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Mathematical Reasoning of Junior High School Students in Solving Linear Equations in One Variable (LEOV) Word Problems

Andi Kurnia Riski Sanneng[1], Rohati Rohati[2]*, and Duano Sapta Nusantara[3]
[1, 2*, 3]University of Jambi, Jambi City, Indonesia
**Corresponding author*
Email: andikurniariski2001@gmail.com[1] , rohati.fkip@unja.ac.id[2*], duanosaptanusantara@unja.ac.id[3]

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ABSTRACT

This study aimed to describe the mathematical reasoning profiles of eighth-grade students in solving linear equations in one variable (LEOV) word problems. A descriptive qualitative approach was employed as a preliminary investigation before the development of an instructional intervention. The participants were 27 eighth-grade students from a public junior high school in Jambi City who had previously studied LEOV. Data were collected through two essay-based word problems developed according to five mathematical reasoning indicators: formulating hypotheses, performing mathematical manipulations, constructing proofs, drawing conclusions, and verifying the validity of arguments. The test items were reviewed by a mathematics education lecturer and complemented by semi-structured interviews with six purposively selected students representing high, moderate, and low reasoning categories. Data were analyzed through data reduction, data display, conclusion drawing, descriptive statistics, and triangulation of written responses, interview results, and supporting documentation. The findings revealed that students' mathematical reasoning ability was generally low, with an average score of 9.19 out of 40. Of the participants, 3.70% were classified in the high category, 14.81% in the moderate category, and 81.48% in the low category. Formulating hypotheses showed the highest achievement at 28.24%, whereas verifying the validity of arguments was the weakest indicator at 9.72%. High-ability students demonstrated relatively systematic and reflective reasoning, while moderate- and low-ability students experienced difficulties in constructing mathematical models, providing logical justification, drawing context-appropriate conclusions, and checking their solutions. These difficulties were particularly associated with students' limited ability to visualize the situations described in word problems. The findings highlight the need for visual, contextual, and step-by-step learning activities that strengthen mathematical modeling, argumentation, verification, and students' confidence in solving LEOV word problems.

ABSTRAK

Penelitian ini bertujuan untuk mendeskripsikan profil penalaran matematis siswa kelas VIII dalam menyelesaikan soal cerita Persamaan Linear Satu Variabel (PLSV). Penelitian menggunakan pendekatan deskriptif kualitatif sebagai studi pendahuluan sebelum pengembangan intervensi pembelajaran. Subjek penelitian terdiri atas 27 siswa kelas VIII di salah satu SMP negeri di Kota Jambi yang telah mempelajari materi PLSV. Data dikumpulkan melalui dua soal uraian berbentuk soal cerita yang dikembangkan berdasarkan lima indikator penalaran matematis, yaitu merumuskan dugaan, melakukan manipulasi matematis, menyusun bukti atau alasan, menarik kesimpulan, dan memeriksa validitas argumen. Instrumen tes telah ditelaah oleh seorang dosen pendidikan matematika dan dilengkapi dengan wawancara semi-terstruktur terhadap enam siswa yang dipilih secara purposif untuk mewakili kategori kemampuan tinggi, sedang, dan rendah. Data dianalisis melalui reduksi data, penyajian data, penarikan kesimpulan, statistik deskriptif, serta triangulasi antara jawaban tertulis, hasil wawancara, dan dokumentasi pendukung. Hasil penelitian menunjukkan bahwa kemampuan penalaran matematis siswa secara umum masih rendah, dengan rata-rata skor 9,19 dari skor maksimum 40. Sebanyak 3,70% siswa berada pada kategori tinggi, 14,81% pada kategori sedang, dan 81,48% pada kategori rendah. Indikator merumuskan dugaan memperoleh capaian tertinggi sebesar 28,24%, sedangkan indikator memeriksa validitas argumen memperoleh capaian terendah sebesar 9,72%. Siswa berkemampuan tinggi menunjukkan proses penalaran yang relatif sistematis dan reflektif, sedangkan siswa berkemampuan sedang dan rendah mengalami kesulitan dalam membangun model matematika, memberikan alasan logis, menarik kesimpulan sesuai konteks, serta memeriksa kembali solusi. Kesulitan tersebut terutama berkaitan dengan keterbatasan siswa dalam memvisualisasikan situasi yang disajikan dalam soal cerita. Temuan ini menegaskan perlunya pembelajaran visual, kontekstual, dan bertahap untuk memperkuat pemodelan, argumentasi, verifikasi, dan kepercayaan diri siswa dalam menyelesaikan soal cerita SPLSV

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INTRODUCTION

Mathematical reasoning ability is a fundamental competency in mathematics education that encompasses the ability to make conjectures, perform mathematical manipulations, construct proofs, draw conclusions, and verify the validity of arguments (Kala & Suwarsono, 2021). PISA 2022 data ranked Indonesia 69th out of 80 countries with a score of 366, far below the OECD average of 472 (OECD, 2023). Most Indonesian students have not yet reached Level 2, which requires contextual reasoning (Syaharani et al., 2025), and TIMSS findings reinforced that significant challenges arose in higher-order reasoning questions (Rohati et al., 2023). This situation indicates that the underlying issue is not merely procedural but rather the students' weak mathematical reasoning skills.

The problem becomes even more pronounced when students encounter word problems. Word problems require a complex reasoning process: identifying information, constructing mathematical models, performing algebraic manipulations, and drawing context-appropriate conclusions (Vebrian et al., 2021). LEOV content inherently requires a series of step-by-step reasoning because students must connect verbal representations with symbolic ones (Reni et al., 2025). Students' algebraic reasoning greatly influences their ability to solve LEOV word problems (Fatio et al., 2020), and research by Afandi and Husna (2020) demonstrated that students tend to answer questions without performing all problem-solving indicators, with a rechecking rate of only 5.36%.

A preliminary study at a public junior high school in Jambi City showed that eighth-grade students' mathematical reasoning skills remained low, with an average score of 22.96 out of 100 and 81.48% of students falling into the low category. These findings are consistent with those of (Rohati et al., 2021)who found a predominance of imitative patterns in the reasoning of junior high school students. Theoretically, mathematical reasoning develops through active knowledge construction (Raharjo et al., 2020; Vebrian et al., 2021), but learning that overemphasizes algorithmic procedures causes students to struggle with contextual problems (Salsabiela et al., 2025; Samsudin et al., 2022). Using a grounded theory approach, Rohati et al. (2021) identified four categories of reasoning behavior: imitative, algorithmic, semi-creative, and creative, which underscores the importance of mapping reasoning profiles as the foundation for adaptive learning.

Although studies on mathematical reasoning abilities have been extensive, significant gaps remain. Most studies have described ability levels in aggregate without mapping reasoning profiles per category within the context of LEOV word problems (Asfyra et al., 2026; Mukuka et al., 2023; Rohati et al., 2023). Existing research has generally not simultaneously distinguished reasoning characteristics among high, medium, and low-ability students (Natalia & Warmi, 2025; Nurhalin & Effendi, 2022). The ability to visualize word problems as a key factor in low reasoning has not been extensively examined through in-depth qualitative analysis (Mukuka & Balimuttajjo, 2021). Furthermore, this low level of reasoning is not limited to the junior high school level but also occurs at higher education levels, with learning approaches and motivation identified as primary factors (Suharti et al., 2021). This situation was exacerbated by a lack of diverse instructional models that explicitly foster active reasoning in the classroom (Atiyah & Priatna, 2023).

This study aimed to describe the profile of eighth-grade students' mathematical reasoning abilities in solving LEOV word problems at a public junior high school in Jambi City, as a preliminary study prior to the development of a learning intervention. The novelty of this study lies in: (1) the integrated use of five reasoning indicators within the LEOV context, and (2) a detailed qualitative profile for each ability category through a combination of written response analysis and in-depth interviews. The findings are expected to serve as an empirical foundation for developing more contextually focused learning to strengthen students' mathematical reasoning.

METHOD

This was a descriptive qualitative study that examined and analyzed the mathematical reasoning abilities of junior high school students when solving LEOV word problems. A qualitative approach was chosen because the study focused on a deep understanding of students' thinking processes in formulating hypotheses, performing mathematical manipulations, constructing evidence, drawing conclusions, and verifying the validity of arguments. This study served as a preliminary study to obtain an initial picture of students' mathematical reasoning abilities before further learning interventions are implemented.

The participants consisted of 27 eighth-grade students from a public junior high school in Jambi City during the second semester of the 2025/2026 academic year, selected for having studied LEOV material. The instruments included a two-question LEOV story problem test designed based on five mathematical reasoning indicators referencing (Kala & Suwarsono, 2021) as presented in Table 1, as well as a semi-structured interview guide. The test instrument was reviewed by a mathematics education lecturer with expertise in mathematics teaching and learning to ensure its suitability for the study. The review examined the relevance of the test content, item construction, their alignment with the mathematical reasoning indicators, and the clarity of the language used. Based on the review, revisions were made to refine the wording of the questions and improve the clarity of the instructions before the instrument was administered to the participants. The instrument consisted of two essay questions, each assessing five mathematical reasoning indicators scored on a scale of 0–4, resulting in a maximum total score of 40. The complete test items and scoring rubric are available at: https://acesse.one/53f728u.

Table 1. Indicators of mathematical reasoning ability

No.	Mathematical Reasoning Indicators
1.	Formulating Hypotheses
2.	Performing mathematical manipulations
3.	Constructing proof
4.	Drawing conclusions
5.	Checking the validity of the argument

The research procedure began with the development and validation of the test instruments. Once the instruments were deemed valid, the tests were administered to all research subjects. Test results were evaluated using an analytical rubric with a score range of 0–4 per indicator, converted to percentages, and classified into three categories of mathematical reasoning ability, as presented in Table 2. Next, students were selected as interview subjects through purposive sampling based on the representation of ability categories (high, moderate, low), with two students per category (one each for question 1 and question 2), resulting in a total of six interview subjects.

Table 2. Categories of mathematical reasoning ability

Percentage of Scores	Category
71–100	High
41–70	Moderate
≤40	Low

Data analysis was conducted using qualitative descriptive methods in three main stages: data reduction, data presentation, and conclusion drawing. Data reduction involved selecting and focusing on data from tests, interviews, and documentation to identify indicators of reasoning ability. Data was presented in the form of tables, narrative descriptions, and interview excerpts. Additionally, descriptive quantitative analysis was conducted by calculating average scores, achievement percentages for each indicator, and the distribution of ability categories. Data credibility was ensured through method and source triangulation. Students' written responses were first analyzed based on the five mathematical reasoning indicators. Semi-structured interviews were then conducted to clarify the reasoning underlying students' written solutions, explore unclear or incomplete responses, and confirm their problem-solving processes. The interview data were subsequently compared with the students' answer sheets to examine the consistency between their written work and verbal explanations. In addition, supporting documentation, including the students' answer sheets, was used to verify and strengthen the interpretation of the findings.

This triangulation process enhanced the credibility of the students' mathematical reasoning profiles.

RESULTS AND DISCUSSION

An analysis of mathematical reasoning ability was conducted with eighth-grade students at a public junior high school in Jambi City, using two LEOV word problems covering five reasoning indicators. The maximum achievable score was 40, and the results are presented as descriptive statistics in Table 3.

Table 3. Descriptive statistics of students' mathematical reasoning ability

Number of students	Minimum score	Maximum score	Mean	Standard deviation
27	0	29	9.19	6.73

Based on the descriptive statistics presented in Table 3, students obtained an average mathematical reasoning score of 9.19 out of a maximum score of 40, indicating generally low performance. The relatively high standard deviation (6.73) suggests considerable variation in students' mathematical reasoning ability. The distribution of students across the three ability categories is presented in Table 4.

Table 4. Distribution of students by category of mathematical reasoning ability

Category	Number of Students	Percentage
High	1	3.70%
Moderate	4	14.81%
Low	22	81.48%

Table 4 shows that most students were classified in the low mathematical reasoning category, accounting for 22 of the 27 participants (81.48%). Only one student (3.70%) demonstrated high mathematical reasoning ability, while four students (14.81%) were categorized as having moderate ability. These findings indicate that the majority of students experienced difficulties in solving LEOV word problems requiring mathematical reasoning. To further examine students' performance, an analysis of each mathematical reasoning indicator was conducted across the two test items. This analysis provides a more detailed understanding of students' strengths and difficulties in each aspect of mathematical reasoning. The average achievement for each mathematical reasoning indicator is presented in Table 5.

Table 5. Average scores for mathematical reasoning indicators

Indicator	**Question 1**	**Question 2**	**Average**	**Percentage**	**Criteria**
Formulate a hypothesis	1.48	0.78	1.13	28.24%	Low
Performing mathematical manipulations	1.63	0.48	1.06	26.39%	Low

Indicator	**Question 1**	**Question 2**	**Average**	**Percentage**	**Criteria**
Organizing evidence/providi ng reasons	1.52	0.63	1.07	26.85%	Low
Drawing conclusions	1.48	0.41	0.94	23.61%	Low
Checking validity	0.70	0.07	0.39	9.72%	Low

Based on Table 5, the "formulating a hypothesis" indicator had the highest achievement (28.24%), while "checking the validity of arguments" had the lowest (9.72%), indicating that students are better at initiating problem-solving than at evaluating and verifying results. This pattern is consistent across all indicators: the score for Question 1 is always higher than that for Question 2, confirming that the more complex the cognitive demands, the lower the quality of students' reasoning (Wulandari et al., 2025).

Subject S-1, as a high-ability student, consistently met all indicators of mathematical reasoning, ranging from formulating conjectures to verifying arguments. This ability is supported by strong conceptual understanding, problem-solving planning skills, and the ability to independently and reflectively identify problem structures. This finding aligns with prior evidence that students with high reasoning ability tend to determine appropriate strategies and solve problems systematically and efficiently, as shown in Figure 1.

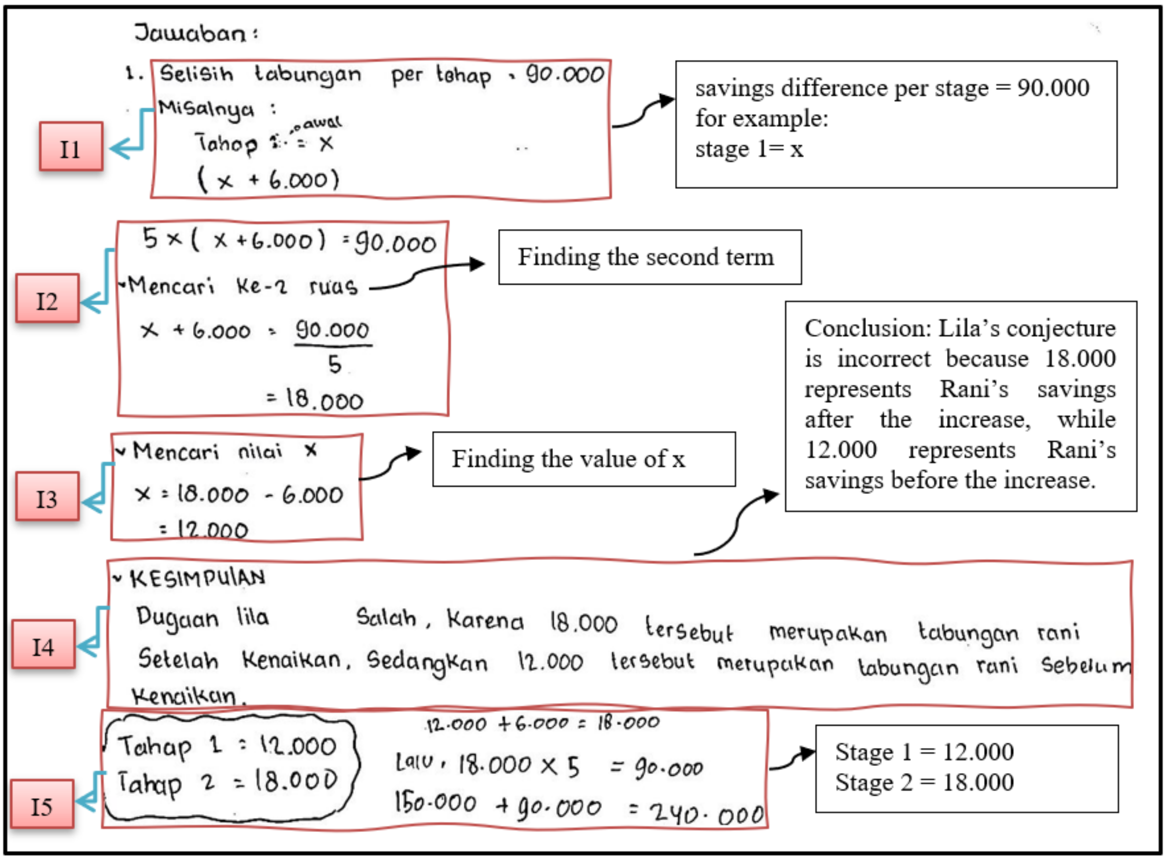

Figure 1. Results of S-1's higher-order reasoning ability (Question 1)

Based on Figure 1, S-1 met all mathematical reasoning indicators when solving the LEOV problem. Regarding the indicator for formulating a hypothesis, S-1 was accurate in identifying variables, making assumptions, and developing a mathematical model. Mathematical manipulation was carried out systematically and sequentially, accompanied by the formulation of logical proofs in accordance with the problem information. S-1 was also able to draw clear conclusions, relate them to the context, and make substitutions to verify the solution's validity. Although there was a slight incompleteness in the second problem, all indicators were met overall. This finding was reinforced by the interview results, in which S-1 answered each question calmly and in a structured manner.

> ***S-1:*** *"Since the savings increase by 6,000 every week, the savings for the second week are x plus 6,000. Then, since the total savings over five weeks is 90,000, I wrote 5 times (x + 6,000) = 90,000. From there, I solved it step by step."*
> ***Q:*** *"After getting the answer, did you double-check the result?"*
> ***S-1:*** *"Yes, I did. I plugged the value of x I obtained back into the original equation. If the result matches the one in the problem, it means the answer is correct. I think that is important, so I do not make a mistake when writing down the conclusion."*

The interview excerpt shows that S-1 not only followed the procedure but also demonstrated high metacognitive awareness by reading the problem twice to improve accuracy and performing back-substitution for verification. This profile confirms that metacognitive skills and verification are the key differentiators of high-level mathematical reasoning.

Subject S-2, who had moderate ability, was in a transitional phase between imitative and creative reasoning. He could understand and follow basic procedures but is not yet consistent in constructing independent arguments. The student could complete the initial indicators well but had difficulty organizing evidence, verifying, and providing in-depth justifications for each step of the mathematical solution to problem number 1, as shown in Figure 2.

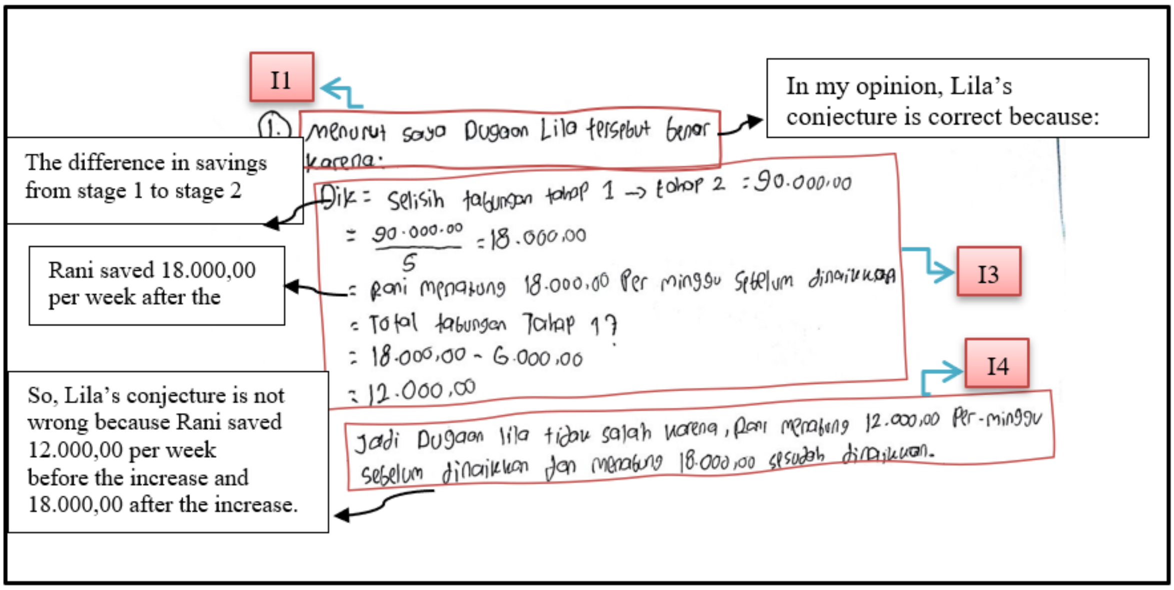

Figure 2. Results of S-2's moderate reasoning ability (Question 1)

Based on Figure 2, S-2 met the indicator of formulating a hypothesis by clearly writing down known and unknown information. However, regarding the mathematical manipulation indicator, S-2 was not yet able to construct a model from the word problem and perform algebraic operations accurately. The proof was reasonably coherent, although the explanation was not sufficiently detailed, and S-2 was able to conclude appropriately for the context. As for the validity check indicator, it was not met because there was no explicit verification of the answer. Overall, S-2 met most of the mathematical reasoning indicators but remained weak in verification and depth of reasoning. To deepen understanding of S-2's thought process, the researcher conducted an interview to explore how S-2 structured the solution steps and to understand the reasoning behind each written step.

> **Q:** *"In your answer just now, you wrote 90,000 divided by 5 equals 18,000. Can you explain why you divided by 5?"*
> **S-2:** *"Because the question mentioned that the difference in savings was 90,000, and that is the difference across five stages, so I divided by five, Sis, to get the value for one stage."*
> **Q:** *"While working on it, were you confident in your method?"*
> **S-2:** *"Actually, I was confused, Sir. Since there was no diagram, it was hard for me to visualize it."*
> **Q:** *"What do you mean?"*
> **S-2:** *"I understand it better if there is a diagram or illustration. If there is not one, I cannot visualize it, and I am unsure how to solve it."*

This interview excerpt confirmed that S-2 tried to use the information from the problem but was still unsure about the steps taken. S-2 also faced difficulties because there were no pictures to help them understand the problem. This indicates that S-2 still needed visual aids to make it easier to think through and solve problems.

Subject S-3, who had low ability, faced obstacles from the start in mathematical reasoning, particularly in connecting the word problem to a linear equation model. This was due to a weak understanding of prerequisite concepts, which caused the student to struggle to construct arguments and solve the problem logically. Consequently, the student was only able to begin the solution without completing it systematically, as weaknesses in the initial stage impacted subsequent stages of reasoning. The state of S-3's mathematical reasoning on problem number 1 is shown in Figure 3.

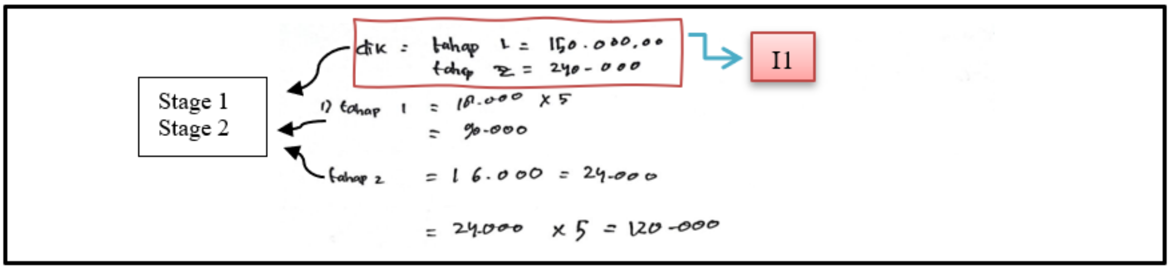

Figure 3. S-3's low-level reasoning response (Question 1)

S-3 could formulate a hypothesis by clearly writing down the known and asked information. S-3 could also set up variables and form equations, although there were still errors in the coefficients. However, S-3 struggled to construct proofs, made elimination errors, and failed to complete algebraic operations. S-3 was confused about the next steps and was unable to draw conclusions or verify the argument's validity.

> ***Q:*** *"Write down steps 1 and 2. Where did you start your calculations? Can you explain the steps?"*
> ***S-3:*** *"This is from the numbers 18,000 and 5 in the problem, Sir. I just multiplied them. Then, for step two, I wrote 16,000 equals 24,000. Then 24,000 multiplied by 5 equals 120,000."*
> ***Q:*** *"Where did you get the numbers 16,000 and 24,000? Can you explain?"*
> ***S-3:*** *"I am not exactly sure, Sir. I looked at the numbers in the problem, then I just tried adding them up. I am not sure where they came from; it just seemed to work out. Because there is no diagram in the problem."*

The interview excerpt shows that S-3 met only one indicator of mathematical reasoning, namely making a conjecture, and even that was limited to observing the numbers in the problem and then trying things out without a clear procedural basis. S-3's inability to read the problem thoroughly and visualize the situation in a word problem without an accompanying illustration prevented the construction of a mathematical model, resulting in the indicators of mathematical manipulation, proof construction, drawing conclusions, and validity checking not being met. These findings underscore the importance of visual-contextual learning media, such as ethnomathematics-based e-comics, as tools to help students represent problems meaningfully.

Subject S-4, categorized as having high ability, had not yet fully demonstrated optimal mathematical reasoning ability. However, compared to their classmates, S-4 showed the strongest performance. This student was only able to write down an initial guess; in subsequent steps, he continued to attempt to solve the problem using different methods, but these were unstructured and unclear. Consequently, the problem-solving process did not yield the correct result, so that at the conclusion stage, the answer obtained remained incorrect. S-4's mathematical reasoning on Problem 2 is shown in Figure 4.

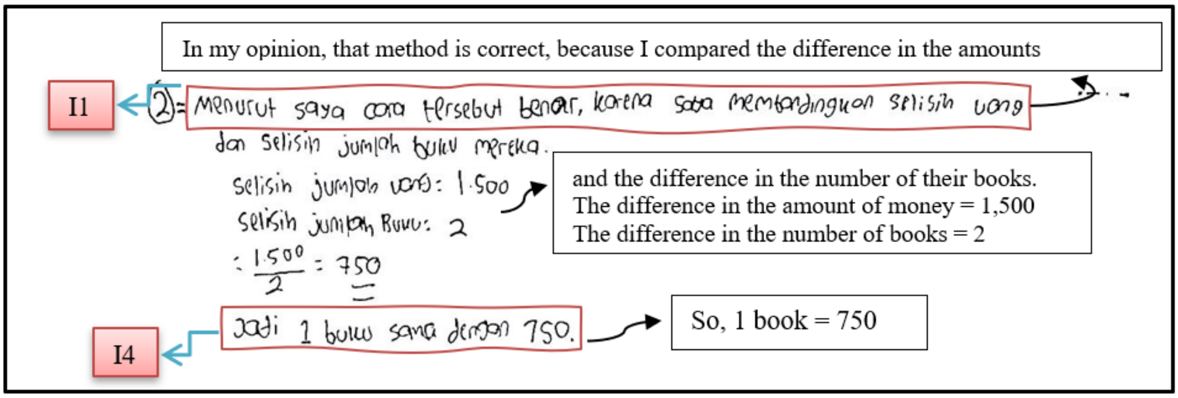

Figure 4. Results of S-4's higher-order reasoning ability (Question 2)

Subject S-4 demonstrated effort in solving the problem, although the procedure used was not yet appropriate. He met only the indicator for making correct assumptions but was not successful on the other indicators. The steps taken to solve the problem were often inaccurate and unstructured, leading to an incorrect conclusion. These findings were reinforced by the researcher's interview with S-4 after the test. S-4 answered each question confidently and in a structured manner:

> ***Q:*** *"Try to explain what you did first when you read this question?"*
> ***S-4:*** *"I read the information first, Sir. Sinta bought 4 books and had 2,000 left. Dinda bought 6 books and had 500 left. I immediately thought, the difference in their money is 1,500, and the difference in the number of books is 2."*
> ***Q:*** *"Then how did you solve it?"*
> ***S-4:*** *"I will just divide 1,500 by 2 because the difference in price between the books is 2. That was 150. So, the price of one book is 750."*
> ***Q:*** *"Are you sure about that method?"*
> ***S-4:*** *"I am not sure yet, Sis. If there were a picture or it were written more clearly, maybe I could understand better, instead of just using the difference like that."*

The interview results showed that S-4 had read and identified key information, such as the number of books and the remaining money. S-4 then determined the difference and immediately divided it to find the price of one book. Although the initial steps were correct, the strategy was not appropriate because it did not adhere to proper mathematical modeling. As a result, S-4 still drew a conclusion, but the result was incorrect. Additionally, S-4 also mentioned that they would find it easier to understand the problem if it included a picture, indicating that their reasoning is still limited and requires visual support.

Subject S-5 fell into the moderate ability category when compared to other students. In solving the problem, S-5 had not fully met the indicators of mathematical reasoning ability. He only demonstrated the ability to make a hypothesis and draw a conclusion, although the hypothesis presented is still not entirely accurate. This indicates that S-5 attempted to understand the problem and formulate an answer, but the reasoning process had not developed optimally, resulting in an inappropriate conclusion. The ability to read and understand the problem context comprehensively before beginning the solution is an aspect that needs to be explicitly trained in mathematics instruction, so that students with moderate ability do not get trapped in misinterpretations that derail their entire reasoning process (Lubis et al., 2025). S-5's mathematical reasoning on problem number 2 is shown in Figure 5.

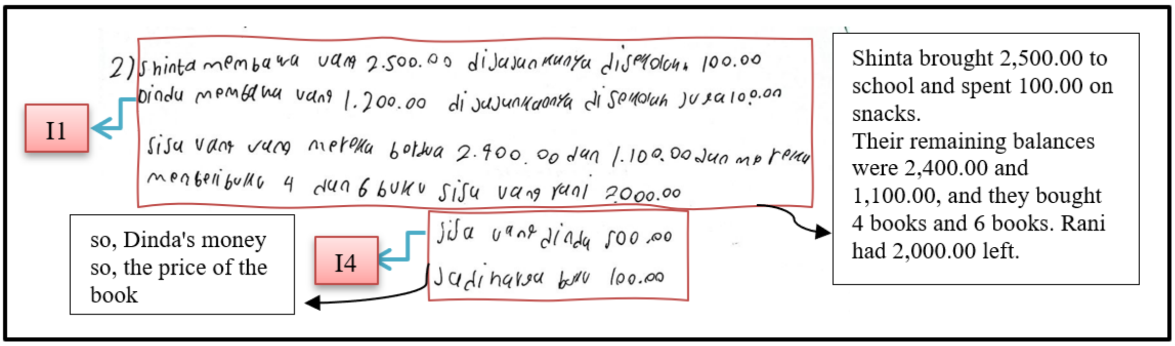

Figure 5. Response results for S-5's moderate reasoning ability (Question 2)

S-5 did not clearly and systematically write down the steps for solving the mathematical problem. He presented the answer only in sentence form, without accompanying supporting calculations. The sentences written were also inaccurate because they were not based on a correct understanding of the concepts. Consequently, the answers provided did not reflect the expected mathematical reasoning process. This situation differs from the typical pattern of students with moderate ability, who are usually able to start the problem-solving process correctly, even if they are weak in the verification stage. To examine the root causes of these errors, the researcher conducted an interview with S-5 after the test.

> **Q:** *"Try to explain where your answer came from?"*
> **S-5:** *"I assumed Sinta had 2,500, spent 100 on snacks, so she had 2,400 left, Sis."*
> **Q: "Is** *that from the question?"*
> **S-5:** *"No, I made it up myself."*
> **Q:** *"What does the actual problem say?"*
> **S-5:** *"Sinta bought 4 books and had 2,000 left, Dinda bought 2 books and had 500 left."*
> **Q:** *"Why didn't you use that?"*
> **S-5:** *"I did not read it all the way through, Sis. I just guessed."*

This interview excerpt shows that S-5's difficulty lies not only in the procedure but also in understanding the problem. S-5 did not read the problem all the way through and tended to guess by inventing numbers. As a result, the steps used did not match the information in the problem. This indicates that S-5 had not fully understood the problem, leading to an incorrect answer. This finding expands the characteristics of students with moderate ability, who are not only weak in verification but also prone to misinterpreting questions when the problem context is more complex and requires a deeper understanding of the text (Lubis et al., 2025). Afandi and Husna (2020) also found that students' cognitive styles influence their ability to interpret contextual problems, where students who tend to be field-dependent are more easily distracted by irrelevant elements of the problem, leading them to misidentify the focus of the solution.

Subject S-6 was a low-ability student who worked on Problem 2. Unlike other categories, S-6's difficulties were not only cognitive (weakness in algebraic procedures) but also communicative: S-6 was unable to express their thought processes verbally or in writing, so none of the reasoning indicators could be documented or evaluated. S-6's mathematical reasoning on Question 2 is shown in Figure 6.

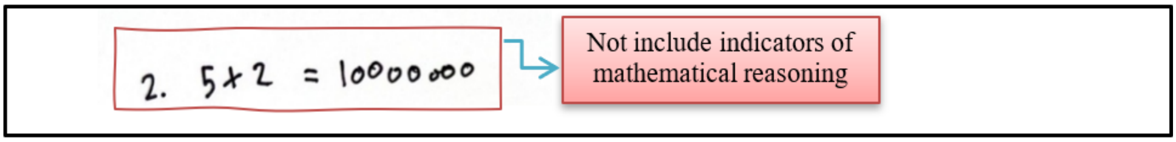

Figure 6. S-6's low reasoning ability response (Question 2)

Based on S-6's answer sheet in Figure 6 and the interview results, S-6 did not provide a single correct or relevant answer to Question 2. S-6's answer sheet did not include variable substitution, contained no equation model, and lacked any solution steps that could be categorized according to the question's context. Thus, S-6 did not meet any of the five mathematical reasoning indicators. Regarding the indicator of making conjectures (Indicator 1), S-6 was unable to identify known information or set up variables appropriately. Regarding the indicator for performing mathematical manipulations (Indicator 2), no algebraic operations could be evaluated. The indicators for constructing evidence (Indicator 3), drawing conclusions (Indicator 4), and checking the validity of arguments (Indicator 5) were also not met. This condition represents the most fundamental obstacle to mathematical reasoning, namely the inability to initiate the problem-solving process at all. The researcher sought to explore the obstacles S-6 experienced through an interview conducted after the test. However, during the interview session, S-6 did not utter a single word. None of the questions asked by the researcher received a verbal response from S-6. The following excerpt was taken from the interview:

> ***R:*** *"Tell me, when you were working on question number 2 just now, how far did you get?"*
> ***S-6:*** *[silent, no response]*
> ***P:*** *"It's okay, don't worry. Did you read the question just now? Which part did you find difficult?"*
> ***S-6:*** *[silent, no response]*

Student S-6 demonstrated serious difficulties in mathematical communication due to anxiety, evident in the inability to respond to questions during the interview. This condition indicated an affective barrier affecting the expression of thought, not merely conceptual difficulty. Based on the analysis of the answer sheet, S-6 was unable to answer any part of the problem, indicating that the student could not visualize the situation in the word problem. The absence of a visual representation of the problem prevented the student from identifying known information, setting up variables, or constructing even a simple mathematical model. Consequently, the reasoning profile was based solely on written responses that showed no indicators of reasoning. These findings underscore the need for holistic intervention: not only strengthening visualization skills and algebraic concepts but also providing emotional support. A safe learning environment, supportive feedback, engaging visual learning materials, and step-by-step tasks are essential for optimally building students' confidence and abilities.

The mathematical reasoning skills of eighth-grade students at a public junior high school in Jambi City were generally low (an average of 9.19 out of 40), with a consistent pattern: the higher the cognitive demands of an indicator, the lower the achievement. This finding aligns with the general condition of junior high school students in Indonesia (Natalia & Warmi, 2025; Nurhalin & Effendi, 2022; Sitepu et al., 2025), which suggests that this low level of reasoning stemmed from students' inability to visualize the situations described in word problems. When problems are presented as verbal narratives, students, particularly those with moderate or low ability, were unable to construct a mental image of the problem, thereby failing to build an appropriate mathematical model. This finding aligns with prior evidence that the most significant errors students made in word problems involving systems of linear equations occur during the comprehension stage (Comprehension Error), particularly when students are unable to write down what is known and fail to properly define variables. Without visual representation, the reasoning process stalls at the initial stage and cannot progress to proof or verification. This situation was exacerbated by learning that remains procedure-oriented: LEOV material is more often taught through lectures and routine problem-solving exercises, so students are not trained to develop arguments, make generalizations, and check their solutions (Sitepu et al., 2025).

The category profiles reinforced these visualization findings. High-ability students (S-1) were able to solve the problem because they could concretely visualize Rani's savings situation and model it into an equation. Conversely, students with moderate ability (S-2, S-5) struggled to construct a complete visual representation, resulting in solution steps that were not entirely accurate, and students with low ability (S-3, S-6) could not even begin the solution because they were unable to grasp the relationships between the components of the problem. The inability to visualize word problems was a fundamental cross-category barrier and the root cause of low performance across all reasoning indicators. Farib & Subianto (2019) and Salam (2020) confirmed that learning that encourages representation and exploration is more effective at developing reasoning than conventional approaches.

The implications of these findings point to the need for learning media that explicitly help students visualize the context of word problems before entering the mathematical modeling stage. Ethnomathematics-based e-comic media set in the Jambi context offered a promising alternative because they present mathematical problems in a visual-narrative format that is close to students' lives, thereby bridging the gap between verbal narratives and representations (Nusantara, Ibarra, et al., 2025; Nusantara, Ilma, et al., 2025). This locally contextualized approach has been shown to enhance student engagement and more authentic reasoning (Marfu'ah et al., 2022; Mendrofa et al., 2025; Widiani & Soepudin, 2025). Thus, the development of visual-contextual media is not merely a methodological innovation, but a direct response to the most fundamental cognitive barriers identified in this study.

CONCLUSION

This study concluded that the mathematical reasoning of eighth-grade students at a public junior high school in Jambi City in solving LEOV word problems remains low, as reflected by an average score of 9.19 out of 40, with 81.48% of students classified in the low category. Among the five reasoning indicators, formulating hypotheses showed the highest achievement (28.24%), whereas verifying the validity of arguments had the lowest achievement (9.72%). The reasoning profiles indicated that high-ability students consistently fulfilled all indicators, moderate-ability students were able to complete the initial stages but experienced difficulties in constructing proofs and verifying their solutions, while low-ability students were limited to basic procedures and were unable to complete the problem-solving process. A key finding of this study is that students' limited ability to visualize situations presented in LEOV word problems hindered the construction of appropriate mathematical models and disrupted the overall reasoning process. These findings should be interpreted in light of the study's limitations, including the small sample size from a single school, the limited number of test items, and the descriptive, non-intervention design. Future research should to develop instructional interventions, such as ethnomathematics-based e-comic learning media in the Jambi context, and to evaluate their effectiveness through separate development, validation, and experimental studies. It should be noted that these interventions were not developed or evaluated in the present study.

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