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Mathematical Critical Thinking in HOTS Problems With a Malay Cultural Context

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***Abstract*:**
This study investigates students' mathematical critical thinking skills in solving Higher Order Thinking Skills (HOTS) problems contextualised within Malay culture, focusing on two-variable linear equation systems. Although numerous studies have examined critical thinking in mathematics, limited research integrates local cultural contexts into HOTS problem design. This qualitative descriptive study involved three ninth-grade students selected purposively from different critical thinking categories (high, medium, and low). Data were collected through written tests and semi-structured interviews based on Facione's six critical thinking indicators: interpretation, analysis, evaluation, inference, explanation, and self-regulation. The findings reveal distinct characteristics across ability levels. Students in the high category were able to interpret contextual information accurately, construct appropriate mathematical models, and explain their reasoning logically before concluding, although minor computational inaccuracies occasionally occurred. Students in the medium category showed adequate ability in identifying relevant information and modelling the problem but experienced difficulties in organising information systematically and formulating precise conclusions. Meanwhile, students in the low category demonstrated limited ability in translating contextual problems into mathematical representations and expressing coherent reasoning in written form. The integration of Malay cultural contexts supported meaningful engagement, yet critical thinking development remained dependent on students' cognitive readiness. These findings highlight the importance of contextual HOTS problem design combined with structured metacognitive scaffolding in mathematics instruction.

Keywords: HOTS Problems, Malay Cultural Context, Mathematical Critical Thinking, SPLDV

Introduction

Critical thinking has become one of the essential competencies expected in 21st-century education. In mathematics learning, this ability is closely related to Higher Order Thinking Skills (HOTS), which encourage students to analyse problems, evaluate solution strategies, and construct logical conclusions. The Merdeka Curriculum emphasises the development of higher-order thinking abilities, including critical thinking, analytical reasoning, and problem solving (Kemendikbud, 2016). These competencies are important for preparing students to face complex challenges in the modern era and the industrial revolution 5.0 (Izzati et al., 2020; Gottschling et al., 2022). In this context, mathematical learning plays a strategic role in developing students' reasoning abilities through activities such as analysing arguments, evaluating ideas, and constructing systematic problem-solving strategies (Men et al., 2020; Syaiful et al., 2022).

A report from the Organisation for Economic Co-operation and Development OECD (2006) identifies teaching methodology as one of the factors influencing students' interest in science learning. This finding is consistent with Hasni and Potvin (2015), who highlight the role of school-related variables, including instructional approaches. Effective teaching methods provide opportunities for students to practise analytical and creative thinking through differentiated learning activities (Tong et al., 2020). Consequently, educational practices that intentionally promote critical thinking have become an important focus for researchers and educators (Sousa & Vieira, 2018). Therefore, mathematics teachers need to develop pedagogical strategies that support students' reasoning, problem-solving abilities, and critical thinking skills (Chandran et al., 2023).

Critical thinking involves the ability to interpret information, analyse relationships, evaluate arguments, draw conclusions, explain reasoning, and regulate one's own thinking processes (Facione, 2020). In mathematics education, these abilities enable students to solve unfamiliar problems through logical reasoning and evaluation of alternative strategies (Zhou et al., 2024). Such competencies are increasingly important for preparing students to respond to the demands of modern education and the global workforce (Schleicher, 2018; World Economic Forum, 2020). Critical thinking is also recognised as one of the key skills needed for decision-making in real-life situations (Costa et al., 2021). These abilities are commonly represented through six indicators: interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2020).

Despite the importance of critical thinking, several studies in Indonesia indicate that students' critical thinking skills remain low. International assessments such as PISA show that Indonesian students still experience difficulties in analysing, evaluating, and solving complex problems, reflecting performance below international standards (OECD, 2023). Most student learning in teacher-centred classrooms focuses on rote memorisation, encouraging learners to remember information instead of thinking, questioning, judging, or critically evaluating it, thereby hindering critical thinking skills (Ghaleb, 2024). Another study by Retnawati et al (2018) revealed that in a study of 15 junior high schools in Indonesia, only 28% of students met the minimum criteria for critical thinking in problem solving, with the majority having difficulty justifying conclusions or identifying assumptions.

The research data, reinforced by the national assessment results (AKM 2021–2023) show that students' literacy and numeracy skills, which are closely related to critical thinking, still require significant improvement. Similarly, international assessments such as PISA 2022 indicate that Indonesia ranks 72nd out of 81 countries in mathematics with a score of 366, far below the OECD average of 472 (OECD, 2023). Previous studies show students still struggle with HOTS-based mathematics problems, especially in understanding problems, formulating strategies, executing procedures, and drawing appropriate conclusions (Billa & Manurung, 2025). These difficulties stem from students' reliance on teacher explanations, which results in reduced confidence and greater difficulty in problem-solving (Maulina et al., 2025). Teacher-centred pedagogy emphasises repetition, drills, and memorised procedures, prioritising single correct answers over developing problem-solving skills (Sunzuma & Luneta, 2023). Consequently, low PISA performance reflects limited abilities in analysis, evaluation, and complex problem solving, which are core components of critical thinking (Schleicher, 2018). The findings show a serious gap in Indonesian students' critical thinking skills. These low achievements indicate the need for learning reform, intensive teacher training, and the integration of problem-based learning approaches into the Merdeka Curriculum.

Previous studies have examined students' critical thinking skills in solving HOTS mathematics problems (Ahmad et al., 2020; Yunita et al., 2023). However, most of these studies focus primarily on cognitive processes in decontextualised mathematical tasks. The integration of meaningful cultural contexts that are closely related to students' daily experiences remains relatively limited. In particular, few studies analyse how culturally contextualised HOTS problems influence the manifestation of students' mathematical critical thinking indicators across different ability levels. Costa et al. (2021) emphasise that the development of critical thinking in underdeveloped aspects, especially in specific contexts, needs to be carried out. Several studies show significant evidence of the development of critical thinking skills constructed with scientific knowledge relevant to students' real lives (Sousa & Vieira, 2018; Udi & Cheng, 2015). In the context of Malay culture, this type of research is still very limited, even though the local values contained in Malay culture can be used to increase the relevance and meaning of mathematics learning. The use of realistic problems encourages students to relate mathematical concepts to real life, while strengthening their critical thinking skills (Anugraheni et al., 2025).

To address this gap, the present study integrates Malay cultural contexts into HOTS mathematics problems to analyse students' mathematical critical thinking processes. Unlike previous studies that primarily examine critical thinking in general mathematical tasks, this research investigates how culturally contextualised situations influence the manifestation of critical thinking indicators, particularly when students solve problems related to two-variable linear equation systems (SPLDV). SPLDV material was chosen due to its concrete nature and suitability for contextualization with Malay culture. In addition, the results of Sihotang & Warmi (2023) showed that SPLDV material has been proven effective in measuring students' critical thinking indicators.

Despite extensive research on mathematical critical thinking and HOTS-based problem solving, most studies focus primarily on cognitive aspects without sufficiently incorporating local cultural contexts that are meaningful to students. Research integrating Malay cultural elements into algebraic problem solving remains limited, particularly in analysing how such contextualization influences students' critical thinking processes across different ability levels. Therefore, this study aims to analyse students' mathematical critical thinking skills when solving HOTS problems embedded in Malay cultural contexts in the topic of two-variable linear equation systems. The study specifically examines how critical thinking indicators appear across students with different ability levels in order to provide a clearer understanding of the characteristics of students' reasoning processes in contextual mathematics learning.

Research Methods

This study employed a qualitative descriptive approach to explore students' mathematical critical thinking processes in solving HOTS problems within a Malay cultural context. A qualitative approach was considered appropriate because the study aimed to obtain an in-depth understanding of students' reasoning processes rather than to generalise findings statistically.

The participants of this study consisted of three students selected purposively from 26 ninth-grade students in SMP Negeri 6 Tanjungpinang during the 2024/2025 academic year. The selection was based on students' critical thinking performance in the initial test and the teacher's recommendation. The students represented three different levels of critical thinking ability: high, medium, and low. This categorisation allowed the researchers to explore how students' reasoning processes differ across high, medium, and low levels of critical thinking ability. The categorisation of students' critical thinking levels was determined using the mean and standard deviation formula. Students whose scores were greater than (Mean + 1 SD) were categorised as high, those within (Mean ± 1 SD) as medium, and those below (Mean – 1 SD) as low. One student with the highest score from each category was selected to represent high, medium, and low levels. This categorisation was used solely to select representative subjects for qualitative analysis.

The research instrument was a set of HOTS mathematics problems related to two-variable linear equation systems that were contextualised within Malay cultural situations with a cognitive level of C5 (evaluation). The problems were designed to encourage students to analyse contextual information, construct mathematical models, evaluate solution strategies, and explain their reasoning. The design of the problems was aligned with six indicators of critical thinking proposed by Facione: interpretation, analysis, evaluation, inference, explanation, and self-regulation. Before being used in the study, the instrument was reviewed by mathematics education experts to ensure the appropriateness of the mathematical content, contextual relevance, alignment with critical thinking indicators, clarity and cognitive level.

Students' responses were analysed using an assessment rubric developed based on the six indicators of mathematical critical thinking proposed by Facione: interpretation, analysis, evaluation, inference, explanation, and self-regulation. Each indicator was evaluated using a four-level scale ranging from 1 (does not meet the standard) to 4 (meets the maximum standard). The rubric describes students' performance in identifying known and unknown information, constructing mathematical models, selecting and applying solution strategies, drawing conclusions, explaining reasoning, and reflecting on possible errors in their solutions. This rubric was used as a guideline to systematically interpret students' written responses and interview data in order to identify the characteristics of students' critical thinking processes across different ability levels. The rubric scores were used to categorise students into high, medium, and low levels of critical thinking ability.

To ensure consistency in data interpretation, each indicator of mathematical critical thinking was operationalised through specific observable criteria. Interpretation was reflected in students' ability to identify known and unknown information accurately. Analysis was indicated by the construction of appropriate mathematical models and representations. Evaluation was reflected in the selection and application of solution strategies, as well as the justification of results. Inference was reflected in the ability to draw valid conclusions based on problem-solving results. Explanation was identified through students' ability to articulate their reasoning clearly, while self-regulation was reflected in students' awareness of errors and their ability to monitor and verify their solutions.

Data were collected through two techniques: written tests and semi-structured interviews. The written test was used to examine students' written reasoning when solving HOTS problems, while the interviews were conducted to explore students' thinking processes more deeply and to clarify their written responses. Referring to the six indicators of mathematical critical thinking proposed by Facione—interpretation, analysis, evaluation, inference, explanation, and self-regulation—data related to the indicators of interpretation, analysis, evaluation, and inference were primarily obtained from students' written responses in the test and were subsequently confirmed through semi-structured interviews. Furthermore, the semi-structured interviews were also used to explore students' abilities related to the indicators of explanation and self-regulation, particularly in understanding how students articulated their reasoning and reflected on the strategies they used while solving the problems.

The data were analysed using the qualitative analysis procedure proposed by Miles and Huberman, which involves three stages: data reduction, data display, and conclusion drawing. In the data reduction stage, students' written responses and interview transcripts were examined to identify evidence related to critical thinking indicators. The data were then organised and presented through descriptive explanations and visual representations of students' work. Finally, conclusions were drawn by interpreting the patterns of students' reasoning across different ability levels.

Results and Discussions

The analysis of 26 students' written test results produced a mean score of 45.31 (SD = 12.10). Based on the categorisation criteria, one representative student from each level (high, medium, and low) was selected for in-depth analysis. The test results and research subjects are presented in Table 1.

Table 1. Critical Thinking Test Results and Research Subjects

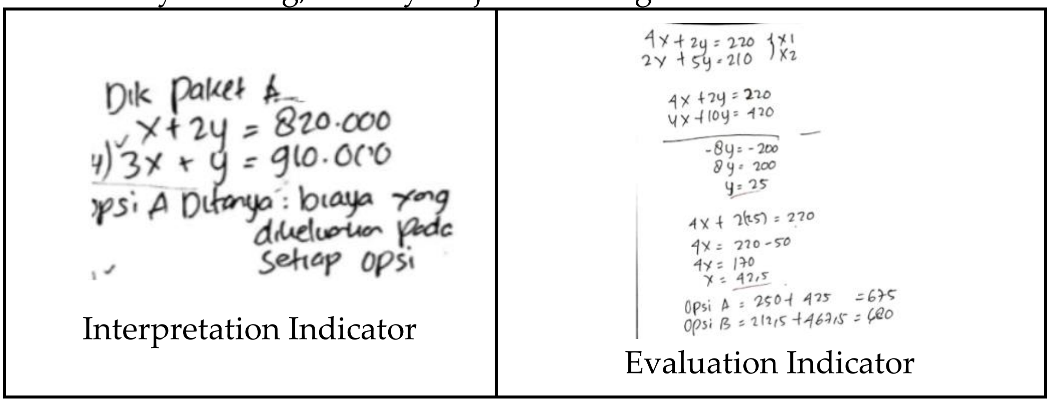
Category	Score Interval	Number of Students	Highest Score	Subject
High	$X >$ 57,41 (Mean+1 SD)	2	87,50	S-1
Medium	(Mean-1 SD) 33,21 $\leq X \leq$ 57,41 (Mean+1 SD)	20	56,25	S-2
Low	$X <$ 33,21 (Mean-1 SD)	4	31,25	S-3

. The following section presents a detailed analysis of students' written responses supported by interview findings. All six indicators of mathematical critical thinking were examined in this study. While interpretation, analysis, evaluation, and inference were primarily identified from students' written responses, the indicators of explanation and self-regulation were further explored through interview data, as these aspects involve verbal articulation and reflective thinking processes that are not always explicitly expressed in written work.

High-Ability Student (S-1)

Analysis of Question 1

Figure 1 presents S-1's written response to the first HOTS problem involving traditional Malay clothing, namely tanjak and songket.



Interpretation Indicator

Evaluation Indicator

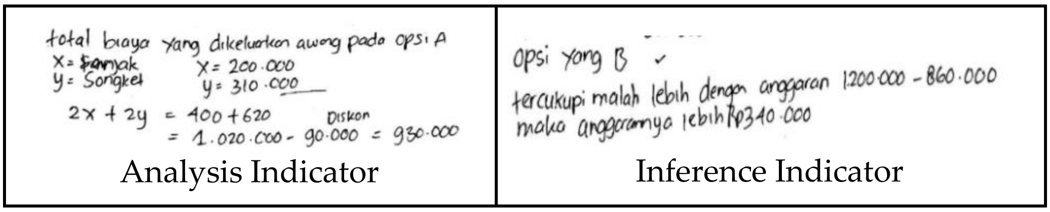


Figure 1. Answer to Question 1 by S-1

In Figure 1, S-1 began by defining variables: x representing the price of one tanjak and y representing the price of one songket. The two package descriptions were translated into the system:

$$2x + 2y = 820.000$$
$$x + 2y = 910.000$$

This transformation demonstrates strong interpretative and analytical ability. Rather than copying the story information mechanically, S-1 reorganised contextual data into a mathematical structure that could be processed symbolically. This reflects the capacity to identify relevant quantitative relationships embedded in narrative form—an essential characteristic of mathematical critical thinking (Facione, 2020).

S-1 applied elimination by multiplying the first equation to obtain 3x + 6y = 2.460.000, subtracting the second equation, and determining y = 310.000, followed by substitution to obtain x = 200,000. The procedure was coherent and accurate. The logical sequence indicates stable analytical reasoning and procedural control.

At the evaluation stage, S-1 calculated the cost of purchasing 2 tanjak and 2 songket individually, obtaining Rp1.020.000. Since the amount exceeded the promotional threshold, S-1 correctly applied the discount per item (2 × 25,000 and 2 × 20,000), leading to a final cost of Rp930,000 for Option 1. For Option 2, S-1 computed the total package purchase (Rp1.730.000), applied the appropriate discount, and subtracted the resale value of the surplus items, resulting in Rp860.000.

The ability to integrate multiple contextual conditions—package composition, promotional discount, resale of surplus items, and budget verification—demonstrates mature evaluative reasoning. The final inference was accurate: Option 2 was more economical and within the available budget.

During the interview, S-1 explained that writing known and asking for information helps clarify the problem before modelling with variables. However, S-1 also admitted to occasionally reversing variable placement or making minor errors in discount calculation. This statement reveals active self-monitoring. Even when mistakes occurred, S-1 demonstrated awareness of possible error sources. Such metacognitive reflection differentiates high-level thinkers from others and aligns with findings that advanced students tend to monitor and evaluate their reasoning processes more consciously (Facione, 2020; Yuliana et al., 2024).

Analysis of Question 2

Figure 2 presents S-1's response to the second problem involving traditional Malay cakes, namely the Bingka–Deram.

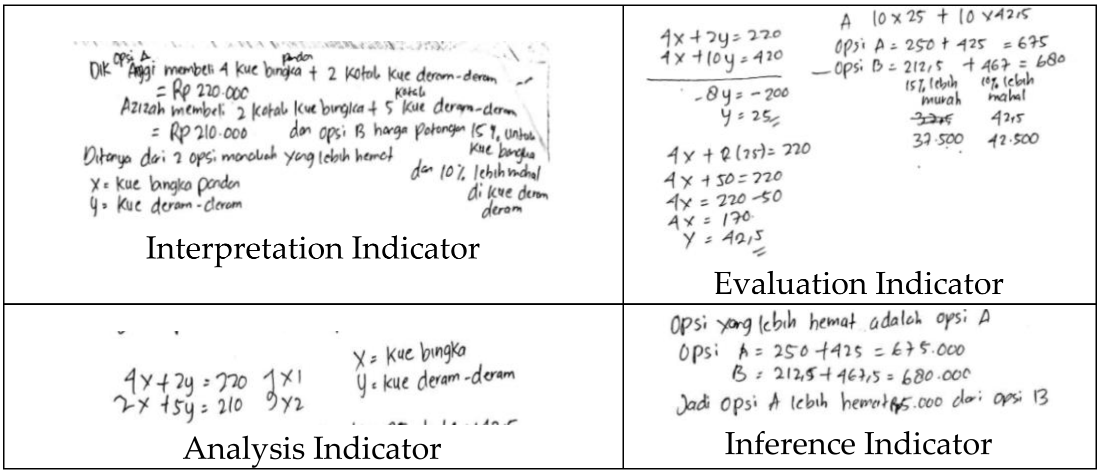


Figure 2. Answer to Question 2 by S-1

In the second problem, S-1 again constructed a valid system of equations:

$$4x + 2y = 220.000$$
$$2x + 5y = 210.000$$

Through elimination and substitution, S-1 correctly obtained y = 25,000 and x = 42,500. Up to this point, the analytical process was precise and systematic. For Option A, S-1 computed the total cost for 10 boxes of each type correctly (Rp675,000). However, an error occurred in Option B when applying the 15% discount and 10% increase. The recalculated price per item did not fully reflect accurate percentage operations, leading to an incorrect total comparison. This case illustrates an important nuance: the weakness did not lie in modelling or solving SPLDV, but in integrating contextual percentage adjustments. In the interview, S-1 acknowledged that mistakes sometimes occurred when handling discount calculations. This indicates awareness of procedural vulnerability.

Research on HOTS problem-solving has shown that errors frequently occur during multi-condition integration rather than during equation formation (Billa & Manurung, 2025). Similarly, studies have emphasised that contextual reasoning involving percentages requires additional cognitive control beyond algebraic manipulation (Yuliana et al., 2024). Thus, S-1’s profile reveals strong analytical competence but highlights that evaluative precision remains sensitive to contextual arithmetic complexity.

This pattern indicates that high-ability students are not only capable of constructing mathematical models but are also able to coordinate multiple contextual conditions simultaneously, reflecting an integrated form of analytical and evaluative reasoning.

Medium-Ability Student (S-2)

Analysis of Question 1

Figure 3 presents S-2’s written work of question 1.

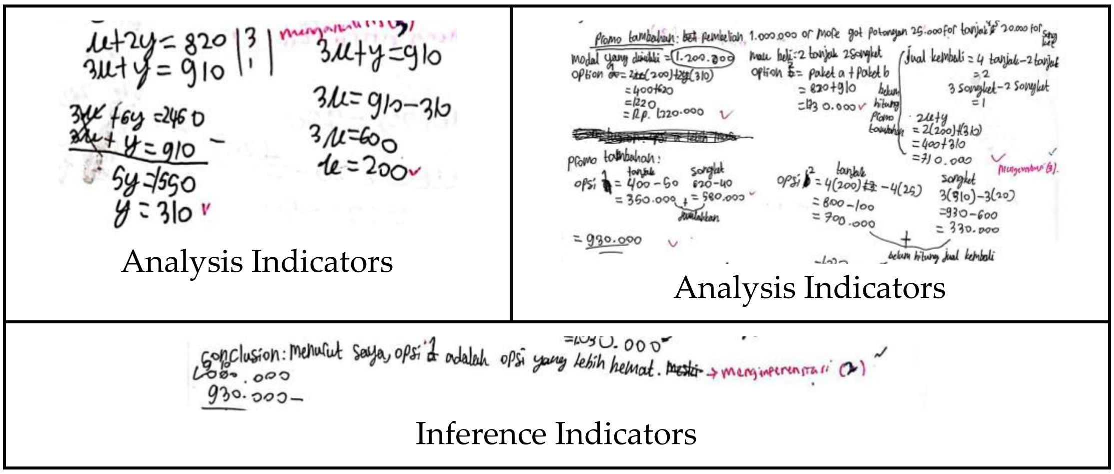


Figure 3. Answer to Question 1 by S-2

S-2 directly constructed equations without explicitly restating known and asked information. In the interview, S-2 stated that writing these elements was unnecessary if the problem was already understood. This suggests internal interpretation, but limited external structuring. The mathematical model formed was correct, and elimination-substitution procedures were applied appropriately. This indicates adequate analytical reasoning at the modelling stage.

However, inaccuracies appeared during the evaluation stage when calculating final costs and applying promotional conditions. When asked whether the answer might be incorrect, S-2 expressed confidence in the solution, indicating limited self-evaluation. This pattern reflects a common characteristic of medium-level students: procedural knowledge is present, yet monitoring and verification remain underdeveloped. Previous studies on HOTS mathematics have reported similar findings, where students successfully construct models but struggle to validate conclusions rigorously (Retnawati et al., 2018).

Analysis of Question 2

Figure 4 shows S-2's response to the second problem.

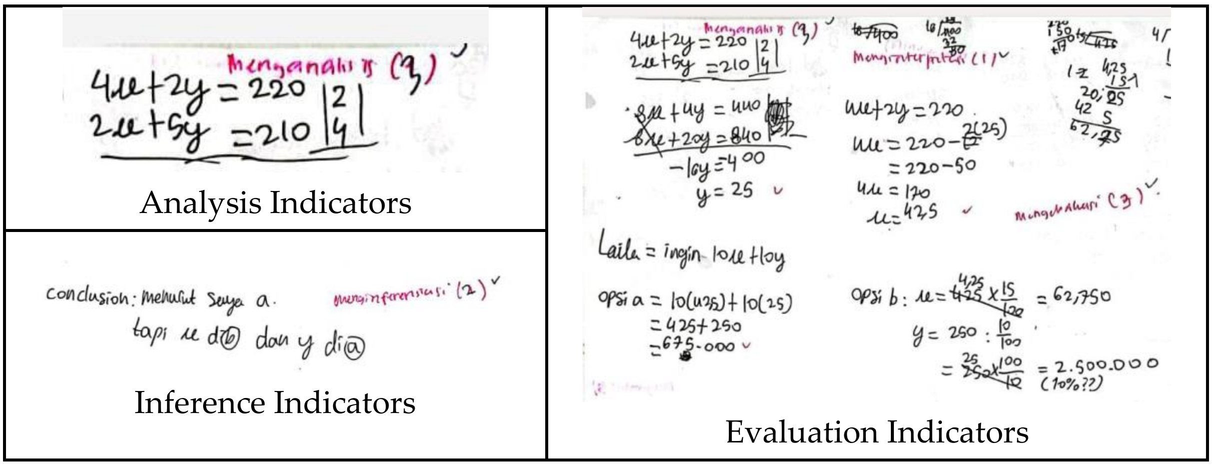


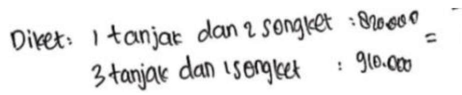
Figure 4. Answer to Question 2 by S-2

In Question 2, S-2 again correctly formed the SPLDV model and solved for unit prices. However, difficulties emerged when calculating percentage adjustments for the alternative store option. Although the algebraic reasoning was sound, the integration of contextual percentage changes led to miscalculations. The final inference was drawn without thorough verification of whether the adjusted prices were reasonable relative to the original values.

This indicates that inferential reasoning was based primarily on procedural completion rather than reflective validation. Research on critical thinking in contextual mathematics tasks suggests that evaluation and justification are often the most cognitively demanding stages, particularly when multiple conditions must be synthesised (Billa & Manurung, 2025). This suggests that the limitation does not lie in modelling ability, but in the lack of reflective verification, where procedural completion is not followed by evaluative checking.

Low-Ability Student (S-3)
Analysis of Question 1

Figure 5 presents S-3's written response to question 1.



Interpretation Indicators

Figure 5. Answer to Question 1 by S-3

S-3 wrote only partial known information and did not construct complete equations. No systematic elimination or substitution was applied. The written work indicates fragmented reasoning.

However, during the interview, S-3 stated:

"I know we need to eliminate to get y."

This verbal awareness was not reflected in written form, revealing difficulty transferring internal understanding into formal representation (Puspitasari et al., 2019) note that low-ability students frequently struggle to organise multi-step mathematical reasoning in writing. The absence of structured modelling and conclusion writing confirms that interpretation, analysis, evaluation, and inference indicators were largely unmet. When asked how to ensure the correctness of the answer, S-3 did not mention any verification strategy, indicating limited self-regulation at the evaluative stage.

Analysis of Question 2

Figure 6 presents S-3's written response to question 2.

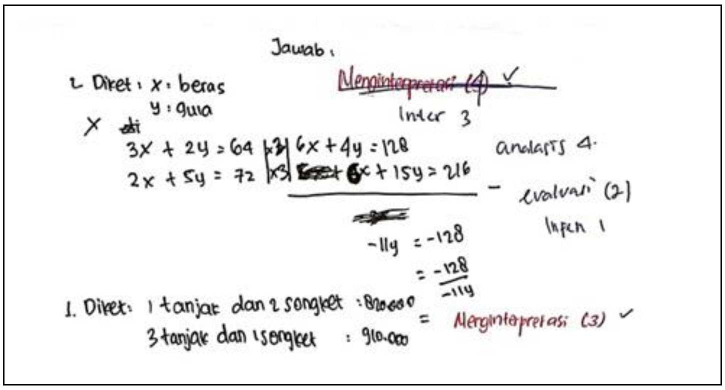


Figure 6. Answer to Question 2 by S-3

In Figure 6, S-3 attempted to represent the contextual information algebraically; however, the modelling process was incomplete and inconsistent. Although two variables were introduced, the equations constructed did not fully correspond to the quantitative relationships described in the problem. This indicates partial interpretation but unstable analytical structuring. Unlike S-1 and S-2, S-3 did not complete the elimination or substitution process accurately. The solution stopped before obtaining valid unit prices, which consequently prevented proper percentage adjustment and comparison between the two purchasing options. Therefore, the difficulty occurred at the transition from interpretation to systematic analysis.

During the interview, S-3 mentioned that elimination should be used to determine one variable first. However, when asked how to proceed after obtaining one value, the student hesitated and was unable to explain the subsequent substitution step clearly. This suggests that procedural awareness existed at a surface level but was not supported by structured reasoning. The explanation indicator was therefore weak, as the student could not articulate the logical sequence of operations. When asked how to verify the correctness of the solution, S-3 stated that checking would be done by comparing answers with peers. No independent verification strategy, such as re-substitution or contextual plausibility checking, was mentioned. This demonstrates limited self-regulation. The absence of systematic modelling and reflective validation confirms that evaluation and inference indicators were not achieved in this problem.

Overall, the contextual complexity involving percentage adjustments further increased cognitive load, preventing S-3 from integrating algebraic modelling with situational reasoning. This finding is consistent with previous studies indicating that low-ability students often experience fragmentation between conceptual recognition and procedural execution in multi-step mathematical problems (Puspitasari et al., 2019). This finding reflects a fragmentation between conceptual awareness and procedural execution, where students recognise the strategy but fail to implement it systematically.

Cross-Category Discussion

A comparative analysis across Figures 1–6 reveals a hierarchical pattern in the manifestation of students' mathematical critical thinking when solving HOTS problems within a Malay cultural context. In terms of interpretation, high-ability students organised contextual information explicitly and systematically. Medium-ability students demonstrated internal understanding but did not consistently externalise it in written form, while low-ability students showed fragmented interpretation. This indicates that interpretation functions as the initial gateway to problem solving, but its effectiveness depends on students' ability to structure contextual information clearly.

At the level of analysis, all students were able to recognise the need to represent contextual situations mathematically. Cultural objects such as tanjak, songket, and traditional cakes were translated into algebraic variables across categories. However, only high-ability students maintained consistency throughout the modelling process. Medium-level students showed partial coherence, while low-level students struggled to construct complete mathematical representations. Highly familiar expressions can be processed more easily because they are stored in long-term memory and can be directly accessed; therefore, additional reasoning processes may become less necessary during comprehension (Wang et al., 2021).

The most significant differentiation occurred at the stages of evaluation and inference. High-ability students demonstrated reflective reasoning by verifying results and integrating multiple contextual conditions. Medium-ability students tended to rely on procedural completion without sufficient verification, while low-ability students were unable to reach valid conclusions. This suggests that evaluation and inference act as critical thresholds distinguishing procedural competence from reflective reasoning (Zhou et al., 2024).

The role of self-regulatio**n** further strengthened this distinction. Only high-ability students showed clear metacognitive control through error awareness and verification strategies. Medium-level students exhibited limited monitoring, whereas low-level students did not demonstrate independent validation. This finding reinforces that self-regulation represents the highest level of critical thinking development (Facione, 2020).

Overall, the findings indicate that mathematical critical thinking develops progressively, where interpretation and analysis emerge earlier, while evaluation, inference, and self-regulation function as higher-level processes requiring cognitive and metacognitive integration. The Malay cultural context supported students' initial understanding by providing familiar representations; however, its effectiveness depended on students' conceptual readiness. Thus, cultural context facilitates entry into problem-solving, while metacognitive regulation determines the depth of reasoning.

Role of Malay Cultural Context

The integration of Malay cultural contexts increased students' engagement and facilitated symbolic representation. Students appeared more motivated when working with familiar objects such as tanjak, songket, and traditional cakes. However, the data suggest that contextual familiarity enhances meaning construction primarily for students with adequate algebraic foundations. For lower-ability students, cognitive load remained high despite contextual relevance. This finding aligns with Ismail et al. (2024), who argue that culturally contextualised mathematics enhances relevance but requires structured pedagogical scaffolding to impact higher-order reasoning. By situating HOTS algebraic problems within authentic Malay cultural contexts, this study advances the theoretical understanding that cultural familiarity may enhance representational access, while metacognitive regulation remains the decisive factor in transforming contextual engagement into higher-order mathematical reasoning.

The Malay cultural context functioned not only as a narrative setting but also as a representational bridge that helped students translate real-life situations into mathematical structures. Familiar cultural objects such as tanjak, songket, and traditional cakes supported initial interpretation; however, the effectiveness of this context depended on students' prior conceptual understanding. This indicates that cultural context facilitates entry into the problem but does not automatically support higher-order reasoning without adequate cognitive and metacognitive readiness.

Conclusions and Suggestions

This study demonstrates that students' mathematical critical thinking in solving HOTS problems embedded within a Malay cultural context develops hierarchically across ability levels. High-ability students exhibited integrated mastery of interpretation, analysis, evaluation, inference, explanation, and self-regulation, characterised by coherent modelling and reflective error monitoring. Medium-ability students showed stable modelling skills but lacked consistent evaluative verification and metacognitive regulation. In contrast, low-ability students experienced fragmentation between conceptual awareness and procedural execution, particularly when contextual conditions required multi-step integration.

The findings contribute theoretically by affirming that self-regulation operates as the culminating indicator that differentiates mature mathematical critical thinking from procedural competence. More importantly, self-regulation functions as a mechanism that transforms procedural problem solving into reflective and evaluative reasoning. The study also provides empirical evidence that culturally contextualised HOTS tasks can facilitate meaningful representation and engagement; however, they do not automatically guarantee higher-order reasoning without structured cognitive and metacognitive scaffolding.

Pedagogically, the results suggest that mathematics instruction should integrate culturally relevant problem contexts with explicit prompts for justification, verification, and reflective monitoring. Teachers are encouraged to design HOTS tasks that not only require algebraic modelling but also systematically guide students to evaluate assumptions, compare alternatives, and validate conclusions.

Although this research involved a limited number of participants within a single classroom setting, it offers a conceptual lens for understanding how cultural context interacts with critical thinking indicators in algebraic problem solving. Future studies may expand the sample scope, incorporate intervention designs, or examine the impact of structured metacognitive strategies on strengthening evaluative and self-regulatory dimensions in culturally contextualised mathematics learning.

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