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DEEP SCAFFOLDING BASED ON RME TO REDUCE SLOW LEARNERS' ERRORS IN NUMERACY PROBLEM SOLVING

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Abstract

Slow learners often struggle with understanding problem contexts, constructing representations, and applying appropriate strategies due to limitations in working memory, processing speed, and conceptual generalization. Therefore, structured, gradual, meaningful and enjoyable assistance is needed which is linked to the experiences and lives around slow learners students, which is called deep scaffolding based on Realistic Mathematics Education (RME). This study aims to explore the implementation of Deep Scaffolding based on RME to reduce thinking errors among slow learner students in numeracy problem solving. An interpretative qualitative method with an exploratory single-case study design was employed to gain an in-depth understanding of the cognitive and affective learning processes of one selected slow learner student. Data were collected through contextual numeracy worksheets, direct observation, and semi-structured interviews guided by the mindful–meaningful–joyful scaffolding framework. The findings reveal that deep scaffolding based on RME effectively improved the student's ability to interpret contexts, build accurate visual representations, apply basic arithmetic strategies, and evaluate multiple solution alternatives. SL1 demonstrated significant growth in conceptual understanding and problem-solving flexibility, alongside increased confidence, motivation, and positive emotional engagement. These results indicate that deep scaffolding integrated with RME provides meaningful cognitive and affective support for slow learners in numeracy learning. This study recommends that teachers in inclusive classrooms apply structured deep scaffolding and contextual task to enhance comprehension and problem-solving accuracy among slow learners.

Keywords: Deep scaffolding; inclusion; numeracy; realistic mathematics education; slow learners.

Abstrak

Siswa slow learner sering mengalami kesulitan dalam memahami konteks masalah, membangun representasi, dan menerapkan strategi yang tepat akibat keterbatasan dalam memori kerja, kecepatan pemrosesan, serta generalisasi konsep. Oleh karena itu, diperlukan bantuan yang terstruktur, bertahap, bermakna, dan menyenangkan yang dikaitkan dengan pengalaman serta kehidupan sehari-hari siswa slow learner, yang dikenal sebagai deep scaffolding berbasis Realistic Mathematics Education (RME). Penelitian ini bertujuan untuk mengeksplorasi implementasi deep scaffolding berbasis RME dalam mengurangi kesalahan berpikir siswa slow learner dalam pemecahan masalah numerasi. Metode kualitatif interpretatif dengan desain studi kasus tunggal eksploratif digunakan untuk memperoleh pemahaman mendalam mengenai proses kognitif dan afektif belajar dari satu siswa slow learner yang dipilih. Data dikumpulkan melalui lembar kerja numerasi kontekstual, observasi langsung, dan wawancara semi-terstruktur yang dipandu oleh kerangka mindful–meaningful–joyful scaffolding. Hasil penelitian menunjukkan bahwa deep scaffolding berbasis RME secara efektif meningkatkan kemampuan siswa dalam menginterpretasikan konteks, membangun representasi visual yang akurat, menerapkan strategi aritmetika dasar, serta mengevaluasi berbagai alternatif penyelesaian. Siswa menunjukkan perkembangan yang signifikan dalam pemahaman konseptual dan fleksibilitas pemecahan masalah, disertai peningkatan kepercayaan diri, motivasi, dan keterlibatan emosional yang positif. Temuan ini mengindikasikan bahwa deep scaffolding yang terintegrasi dengan RME memberikan dukungan kognitif dan afektif yang bermakna bagi siswa slow learner dalam pembelajaran numerasi. Penelitian ini merekomendasikan agar guru di kelas inklusif menerapkan deep scaffolding yang terstruktur serta tugas kontekstual untuk meningkatkan pemahaman dan akurasi pemecahan masalah pada siswa slow learner.

***Kata kunci**: Deep scaffolding; inklusi; numerasi; pembelajar lamban; pendidikan matematika realistik.*

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INTRODUCTION

Numeracy is an essential competency required in everyday life to interpret number-based information, make rational decisions, and solve problems across various contexts (Geiger & Schmid, 2024; Sobkow et al., 2020). Strong numeracy skills play a crucial role in supporting social participation, workforce readiness, and students' functional literacy in the twenty-first century. However, numeracy achievement among students in Indonesia continues to face significant challenges, as reflected in the PISA 2022 report, which places Indonesia at a low level in understanding contextual problems and mathematical reasoning (OECD, 2020). This situation becomes even more complex when involving students with special learning needs, particularly slow learners, who gene-rally exhibit below-average processing speed, short attention spans, and difficulties in generalizing abstract concepts to real-life contexts (Listiawati et al., 2023).

Among slow learner students, limitations in working memory, information-processing speed, and the ability to transform concrete representations into abstract ones often result in difficulties in understanding fundamental mathematical concepts, particularly those related to geometric representation, arithmetic operations, and context-based problem solving (Cheong et al., 2017; Hord, 2023). Numerous studies indicate that slow learners are prone to thinking errors such as misconceptions, misunderstandings of key vocabulary, and inaccuracies in choosing appropriate solution strategies (Bouck et al., 2018; Yustitia et al., 2025). These challenges highlight the need for pedagogical approaches that support gradual, meaningful, and contextually grounded understanding.

To optimize the effectiveness for slow learners, structured and in-depth instructional support is required, particularly through a deep scaffolding approach. Unlike surface scaffolding, which focuses mainly on procedural assistance, deep scaffolding emphasizes eliciting prior knowledge, diagnosing thinking errors, activating meaningful experiences, and providing emotional support to foster learners' confidence (Clements & Sarama, 2025; Sellars, 2017). This approach aligns strongly with the characteristics of slow learners, who require more time, more concrete explanations, and emotional reassurance to build cognitive readiness when dealing with contextual numeracy problems.

Therefore, structured, gradual, meaningful and enjoyable assistance is needed which is linked to the experiences and lives around slow learner students, which is called deep scaffolding based on Realistic Mathematics Education (RME). Rooted in Freudenthal's philosophy, RME positions real-life experiences as the starting point for learning, allowing students to construct meaning through authentic situations that are familiar to them (Das, 2020; Yilmaz, 2020). Prior studies show that RME not only enhances conceptual understanding but also strengthens motivation, positive disposition, and learner engagement (Nurmasari et al., 2024; Tong et al., 2022). Specifically, recent work by Listiawati et al. (2023) demonstrates that the principles of RME are effective in improving the mathematical competencies of slow learners when combined with concrete materials, visual representations, and real-life contexts. However, the transition from "model of" to "model for" is often hindered by slow learners' limited reflective ability, weak

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generalization skills, and challenges in metacognitive regulation (Van den Heuvel-Panhuizen & Drijvers, 2020).

Although several international studies affirm the effectiveness of scaffolding in improving mathematical reasoning (Esparcia et al., 2024; Reinhold et al., 2020) most focus on technology-based or procedural scaffolding (Long et al., 2021; Malik et al., 2025). In contrast, slow learners require deeper, more personalized, and more reflective forms of scaffolding, particularly when confronted with complex numeracy tasks. This gap underscores the importance of developing empirical studies that investigate how deep scaffolding within an RME framework can reduce thinking errors among slow learners when solving contextual numeracy problems.

Given this urgency, the present study aims to explore the implementation of deep scaffolding based on Realistic Mathematics Education to reduce thinking errors among slow learner students in solving numeracy problems. Theoretically, this study is expected to contribute to the development of a numeracy learning model that integrates cognitive, metacognitive, and affective dimensions simultaneously. Practically, its findings may provide valuable guidance for teachers in designing adaptive and inclusive learning environments, and enrich numeracy education practices that are more humanistic, contextual, and empowering for slow learners in Indonesia.

METHODS

Research Type and Design of Research

This study employed an interpretative qualitative approach with an exploratory single-case study design to obtain an in-depth understanding of the meanings, experiences, and interaction processes between the researcher (teacher) and a student identified as a slow learner (SL) during numeracy learning through deep scaffolding based on Realistic Mathematics Education (RME).

An exploratory case study design was deemed suitable for capturing the dynamics of individualized learning, scaffolding interactions, and reflective learning behavior as they naturally occur in authentic classroom contexts. The researcher acted as a facilitator and participant observer, providing instructional support and documenting the student’s responses during the learning process.

The research was conducted at a private elementary school in Bali Province, which was officially designated as a PISA 2025 sample school by Kementerian Pendidikan Dasar dan Menengah. The school was selected purposively because it represents inclusive educational practice in Indonesia and participates in the PISA numeracy assessment, reflecting the country’s real classroom conditions and learning outcomes in global assessment frameworks.

In the preliminary stage, 61 upper-grade students (Grades 9) participated in a psychological assessment using the Culture Fair Intelligence Test (CFIT) administered by a licensed educational psychologist. The results identified 34 students (55,73%) with IQ scores between 70 and 90, classified as Slow Learners (SL) according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2013). Among the 34 students, there were 17 males and 17 females.

From these 34 students, one participant (coded as SL1) was selected as the primary case for an in-depth

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analysis using a single-case study design based on the following criteria: demonstrated sufficient verbal communication skills to engage in interviews and learning sessions, maintained consistent attendance throughout the intervention period, and exhibited the most representative profile of numeracy difficulties among the SL participants.

Research Instruments

Two main instruments were utilized: a contextual numeracy worksheet and a semi-structured interview guideline.

a. Contextual Numeracy Worksheet

The worksheet was designed following Realistic Mathematics Education (RME) principles, situating mathematical problems in real-life contexts familiar to students—such as counting money, comparing quantities, and measuring length. The tasks were structured according to three levels of complexity aligned with Programme for International Student Assessment (PISA) numeracy indicators OECD (2020) Identifying relevant information and understanding contextual problems, Formulating mathematical representations and strategies, and Interpreting and evaluating mathematical results within real-world contexts.

The instrument development involved three systematic phases: Content validation by two mathematics education experts and one educational psychologist, Limited pilot testing with two students identified as having mild learning difficulties to assess clarity and contextual appropriateness, and Reliability testing through inter-rater agreement on students' numeracy comprehension scores.

The validation results showed a content validity index of 92% (very high category), and the reliability coefficient from the pilot test was 0.86 (high reliability), indicating strong internal consistency and suitability for assessing contextual numeracy among SL students.

b. Semi-structured Interview Guideline

The interview guideline was developed based on the Deep Scaffolding framework, which comprises three interconnected domains: mindful scaffolding, helping students recognize their misconceptions and cognitive barriers, meaningful scaffolding, connecting prior knowledge to new contexts and strengthening conceptual understanding, and joyful scaffolding, fostering positive emotions, motivation, and reflective engagement in learning.

The interviews were conducted individually (one-on-one) between the researcher (coded as R) and the student (S1) for 40–60 minutes per session. Each question was designed to elicit cognitive reasoning, self-reflection, and emotional responses during the scaffolding process.

Examples of questions include: Mindful Scaffolding (MiScaff): "How did you solve this problem? What was the first thing you thought about when reading it?". Meaningful Scaffolding (MeScaff): "Why did you choose that strategy? Can you think of another way to solve it?". Joyful Scaffolding (JoyScaff): "How did you feel when you found the answer?"

The interview guide was validated by two special education experts and one educational psychologist. The inter-rater reliability coefficient was 0.88 (high), confirming consistency in interpreting the qualitative data collected through the interviews.

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Data Collection

The data collection took place over three weeks, consisting of four systematic stages:

- Participant Identification and Selection: The CFIT assessment was administered to all 61 students. Based on the results, 34 students were classified as SL (IQ 70–90), and one student (S1) was purposively selected for the single-case study.
- Implementation of One-on-One Intervention and Observation: All interactions were audio-video recorded and supplemented with field observation notes to capture verbal expressions, gestures, and problem-solving strategies in detail.
- Interviews and data triangulation: semi-structured interviews were conducted between R and SL1 (40–60 minutes) to explore cognitive and emotional reflections. The result of interview are transcribed verbatim and verified through member checking to confirm accuracy of interpretation.
- Data Management and Confidentiality: All data were stored digitally using an anonymized coding system:

Each file was coded with the session number and date and securely stored in an encrypted research repository accessible only to the research team.

Data Analysis

Data were analyzed using thematic analysis (Braun & Clarke, 2006) through six iterative stages: familiarization with data through repeated reading of transcripts and field notes, initial coding to identify significant patterns and meanings, generating preliminary themes according to the mindful–meaningful–joyful framework, reviewing and refining the thematic structure, defining and naming themes operationally, and producing the analytical report, including thematic narratives and interaction matrices between researcher (R) and slow learner student (SL1).

To ensure credibility and trustworthiness, several validation techniques were applied: Source and method triangulation (worksheet, observation, interview), Member checking with participants to verify interpretations, Peer debriefing with two university lecturers in mathematics and educational psychology, and Audit trail documentation to record the entire analytical process.

Additionally, intercoder reliability was established by having two independent researchers re-code the transcripts. The resulting intercoder agreement was 0.91 (very high category), demonstrating stable and reliable interpretation of the qualitative data.

RESULTS AND DISCUSSION

Based on the results of the psychological assessment, it was found that 34 students (55.73%) were categorized as slow learners. The measurement of intellectual abilities among 61 students revealed a considerable variation in IQ category distribution. A total of 11 students (18.03%) were classified as having Mild Intellectual Disabilities (IQ 50–69). This group exhibits limitations in abstract academic skills but can acquire basic competencies such as reading, writing, and simple arithmetic with appropriate support. The majority of students, totaling 34 individuals (55.73%), fell into the Low Average or Slow Learner category (IQ 70–90). These students learn at a slower pace than their peers and therefore require repeated practice, concrete explanations, and contextualized

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instructional approaches. Meanwhile, 16 students (26.24%) were categorized as Average (IQ 90–110).

This group demonstrates intellectual abilities consistent with the general population and can participate in regular instruction without significant difficulty, although their proportion is relatively small compared with the slow learner group. Overall, this distribution profile indicates that more than half of the students fall within the slow learner category, while those with average intellectual abilities comprise only about one quarter of the population. These conditions underscore the need for adaptive, inclusive, and needs-based instructional approaches to ensure that every student is able to achieve their full potential.

Based on the numeracy test results, 7 slow learner students (20.59%) reported that they were unable to solve the problem and did not know what steps to take. A total of 16 students (47.09%) attempted to complete the task, but their demonstrated understanding remained incomplete. The remaining 11 students (32.32%) provided no response. The slow learner group generally struggled to translate the problem into an appropriate mathematical model. Several students stated, "I don't know the formula," indicating a strong dependence on formulas for problem solving, even though the fundamental step should be understanding the problem context. Among all slow learner students, none reached the final answer and none provided a correct solution.

The researcher then selected one student with slow learners referred to as SL 1, to receive deep scaffolding through a semi-structured interview. The description of SL 1 begins with the initial process of solving numeracy problems prior to the intervention, followed by an in-depth exploration of the student's prior knowledge, which was then connected to the evolving understanding aligned with the numeracy challenges presented. In attempting to solve the numeracy problems, SL 1 initially encountered significant cognitive barriers and was unable to arrive at the correct solution. The primary obstacle was a lack of comprehension of the problem itself, which the student described as not registering in their thoughts or memory. SL 1 attempted to solve the following problem:

In solving the numeracy problem, SL1 initially added 60,000 and 80,000, resulting in 110,000. This was done because SL1 recalled having solved a previous problem in which adding the two numbers produced the correct answer. SL1 acknowledged that he tended to interpret numeracy problems merely as tasks requiring the addition of two numbers and felt uncertain about what steps to take next (Figure 1). SL1 also made an error in performing the basic calculation of 6 plus 8, requiring considerable time to determine the correct sum. After receiving scaffolding, particularly through the *counting-on* method (holding the number 8, raising six fingers, and counting forward from 9 until reaching 14), SL1 eventually recognized the error and was able to correct it.

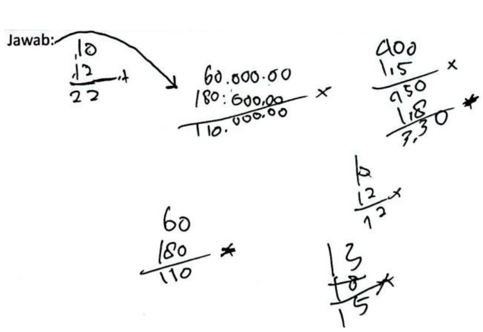

Figure 1. Answer to SL 1 before deep scaffolding was carried out

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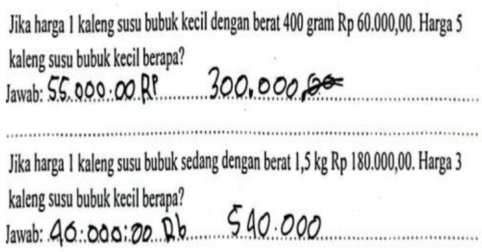
Based on the interview, SL1 was actually able to understand the core of the problem, namely that he was required to determine the maximum total price of powdered milk that could be placed inside the box. SL1 also understood that more than one can of powdered milk needed to be placed in the box. After probing his prior knowledge, it was found that SL1 was able to draw and recognize a cylindrical shape; however, he did not know its specific attributes, such as the diameter. SL1 identified cylinders by associating them with familiar objects such as gas cylinders and "Bear Brand" canned milk. In response, the researcher conducted the first Meaningful Scaffolding (MeScaff 1) by asking SL1 to observe the bottom of the can and draw it. The researcher then asked SL1 to determine the diameter based on his drawing.

In understanding the concept of area, SL1 made an error when determining how many circles could completely fill a rectangle. After receiving Meaningful Scaffolding "try to complete the empty spaces with identical circles", SL1 was able to determine the number of circles accurately, although the method used was still ineffective (counting each circle one by one). The researcher then provided a second Meaningful Scaffolding prompt: "observe the number of circles along the length and width." After careful observation, SL1 was able to identify a more efficient calculation strategy, namely multiplying the number of circles along the length by those along the width.

Furthermore, in determining proportional relationships, SL1 made errors by not performing calculations and instead relying on guesses. SL1 stated that the price of five small cans of powdered milk was 55,000 rupiah, even though the price of one small can was 60,000 rupiah. The researcher provided Meaningful Scaffolding "look at the problem carefully; one can costs sixty thousand, so how much would five cost?" SL1 recognized that the correct calculation was five times sixty thousand, but he was unable to perform the multiplication immediately. He required considerable time to reach the correct answer, reflecting slow performance in basic multiplication algorithms. SL1's written response is shown in the Figure 2.


Jika harga 1 kaleng susu bubuk kecil dengan berat 400 gram Rp 60.000,00. Harga 5 kaleng susu bubuk kecil berapa?
Jawab: 55.000:00 RP 300.000,00

Jika harga 1 kaleng susu bubuk sedang dengan berat 1,5 kg Rp 180.000,00. Harga 3 kaleng susu bubuk kecil berapa?
Jawab: 90.000:00 Rb 540.000

Figure 2. Results of the initial knowledge test for SL 1

Based on SL1's prior knowledge, the researcher implemented Meaningful Scaffolding (MeScaff) by asking SL1 to attempt the numeracy problem once again. However, SL1 was still unable to solve it. The researcher then provided more specific and targeted MeScaff support.

R : What types of powdered milk can be placed in the carton?
SL1 : The small one can, sir.
R : Okay, the small one. Along this side (pointing to the length of the carton), how many small powdered milk cans can be placed?
SL1 : Seven.
R : Why seven?
SL1 : *Thinks for a long time and does not answer.*
R : How much space does one small powdered milk can require?

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SL1 : *Thinks for a long time.* Ten centimeters.
R : And how much space do all of them need?
SL1 : Six.
R : What about along this side? (pointing to the width of the carton)
SL1 : Three.
R : And upward? (pointing to the height of the carton)
SL1 : *Thinks for a long time.*
R : How much space does one can require?
SL1 : Twelve.
R : What about two cans?
SL1 : Twenty-four.
R : And then?
SL1 : Up to three cans.

Based on the interview excerpt above, SL1 was able to determine the number of small powdered milk cans that could fit along the length, width, and height of the carton. In implementing MeScaff, the researcher simplified the problem and connected it to the student's prior knowledge. The scaffolding process required considerable time because SL1 demonstrated low proficiency in basic addition and column multiplication. SL1 determined the number of small cans that could fit along the length, width, and height of the carton as 6, 3, and 3 respectively, which when multiplied resulted in 54 cans. SL1 then calculated the total price by multiplying 54 by 60,000 rupiah, yielding 3,240,000 rupiah. However, SL1 also experienced difficulties when determining the total cost, as he was unable to decide on the correct procedure or compute the total independently. The researcher guided SL1 by linking his prior knowledge to the problem at hand, asking him to recall the price of one small powdered milk can and to determine the cost of 54 cans. SL1 was able to write the expression 54 × 60,000, but due to his limited multiplication skills, he required a substantial amount of time to complete the calculation.

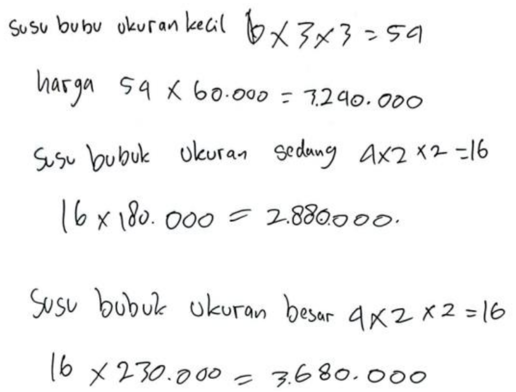

Figure 3. Answer to SL 1 in determining the price of powdered milk

Based on SL1's work as shown in the figure above, SL1 continued solving the numeracy problem by independently determining the number of medium-sized powdered milk cans (with assistance provided only to verify the multiplication results). SL1 wrote that the number of medium-sized cans fitting along the length, width, and height of the carton was 4, 2, and 2, respectively. He then calculated the total number of cans as 16 and computed the price as 16 × 180,000, resulting in 2,880,000 rupiah.

Next, SL1 proceeded to determine the number of large-sized powdered milk cans. He independently decided on the procedure and carried out the calculations, although he continued to experience the same difficulties with column multiplication. SL1 identified the number of large cans fitting along the length, width, and height of the carton as 4, 2, and 2, respectively. He calculated the total number as 16 and determined the price as 16 × 230,000, yielding 3,680,000 rupiah.

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SL1 became stuck on the three solutions he had already obtained. The researcher then provided additional Mindful Scaffolding (MiScaff) as follows:

R : Are there any other possibilities?
SL1 : *Thinks for a long time. Does not answer.*
R : You have been working very hard. How about mixing them—medium-sized cans at the bottom and small ones on top?
SL1 : Yes, that works, sir. *(Writes down a mixed combination of medium and small cans.)*
R : Try to work it out.
SL1 : Alright, sir.

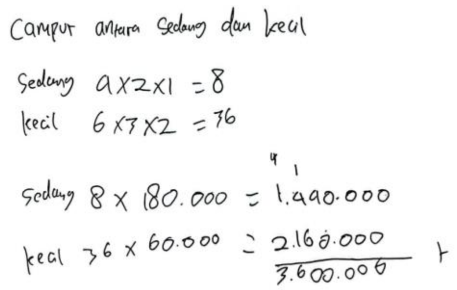

Figure 4. Answer to SL 1 in determining the price of various sizes of powdered milk

Based on the interview above, SL1 was able to determine the quantities of medium and small-sized powdered milk cans, namely 8 and 16, respectively. SL1 successfully calculated the separate prices for the medium- and small-sized cans, resulting in 8 × 180,000 = 1,440,000 rupiah and 36 × 60,000 = 2,160,000 rupiah. He then added the two amounts to obtain the total price of 3,600,000 rupiah.

The researcher asked whether there were any additional possibilities, and SL1 responded that another option would be a combination of large- and small-sized cans. SL1 proceeded by determining the number of large cans as 4 × 2 × 1 = 8 and the number of small cans as 6 × 3 × 2 = 36. SL1 did not encounter conceptual difficulties in performing these calculations, although his computational process remained slow, particularly in column multi-plication. SL1 then calculated the price of the large cans as 8 × 230,000 = 1,840,000 rupiah and the price of the small cans as 36 × 60,000 = 2,160,000 rupiah. He subsequently determined the total to be 4,000,000 rupiah.

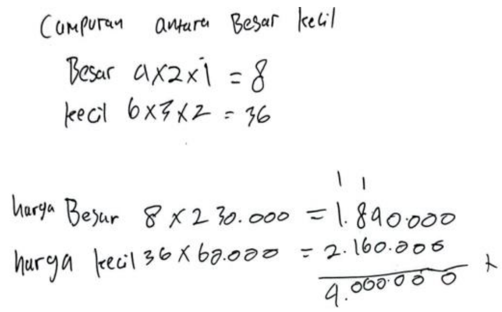

Figure 5. Answer to SL 1 in determining the total price of powdered milk

SL1 then wrote his final answer, stating that the combination of large- and small-sized powdered milk cans was the best option to place inside the carton because it produced the highest total value compared to the other alternatives. In addition, SL1 completed his response by specifying that 8 large cans and 36 small cans were placed inside the carton. The following is SL1's final answer.

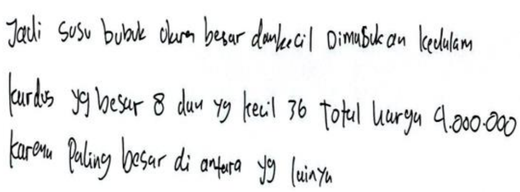

Figure 6. SL 1's answer in determining conclusions

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After SL1 successfully arrived at the correct solution, the researcher invited him to reflect on his experience and express his feelings throughout the deep scaffolding process.

R : On a scale from one to five, which number would you choose to describe your feelings? One means very unhappy, and five means very happy.
SL1 : Five.
R : Why?
SL1 : I feel happy being taught by you, sir. At first, I couldn't do it, but then I could. At first, I didn't understand, but then I understood.

SL1 described his emotional experience, stating that he felt joyful throughout the deep scaffolding process. He also noted that it was the first time he had received such in-depth assistance without judgment or comments that undermined his basic abilities. SL1 appeared to work very hard during the scaffolding sessions and seemed touched and genuinely happy to be able to solve the numeracy problem based on his own prior knowledge.

The findings of this study demonstrate that the implementation of deep scaffolding based on Realistic Mathematics Education (RME) has a significant impact on correcting the thinking errors of slow learners when solving contextual numeracy problems. The results obtained throughout the intervention process provide an in-depth depiction of how structured, meaningful, and iterative instructional support can address the cognitive, metacognitive, and affective barriers commonly experienced by slow learners.

The study revealed that prior to the intervention, the student faced fundamental difficulties in understanding the problem context. SL1 was unable to determine the initial steps and tended to simply add visible numbers without considering the relevant mathematical relationships. This finding aligns with Cheong et al. (2017) and Listiawati et al. (2023), who note that slow learners often experience cognitive disorientation when confronted with contextual tasks due to limited ability to identify key information and weak conceptual integration. Through mindful scaffolding, the researcher guided SL1 to reread the problem, identify its objectives, and activate prior knowledge, enabling the student to understand the structure of the problem more clearly. This highlights the role of mindful scaffolding as an early detection and correction strategy for common thinking errors among slow learners.

The study also shows substantial improvement in the student's visual representation skills. Initially, SL1 recognized the shape of a cylinder only in a general sense and could not connect the concepts of diameter and height as essential mathematical components. With meaningful scaffolding, SL1 was guided to draw the cylinder based on his concrete perception, observe circular shapes, and determine how many circles could fill a rectangular space more effectively. This progression supports the concept of progressive mathematization in RME, which emphasizes the gradual shift from concrete models ("model of") to abstract models ("model for") as the foundation for mathematical understanding (Van den Heuvel-Panhuizen & Drijvers, 2020). It also aligns with Reinhold et al. (2020), who found that concrete and visual representations can reduce cognitive load and enhance students' ability to construct complex mathematical structures.

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The results further indicate that deep scaffolding plays a crucial role in improving basic computational strategies, particularly addition and column multiplication. SL1 initially struggled with simple calculations and required considerable time to complete them. This is consistent with Bouck et al. (2018) and (Hord, 2023), who argue that slow learners typically have limited working memory capacity, making step-by-step support essential. The use of counting-on strategies and emphasizing multiplication as repeated addition helped SL1 improve both accuracy and cognitive efficiency. Thus, deep scaffolding facilitated a shift from rote dependence toward stronger procedural understanding.

The study identifies significant improvement in SL1's understanding of proportional relationships and multiplicative reasoning. Initially, SL1 relied on guessing when determining prices, without performing calculations. After receiving meaningful scaffolding, SL1 could apply appropriate multiplication, understand proportional relationships, and evaluate results systematically. This aligns with Geiger & Schmid (2024) and OECD (2020), who emphasize that numeracy requires the ability to connect mathematical operations with real-world contexts rather than relying solely on procedural execution.

Another key finding is SL1's improvement in generating alternative solutions and selecting the most optimal outcome. SL1 successfully identified three possible combinations based on can sizes, evaluated the total price of each, and chose the large–small combination that yielded the maximum value. This illustrates that deep scaffolding supports not only problem-solving techniques but also cognitive flexibility, comparative reasoning, and evidence-based decision-making. These findings reinforce (Sobkow et al., 2020), who link numerical competence with more rational decision-making.

Equally important is the affective growth demonstrated by the student throughout the learning process. SL1 reported feeling happy, confident, and proud after successfully solving the numeracy problem. This positive emotional engagement arose from the joyful scaffolding approach, in which the teacher provided emotional support, avoided negative judgment, and created an inclusive and psychologically safe learning environment. This finding is consistent with Chua (2021) and Nurmasari et al. (2024), who highlight that a positive mathematical mindset enhances persistence, motivation, and productive disposition. For slow learners, such affective support is particularly crucial because prior experiences of struggle often diminish their self-confidence in mathematics.

The findings of this study provide significant contributions both theoretically and practically to the development of numeracy learning for slow learners. Theoretically, this study strengthens the integration of deep scaffolding and Realistic Mathematics Education (RME) as a learning framework that not only focuses on cognitive aspects but also simultaneously accommodates metacognitive and affective dimensions. Practically, the results demonstrate that the implementation of structured scaffolding through the mindful, meaningful, and joyful stages serves as an effective strategy for identifying, correcting, and preventing students' thinking errors in a sustained manner. This approach also contributes to enhancing students' confidence, motivation, and emotional engagement in mathematics learning. Therefore, this

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study implies the importance of designing adaptive, contextual, and student-centered learning, particularly in inclusive classroom settings, and opens opportunities for the development of more humanistic and sustainable numeracy learning models in the future.

CONCLUSIONS

This study demonstrates that the implementation of deep scaffolding based on Realistic Mathematics Education (RME) is effective in correcting the thinking errors of slow learners when solving contextual numeracy problems. Through the stages of mindful, meaningful, and joyful scaffolding, the student was able to understand the problem context, construct accurate visual representations, apply more precise computational strategies, and evaluate multiple solution alternatives to determine the optimal answer. The intervention not only enhanced cognitive performance and mathematical modeling skills but also strengthened affective aspects such as confidence, motivation, and positive learning experiences. These findings reaffirm that deep scaffolding is a relevant, adaptive, and inclusive approach for supporting numeracy learning among slow learners.

This study has limitations, as it involved only a single participant, making the findings not yet generalizable. The relatively short intervention period also did not allow for an examination of long-term effects on numeracy retention or transfer. In addition, the researcher's role as the primary facilitator may have introduced interaction bias during the learning process.

Given these limitations, future research is recommended to involve a larger number of participants and employ designs that enable comparative analysis. Long-term studies are also needed to investigate the sustainability of deep scaffolding effects. Practically, teachers in inclusive school settings can apply this approach gradually and consistently to help slow learners understand numeracy problems more meaningfully and contextually. Teachers should also strengthen the use of visual representations and maintain a positive learning environment to enhance the effectiveness of the problem-solving process.

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