integrate TAST strategies into pre-service teacher education programs to cultivate reflective, inclusive, and context-sensitive pedagogical practices.

Through these theoretical insights and practical applications, the study not only deepens understanding of scaffolding within inclusive STEM education but also offers concrete steps for enhancing mathematics teaching in diverse learning environments.

LIMITATION & FURTHER RESEARCH

The study is limited by its reliance on a specific instructional technique within a single classroom context, which may restrict the generalizability of the findings to broader educational settings. Since the results were based on observed classroom practices and pupil responses, the study may not fully account for variations in language proficiency, learning pace, and resource availability in other contexts. Further research is recommended to test the effectiveness of TAST across different grade levels and subject areas, to explore its impact through quantitative measures of student achievement, and to investigate how teacher training, adequate instructional materials, and language support can enhance its implementation.

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