

Students' Metacognitive Regulation in Mathematical Modeling Based on Gender

Ely Aulia Haq^{1*}, Abadi², Janet Trineke Manoy³

^{1*}Universitas Negeri Surabaya, ely.23015@mhs.unesa.ac.id

²Universitas Negeri Surabaya, abadi@unesa.ac.id

³Universitas Negeri Surabaya, janetmanoy@unesa.ac.id

Submitted: 26 July 2025; Revised: 19 October 2025; Accepted: 27 November 2025

ABSTRACT

Metacognitive regulation is an essential component of mathematics learning, as it governs how students plan, monitor, and evaluate their thinking during problem-solving. This study aims to explore students' metacognitive regulation patterns in mathematical modeling based on masculine and feminine gender characteristics. A qualitative case study approach was employed, involving two purposively selected students one masculine male and one feminine female with comparable mathematical abilities. Data were collected through questionnaires, tests, mathematical modeling tasks, and semi-structured interviews, and analyzed according to the stages of the mathematical modeling process. Findings revealed that the masculine male student demonstrated efficient metacognitive regulation, emphasizing procedural accuracy and selective internal monitoring. He simplified the modeling process without compromising accuracy and showed confidence in validating his solutions. In contrast, the feminine female student exhibited reflective and comprehensive regulatory patterns, emphasizing contextual understanding and layered validation. She systematically constructed models and performed repeated checks on alternative solutions. These findings suggest a possible influence of gender characteristics on students' metacognitive regulation during mathematical modeling. The results are expected to inform the design of mathematics instruction that accommodates students' metacognitive diversity based on gender, enabling teachers to plan learning activities that foster both reflective and efficient self-regulated thinking. The study highlights the importance of recognizing gender-based metacognitive variations in mathematical modeling and encourages future research to further explore how gender-related cognitive traits interact with metacognitive regulation across diverse mathematical contexts.

Keywords: *Metacognitive regulation, mathematical modeling, gender*

Regulasi Metakognitif Siswa dalam Pemodelan Matematika Berdasarkan Gender

ABSTRAK

Regulasi metakognitif merupakan komponen penting dalam pembelajaran matematika karena berperan dalam mengatur bagaimana siswa merencanakan, memantau, dan

mengevaluasi pemikiran mereka selama pemecahan masalah. Penelitian ini bertujuan untuk mengeksplorasi pola regulasi metakognitif siswa dalam pemodelan matematika berdasarkan karakteristik gender maskulin dan feminin. Pendekatan yang digunakan adalah studi kasus kualitatif dengan melibatkan dua siswa yang dipilih secara purposif satu siswa laki-laki dengan karakteristik maskulin dan satu siswa perempuan dengan karakteristik feminin yang memiliki kemampuan matematika setara. Data dikumpulkan melalui angket, tes, tugas pemodelan matematika, dan wawancara semi-terstruktur, kemudian dianalisis berdasarkan tahapan proses pemodelan matematika. Hasil penelitian menunjukkan bahwa siswa laki-laki maskulin memperlihatkan regulasi metakognitif yang efisien, menekankan pada ketepatan prosedural dan pemantauan internal yang selektif. Ia menyederhanakan proses pemodelan tanpa mengorbankan ketepatan serta menunjukkan kepercayaan diri dalam memvalidasi solusinya. Sebaliknya, siswa perempuan feminin menunjukkan pola regulasi yang reflektif dan komprehensif dengan penekanan pada pemahaman kontekstual dan proses validasi yang berlapis. Ia menyusun model secara sistematis dan melakukan pemeriksaan berulang terhadap alternatif solusi. Temuan ini mengindikasikan adanya pengaruh karakteristik gender terhadap regulasi metakognitif siswa dalam pemodelan matematika. Hasil penelitian ini diharapkan dapat menjadi acuan dalam perancangan pembelajaran matematika yang mengakomodasi keragaman metakognitif siswa berdasarkan karakteristik gender, sehingga guru dapat merancang kegiatan belajar yang menumbuhkan pemikiran reflektif dan efisien secara bersamaan. Studi ini juga menegaskan pentingnya mengenali variasi metakognitif berbasis gender dalam pemodelan matematika serta mendorong penelitian lanjutan untuk mengkaji lebih jauh interaksi antara karakteristik kognitif berbasis gender dan regulasi metakognitif dalam berbagai konteks matematika.

Kata Kunci: *Regulasi Metakognitif, Pemodelan Matematika, Gender*

How to cite: Haq, E.A., Abadi, Manoy, J.T. (2025). Students' Metacognitive Regulation in Mathematical Modeling Based on Gender. *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, 9(2), 197-210. <https://doi.org/10.26740/jrpipm.v9n2.p197-210>

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1. Introduction

Metacognitive regulation is a crucial aspect of mathematics learning, as it directly influences students' ability to plan, monitor, and evaluate their cognitive processes during problem-solving. [Flavell \(1979\)](#) defined metacognitive regulation as part of metacognition that enables learners to consciously control their thinking strategies. In mathematical contexts, this regulation supports students in organizing their reasoning, tracking their progress, and reflecting on the accuracy of their solutions ([Schraw & Moshman, 1995](#)).

Mathematical problem-solving is not limited to the application of formulas or procedures; it requires reflective awareness of how and why a strategy is used. One mathematical activity that demands this reflective awareness is mathematical modeling, which involves transforming real-world situations into mathematical representations, solving them, and interpreting the results in context ([Blum & Leiß, 2006](#)). Through modeling, students must constantly regulate their understanding selecting relevant information, constructing assumptions, and validating results.

However, previous studies have shown that many students encounter difficulties in constructing appropriate mathematical models ([Khairunnisa & Setyaningsih, 2017](#); [Muntaha et al., 2020](#)). They often struggle to connect contextual information with mathematical concepts,

leading to inaccurate models or irrelevant conclusions. Such difficulties are frequently attributed to insufficient metacognitive regulation during key modeling stages, particularly in planning and evaluation.

The system of linear equations in two variables is one mathematical topic that naturally incorporates modeling contexts. It requires students to represent real-world relationships symbolically and solve them systematically. Nevertheless, field observations show that many students still have difficulty modeling problems correctly, especially in the subject of two-variable linear equation systems. They fail to identify key information, misinterpret relationships between variables, or neglect to validate their answers symptoms of metacognitive regulation engagement.

These findings imply variations in students' metacognitive regulation strategies, which may be influenced by gender-related factors ([Ma'rifah et al., 2021](#); [Rismawati et al., 2023](#)). Research has revealed that female students tend to exhibit stronger monitoring and evaluation behaviors, while male students are often more focused on efficiency and procedural completion ([Henra, 2025](#)). Despite these insights, most studies categorize gender only in biological terms (male-female), overlooking the psychological dimensions of gender identity.

From a psychological standpoint, gender is not merely a biological construct but a social and cognitive schema that shapes one's behavior, preferences, and thinking patterns ([Bem, 1974](#)). Masculine and feminine traits exist across individuals regardless of biological sex, influencing how they approach and regulate cognitive tasks. Thus, understanding gender through this psychological lens can offer deeper insight into students' metacognitive behaviors in mathematical settings.

The research gap lies in the limited exploration of how *psychological gender constructs*-masculinity and femininity-affect metacognitive regulation within mathematical modeling tasks. While prior research has examined gender differences in general problem-solving ([Zuhairini et al., 2023](#); [Rismawati et al., 2023](#)), few have analyzed these patterns through the lens of gender schema theory or within a modeling context such as the system of linear equations in two variables (SLETV).

This gap indicates an academic urgency to investigate metacognitive regulation not merely by biological sex but by the underlying psychological gender characteristics that may drive cognitive strategies. Exploring this dimension could provide a more nuanced understanding of students' thought regulation and open pathways for gender-sensitive mathematics pedagogy.

The practical urgency of this research is also significant. Understanding how masculine and feminine traits influence metacognitive regulation can help teachers design instruction that aligns with diverse cognitive preferences. For instance, students with masculine traits may benefit from structured reflection activities, while those with feminine traits might excel through tasks that emphasize planning and systematic validation.

Therefore, the present study aims to explore the metacognitive regulation of students in mathematical modeling of SLETV based on masculine and feminine gender characteristics. Specifically, it seeks to describe how students plan, monitor, and evaluate their cognitive processes throughout the modeling stages. The findings are expected to contribute to theoretical understanding of gendered cognition and provide practical implications for improving metacognitive-based mathematics instruction.

2. Methods

This study employs a qualitative case study approach to explore students' metacognitive regulation during mathematical modeling of systems of linear equations in two variables. Two students were purposively selected: one masculine male and one feminine female with equivalent mathematical abilities. These two gender types were chosen to represent contrasting

cognitive orientations as described by Bem's Gender Schema Theory ([1974](#)), which emphasizes how masculine and feminine traits distinctly influence cognitive and metacognitive functioning. The androgynous type was excluded to avoid overlapping gender traits that might obscure the clarity of comparison between distinctly gendered metacognitive regulation patterns. Gender characteristics were identified using the Bem Sex-Role Inventory (BSRI), and mathematical ability was determined through a test adapted from national examination items.

Research instruments consisted of the gender inventory, mathematics ability test, mathematical modeling task, and semi-structured interview guide. The modeling task was constructed based on the six stages of [Blum and Leiß's \(2006\)](#) modeling process, with metacognitive regulation indicators including planning, monitoring, and evaluation. Instrument validity was examined by two experts using Aiken's V index, with item clarity, relevance, and representativeness as validity indicators; results showed $V \geq 0.8$, indicating strong validity.

Data analysis followed [Miles and Huberman's \(1994\)](#) interactive model, consisting of data reduction, data display, and conclusion drawing. Each stage was further interpreted according to the modeling process: understanding, simplifying, mathematizing, solving, interpreting, and validating to reveal how students' metacognitive regulation manifested across modeling phases.

3. Results and Discussion

These findings were aligned with the indicators of metacognitive regulation in mathematical modeling based on [Blum and Leiß's \(2006\)](#) framework, which consists of understanding, simplifying/formulating, mathematizing, working mathematically, interpreting, and validating.

3.1 Metacognitive Regulation of a Masculine Male Student in Mathematical Modeling of SLETV Problems

Based on the results of the study, several findings were identified regarding students' metacognitive regulation in mathematical modeling. The findings indicate that students' metacognitive regulation in the modeling process involves several key aspects, including planning, monitoring, and evaluation.

3.1.1 Understanding

In the Understanding, under the planning aspect, the masculine male student chose to read the problem thoroughly and repeatedly. He recognized the complexity of the problem due to the abundance of information, realizing that a single reading was insufficient. This strategy demonstrates early awareness of the importance of developing a comprehensive understanding before moving on to the next stage. According to [Moos and Ringdal \(2012\)](#), the goal of this stage is to help students formulate goals by developing questions based on the problem. This aligns with [Meijer et al. \(2006\)](#), who state that paying attention to information and questions within the problem facilitates the determination and construction of solution steps, selection of relevant sources, and design of appropriate strategies. In the monitoring process, the student was aware of his confusion. He admitted that he initially did not understand the core of the problem but did not stop there. In line with [Meijer et al. \(2006\)](#), monitoring serves to identify difficulties and optimize the use of relevant information needed for problem-solving. According to [Metcalf \(2009\)](#) and [Serra & Metcalfe \(2009\)](#), monitoring involves deep adjustments to declarative, procedural, and conditional knowledge to select appropriate steps and enhance problem comprehension. The purpose of evaluation, as demonstrated by the student, is to ensure the accuracy of the knowledge acquired and the appropriateness of the strategy applied ([Schraw](#)

& Moshman, 1995). This finding supports research by [Zuhairini et al. \(2023\)](#), which showed that both male and female students actively engage in planning, monitoring, and evaluating their understanding of problems. However, in this study, the masculine male student's metacognitive regulation appeared more as detailed internal reflection such as repeated reading, awareness of misunderstood information, and rechecking comprehension.

3.1.2 Simplifying/Structuring

In the simplifying/structuring, the masculine male student demonstrated the ability to manage contextual information and reorganize it into a more structured and relevant form to construct a mathematical model. During the planning stage, he focused on information he deemed important. Although he did not explicitly write a situational model, he built one internally, drawing on elements he found relevant for solving the problem. He was initially unaware of stating assumptions, but once prompted, he was able to articulate that the goods to be purchased must meet the needs of the 28 students in the class. This indicates that the simplification plan was carried out intuitively and contextually. In solving the problem, the student followed [Blum's \(2006\)](#) modeling steps by simplifying and constructing a situational model before proceeding to the next stages. The key finding at this stage is that while the masculine male student did not write an explicit situational model, he was able to filter essential information and think efficiently, directing his focus immediately toward a solution strategy.

3.1.3 Mathematization

Handwritten mathematical work showing the student's process of solving a system of linear equations in two variables (SLTV). The work includes two columns of equations, with the left column showing the elimination method and the right column showing the substitution method. The student uses variables x and y , and includes a green box labeled 'M3' on the right side.

Left Column (Elimination Method):

$$\begin{aligned} x + 2y &= 32.000 \\ 2x + 2y &= 43.250 \\ \hline -2x &= -17.000 \\ -x &= 8.500 \\ x &= 8.500 \end{aligned}$$

$$\begin{aligned} 8.500 + 2x &= 32.000 \\ 8.500 + 2(8.500) &= 32.000 \\ 8.500 + 17.000 &= 32.000 \\ 25.500 &= 32.000 \end{aligned}$$

$$\begin{aligned} 2x + 2y &= 43.250 \\ 17.000 + 25.500 &= 43.250 \\ 42.500 &= 43.250 \end{aligned}$$

$$\begin{aligned} -2x &= -17.260 \\ -x &= 8.625 \\ x &= 8.625 \end{aligned}$$

$$\begin{aligned} 8.625 + 2y &= 32.000 \\ 8.625 + 2y - 8.625 &= 32.000 - 8.625 \\ 2y &= 23.375 \\ y &= 11.687,5 \end{aligned}$$

Right Column (Substitution Method):

$$\begin{aligned} 8.500 + 2y &= 32.000 \\ 8.500 + 2y - 8.500 &= 32.000 - 8.500 \\ 2y &= 23.500 \\ y &= 11.750 \end{aligned}$$

Figure 1. Masculine male students' responses at the mathematization

In the mathematization stage that showed in Figure 1, in terms of planning, the masculine male student defined variables x and y to represent the prices of a millimeter blocks and compasses, respectively, and then formulated two equations based on the information from the purchase receipt. He stated that the choice of using a system of linear equations in two variables was made because it aligned with the available information and facilitated the search for a solution. This indicates the presence of a deliberate strategy in selecting appropriate mathematical representation and formulating relationships between variables. This finding is consistent with the study by [Cárcamo-Mansilla and Aravena-Díaz \(2024\)](#), which found that students with good metacognitive regulation are able to plan appropriate forms of representation and perform initial validations of the models they construct. In the monitoring aspect, the masculine male student stated that he did not encounter difficulties while constructing the mathematical model, but he still reviewed whether each coefficient and constant in the

equations aligned with the given information. He conducted this verification to ensure there were no logical or numerical errors in translating the contextual situation into mathematical symbols.

3.1.4 Working Mathematically

$$\begin{array}{l}
 x + y = 32.000 \\
 2x + 2y = 49.250 \\
 \hline
 -x = -17.250 \\
 x = 17.250 // \\
 17.250 + 2y = 32.000 \\
 19.250 + 2y = 32.000 - 17.250 \\
 2y = 14.750 \\
 y = 7.375 // \\
 17.250 + 2 \times 7.375 = 32.000
 \end{array}$$

Figure 2. Masculine male students' responses at the working mathematically

At the working mathematically, the masculine male student began by planning a solution strategy using the elimination and substitution methods, which he considered the easiest and most efficient approaches. This choice was not made arbitrarily but was based on his prior experience and understanding of the characteristics of systems of linear equations in two variables. This indicates that the student possesses strong procedural knowledge and is capable of independently devising a problem-solving plan. In terms of monitoring, the masculine male student consciously checked each step of his calculations, demonstrating caution regarding potential computational or logical errors. During the evaluation phase, he assessed that the steps he had taken were correct and mathematically sound. He was not merely satisfied with finding the solution but also ensured that the solution could be meaningfully connected back to the contextual meaning of the problem namely, the unit prices of each item. This indicates a comprehensive evaluation of both the procedures and outcomes, reflecting a mature level of metacognitive regulation. These findings align with the study by [Stephanou and Mpiontini \(2017\)](#), which showed that students with strong metacognitive regulation engage in systematic monitoring and evaluation of their thinking processes, particularly when solving mathematical problems that require structural understanding, such as systems of linear equations in two variables.

3.1.5 Interpreting

$$\begin{array}{l}
 x = 17.250 // \quad 17.250 + 2y = 32.000 - 17.250 \\
 2y = 14.750 \\
 y = 7.375 // \\
 17.250 + 2 \times 7.375 = 32.000 \\
 17.250 + 14.750 = 32.000 \\
 32.000 = 32.000 // \\
 2 \times 17.250 + 2 \times 7.375 = 49.250 \\
 34.500 + 14.750 = 49.250 \\
 49.250 = 49.250 // \\
 46.250 \times 14 = 648.130 \\
 648.130 : 28 = 23.147,5
 \end{array}$$

Figure 3. Masculine male students' responses at the interpreting

In the interpreting, During the planning process, he explained that the calculated values of variables x and y would be interpreted as the unit prices of millimeter blocks and compasses, respectively, and these would be used to compare the total purchase costs between unit prices

3.2 Metacognitive Regulation of a Feminine Female Student in Mathematical Modeling of SLETV Problems

3.2.1 Understanding

In the *understanding*, in terms of planning, the feminine female student carefully read the problem thoroughly and repeated the reading several times, indicating a cautious approach in constructing her understanding. She consciously identified key information such as the contents of the receipt, unit prices, students' needs, and the goal of the problem. Even when the information was not presented explicitly, she still attempted to extract meaning through repeated reading and logical interpretation. This finding is consistent with the study by [Stephanou & Mpiontini \(2017\)](#), which showed that female students tend to use metacognitive regulation more explicitly and reflectively, particularly during processes of reading, elaborating, and evaluating information from contextual problems. In terms of monitoring, the feminine female student demonstrated close oversight of her understanding process. She became aware when she had not fully grasped the purpose of the problem and chose to reread and connect different pieces of information. Once she felt confident, she stated that there was no part of the problem that was confusing, indicating a conscious reflection on her initial comprehension. According to the mathematical modeling framework of [Blum & Leiß \(2006\)](#), the first stage (understanding the problem) requires students to identify relevant information and build an initial understanding of the problem context. The feminine female student exhibited strong regulation in connecting explicit and implicit information from the problem and in considering the final goal of the solution. Regarding evaluation, the student compared her understanding with the context and objectives of the problem. She affirmed that no information was missed or misunderstood after repeated reviews and careful consideration. In this case, the student not only understood the problem content but also actively validated her comprehension before proceeding to the next stage. A unique aspect observed in the feminine female student's data was her ability to identify problems that did not present explicit procedures. From the perspective of Bem's gender schema theory ([1974](#)), feminine traits such as empathy, caution, and reflection appeared to influence how the student thoroughly understood the problem before taking action. This became a strength in the early stages of metacognitive processing. The problem understanding stage in the feminine female student showed structured, reflective, and explicit metacognitive regulation

3.2.2 Simplifying/Structuring

M2

Based on the given information:

Package 1: 1 millimeter blocks + 2 compasses = 32,000

Package 2: 2 millimeter blocks + 2 compasses = 49,250

For students, a 6% discount is applied to each purchase of Package 2, provided that more than 12 packages are purchased.

Each student needs 10 sheets of millimeter block and 1 compass.

Help the class coordinator determine which package is more economical to buy and how much each student should contribute.

There are 28 students in the class.

Each millimeter block contains 20 sheets.

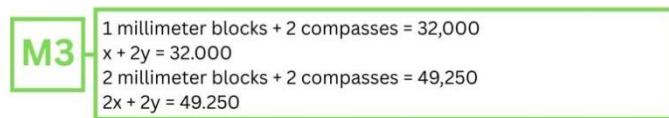
Determine the price of each item first.

1. Identify the total needs (each student requires 10 sheets of millimeter block and 1 compass).
2. Find the most cost-effective option.

Figure 5. Feminine female students' answers at the simplifying/structuring

At the stage of *simplifying or constructing*, the feminine female student demonstrated a systematic and reflective process of metacognitive regulation. She planned her initial strategy by rewriting key information from the problem into a simpler and more structured form. A unique finding from the feminine female student lies in her conscious and directed ability to eliminate irrelevant information. Rather than merely copying the given data, she selected which information was essential and aligned with the purpose of the problem. In terms of monitoring, the feminine female student actively checked the consistency between the original information and the model she constructed. She explained that the simplification process did not alter the meaning of the information but instead summarized the key points to make them easier to analyze. According to interview, the feminine female student emphasized that she was confident the form and presentation of the important information were sufficient to proceed with the solution process. This evaluation shows that she did not merely reproduce the given information but consciously structured the situation coherently with the problem's requirements. The feminine female student also showed a tendency to rewrite information as part of her strategy. This suggests that students with feminine characteristics are more inclined to apply an externalization of thinking strategy, that is, constructing models through writing or visualization as a means of understanding and managing their thinking processes. From the perspective of the mathematical modeling theory by [Blum and Leiß \(2006\)](#), the stage of simplifying/building a model serves as a bridge between the real world and the mathematical world. In this case, the feminine female student was not only engaged in the technical process of filtering information but also reflected on the accuracy of her representation of the real-world situation.

3.2.3 Mathematizing



M3	1 millimeter blocks + 2 compasses = 32,000
	$x + 2y = 32.000$
	2 millimeter blocks + 2 compasses = 49,250
	$2x + 2y = 49.250$

Figure 6 Feminine female students' answers at the mathematization

In the *mathematization*, in terms of planning, the feminine female student determined the variables and constructed two linear equations based on the information she had previously simplified. The uniqueness of this finding lies in the student's ability to clearly and consistently relate each symbolic element to its contextual meaning. During the monitoring process, the student demonstrated control over the accuracy of transforming verbal information into symbolic form. She stated that she rechecked the two equations she wrote to ensure there were no errors in data substitution or price referencing. The student did not proceed directly to the solution stage; instead, she first ensured that the model she had built truly represented the real situation. She evaluated that the model was appropriate because it accurately described the relationship between the price of pencils and erasers with the total purchase value under two different conditions. These results align with the theory of [Schraw and Moshman \(1995\)](#), which posits that metacognitive regulation particularly evaluation involves assessing one's thinking process and problem-solving outcomes. Similarly, [Meijer et al. \(2006\)](#) emphasized that evaluation should not only focus on final outcomes but also on the process through which a solution is developed. This finding is also consistent with the study by [Cárcamo-Mansilla and Aravena-Díaz \(2024\)](#), which showed that students with high metacognitive awareness tend to be more systematic in constructing mathematical models and reflecting on their accuracy. Moreover, the result supports the study by [Stephanou and Mpiontini \(2017\)](#), who found that female students tend to be more meticulous in connecting mathematical symbols to contextual meanings and are more inclined to conduct thorough evaluations before making decisions. However, this result does not fully align with the findings of [Khusna et al. \(2021\)](#), which

indicated that students often struggle to connect contextual information to appropriate equations and rarely reflect on the accuracy of the models they construct.

3.2.4 Working Mathematically

M4

$$\begin{aligned} x + 2y &= 32.000 \\ 2x + 2y &= 49.250 \\ \hline -1x &= -17.250 \\ x &= 17.250 \\ x + 2y &= 32.000 \\ 17.250 + 2y &= 32.000 \\ 2y &= 32.000 - 17.250 \\ 2y &= 14.750 \\ y &= 7.375 \end{aligned}$$

M4

$$\begin{aligned} x + 2y &= 32.000 \\ 17.250 + 2 \cdot 7.375 &= 32.000 \\ 17.250 + 14.750 &= 32.000 \\ 32.000 &= 32.000 \end{aligned} \quad \begin{aligned} 2x + 2y &= 49.250 \\ 2 \cdot 17.250 + 2 \cdot 7.375 &= 49.250 \\ 34.500 + 14.750 &= 49.250 \\ 49.250 &= 49.250 \end{aligned}$$

Figure 7. Feminine female students' answers at the working mathematically

In the *working mathematically*, from the planning aspect, the feminine female student explicitly stated that she would use the elimination or substitution method because she felt more familiar with those approaches. During the monitoring process, she demonstrated active oversight of the steps being executed. The student carefully checked her calculations, ensuring the correctness of each step. This indicates a high level of self-regulation and control over her own thinking processes. The evaluation process was also clearly evident in the student's actions, as she reflected on the accuracy of the results in relation to the contextual model. After obtaining the variable values, she rechecked the results and compared them with the values provided in the problem. This behavior reinforces the metacognitive regulation theory of evaluation proposed by [Schraw and Moshman \(1995\)](#), which describes the process of assessing the effectiveness of the strategies used and the outcomes achieved, both logically and contextually. This finding is consistent with the study by [Zuhairini et al. \(2023\)](#), which reported that female students tend to be more systematic in solving mathematical problems and often exhibit a high level of reflective ability during the evaluation of their results.

3.2.5 Interpreting

M5

So, the price of one millimeter block is Rp17,250, and the price of one compass is Rp7,375.

Discount:

$$\begin{aligned} 6\% \times 49.250 \\ \frac{6\% \times 49.250}{100} \\ \frac{295.500}{100} = 2.955 \end{aligned}$$

So, the discounted price is $49,250 - 2,955 = 46,295$.
Therefore, Package 1 costs 32,000, and Package 2, after a 6% discount, costs 46,295.

Figure 8. Feminine female students' answers at the interpreting

At the *interpreting* stage, in terms of planning, the feminine female student explicitly stated that the results of the calculations must be linked back to the original purpose of the problem, namely to determine the most efficient contribution per student. She did not stop at obtaining

the values of x and y as the solutions of the linear system, but interpreted these values within the original context, demonstrating an initiative to design an interpretation strategy based on efficiency and practical relevance. Regarding monitoring, the student actively oversaw her interpretation process by examining whether the results truly addressed the problem's needs. She evaluated the outcome not only mathematically but also in terms of practicality and efficiency. In the evaluation aspect, the feminine female student reflected on the obtained solution and concluded that the best decision was to purchase the items individually, as it resulted in a lower total contribution. She confidently expressed this decision after conducting a quantitative comparison and considering practical needs. This indicates that the student evaluated the solution not only in numerical terms but also through a realistic contextual lens. These findings are consistent with the study by [Stephanou and Mpiontini \(2017\)](#), which found that female students tend to be more reflective and consider social contexts when making mathematics-based decisions. Additionally, this reinforces [Flavell's \(1979\)](#) metacognitive theory, which emphasizes that metacognition involves not only awareness of strategies but also the ability to evaluate their effectiveness and outcomes in real-world situations.

3.2.6 Validating

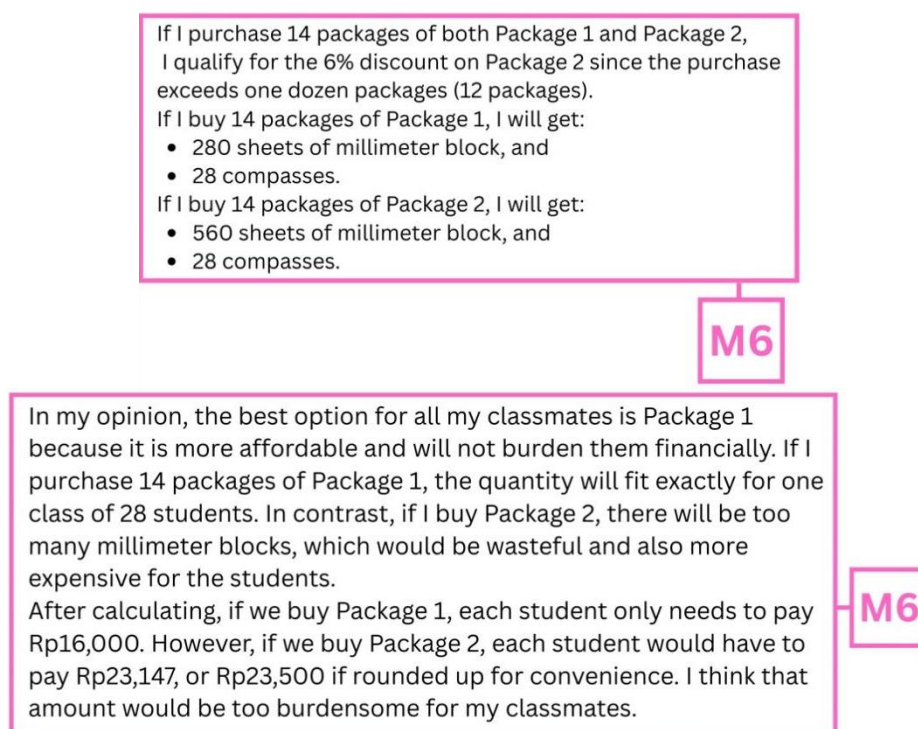


Figure 9. Feminine female students' answers at the validating

At the *validating* stage, in terms of planning, the feminine female student consciously devised a strategy to re-examine the calculation results by aligning them with the original goal determining the amount of contribution per student. She identified that the final decision had to consider the two available options presented in the problem. She also reassessed whether all relevant information had been utilized and ensured that no essential details were overlooked. This process reflects a monitoring approach focused on accuracy and the completeness of both mathematical and narrative representations. In the evaluation aspect, the feminine female student concluded that the constructed mathematical model was accurate and required no revisions, as all stages had been carried out carefully, and the results were deemed reasonable and efficient within the classroom context. She also acknowledged that the solution was flexible, yet still valid as long as the context remained unchanged. These findings support the

metacognitive regulation theory by [Schraw and Moshman \(1995\)](#), which emphasizes that final evaluation should include a review of the overall logical coherence and the appropriateness of the strategies used. Moreover, this result aligns with [Stephanou and Mpiontini \(2017\)](#), who found that female students often exhibit deeper internal validation through reflection on alternative solutions and contextual feasibility. Interestingly, the finding contrasts with [Khusna et al. \(2021\)](#), who reported that students often stop once a numerical answer is obtained without engaging in further contextual validation. In this study, the feminine female student treated validation as a critical reflective process before finalizing the solution.

4. Conclusion

The findings of this study indicate that gender characteristics can influence students' metacognitive regulation patterns in mathematical modeling, where masculine male students tend to exhibit strong efficiency and self-control, while feminine female students demonstrate reflective and contextually deep thinking. The implication of these findings is that teachers should consider gender-based metacognitive tendencies in mathematics instruction and design activities that balance efficiency and reflectiveness, enabling students to develop accurate strategies alongside contextual awareness in problem-solving. The limitation of this study lies in the small number of participants, with only two students representing two contrasting gender types, and the exclusion of the androgynous type, so the results cannot be generalized. Nevertheless, the study provides an initial illustration of students' metacognition based on gender, while more diverse metacognitive characteristics remain unexplored. For future research, it is recommended to involve a larger number of participants with more varied gender backgrounds, including androgynous or undifferentiated types, to explore the relationship between gender identity, metacognitive regulation, and mathematical performance across different learning contexts.

5. References

- Bem, S. L. (1974). The measurement of psychological androgyny. *Journal of consulting and clinical psychology*, 42(2), 155–162. <https://doi.org/10.1037/h0036215>
- Blum, W., & Leiß, D. (2006). “Filling Up”-The Problem of Independence-Preserving Teacher Interventions in Lessons with Demanding Modelling Tasks. *Proceedings of the 4. Conference of the European Society for Research in Mathematics Education*, 1623–1633. https://www.academia.edu/download/75423415/CERME4_WG13.pdf#page=13
- Boaler, J. (2001). Mathematical Modelling and New Theories of Learning. *Teaching Mathematics and Its Applications*, 20(3), 121–128.
- Cárcamo-Mansilla, N., & Aravena-Díaz, M. D. (2024). Metacognitive Strategies for Mathematical Modeling with Engineering Groups of Students: Adaptation and Validation of a Questionnaire. *International Journal of Cognitive Research in Science, Engineering and Education*, 12(1), 41–55. <https://doi.org/10.23947/2334-8496-2024-12-1-41-55>
- Chotim, E. E. (2020). Kesetaraan Gender Dan Pemberdayaan Perempuan di Indonesia: Keinginan Dan Keniscayaan Pendekatan Pragmatis (Studi Terhadap UKM Cirebon Home Made). *Akselerasi: Jurnal Ilmiah Nasional*, 2(1), 70-82. <https://doi.org/10.54783/jin.v2i1.357>
- Flavell, J. H. (1979). Metacognition and Cognitive Monitoring: A New Area of Cognitive-Developmental Inquiry A Model of Cognitive Monitoring. *American psychologist*, 34(10), 906. <https://doi.org/10.1037/0003-066x.34.10.906>

- Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest, Supplement*, 8(1), 1–51. <https://doi.org/10.1111/j.1529-1006.2007.00032.x>
- Handayani, B., & Daherman, Y. (2020). Wacana Kesetaraan Gender: Kajian Konseptual Perempuan Dan Pelaku Media Massa. *Jurnal Ranah Komunikasi (JRK)*, 4(1), 106-121. <https://doi.org/10.25077/rk.4.1.106-121.2020>
- Henra, K., Budayasa, I. K., & Ismail. (2024). Revealing the dominant metacognitive activities of high school students in solving central tendency and dispersion problems based on gender. *Journal on Mathematics Education*, 15(4), 1357–1382. <https://doi.org/10.22342/jme.v15i4.pp1357-1382>
- Khairunnisa, R., & Setyaningsih, N. (2017). Analisis Metakognisi Siswa dalam Pemecahan Masalah Aritmatika Sosial Ditinjau dari Perbedaan Gender. *Prosiding Konferensi Nasional Penelitian Matematika dan Pembelajarannya*, 465–474.
- Khusna, H., Ulfah, S., Merdeka, J. T., Rambutun, K., & Id, H. A. (2021). Kemampuan Pemodelan Matematis dalam Menyelesaikan Soal Matematika Kontekstual. *Mosharafa: Jurnal Pendidikan Matematika*, 10(1), 153-164. <https://doi.org/https://doi.org/10.31980/mosharafa.v10i1.649>
- Lesh, R. A., & Doerr, H. M. (2003). Beyond Constructivism Models and Modeling Perspectives on Mathematics Problem Solving, Learning, and Teaching. *Mathematical thinking and learning*, 5(2), 211-233. <https://doi.org/https://doi.org/10.4324/9781410607713>
- Ma'rifah, N., Sutawidjaja, A., & Sulandra, I. M. (2021). Analisis Keterampilan Metakognisi Siswa dalam Memecahkan Masalah SPLDV di SMP Negeri 4 Malang. *Jurnal Kajian dan Pembelajaran Matematika*, 5(2), 54-62. <https://journal2.um.ac.id/index.php/jkpm/article/view/26508/>
- Meijer, J., Veenman, M. V. J., & van Hout-Wolters, B. H. A. M. (2006). Metacognitive activities in text-studying and problem-solving: Development of a taxonomy. *Educational Research and Evaluation*, 12(3), 209–237. <https://doi.org/10.1080/13803610500479991>
- Metcalf, J. (2009). Metacognitive judgments and control of study. *Current Directions in Psychological Science*, 18(3), 159–163. <https://doi.org/10.1111/j.1467-8721.2009.01628.x>
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). SAGE Publications.
- Moos, D. C., & Ringdal, A. (2012). Self-regulated learning in the classroom: A literature review on the teacher's role. *Education Research International*, 2012, 423284. <https://doi.org/10.1155/2012/423284>
- Muntaha, A., Wibowo, T., & Kurniasih, N. (2020). Analisis Kesulitan Siswa Dalam Mengonstruksi Model Matematika Pada Soal Cerita. *Jurnal Maju*, 7(2), 53–58.
- Muttaqin, A. (2020). Women's identity in the digital islam age: Social media, new religious authority, and gender bias. *Qudus International Journal of Islamic Studies*, 8(2), 353–388. <https://doi.org/10.21043/qijis.v8i2.7095>
- Retnawati, H. (2016). *Analisis Kuantitatif Instrumen Penelitian*. Parama Publishing.
- Rismawati, I., Rahayuningsih, S., & Wiyono, H. J. (2023). *Analisis Kemampuan Pemodelan Matematis Siswa Dalam Menyelesaikan Soal Cerita Materi SPLTV Kelas X Ditinjau Dari Gender*. Doctoral dissertation, Universitas Islam Majapahit.
- Schraw, G., & Dennison, R. S. (1994). Assessing Metacognitive Awareness. *Contemporary Educational Psychology*, 19(4), 460–475. <https://doi.org/https://doi.org/10.1006/ceps.1994.1033>

- Schraw, G., & Moshman, D. (1995). Metacognitive Theories. In *Educational Psychology Review (Vol. 7, Issue 4)*.
- Serra, M. J., & Metcalfe, J. (2009). Effective implementation of metacognition. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 278–298). Routledge.
- Stephanou, G., & Mpiontini, M. H. (2017). Metacognitive knowledge and metacognitive regulation in self-regulatory learning style, and in its effects on performance expectation and subsequent performance across diverse school subjects. *Psychology*, 8(12), 1941-1975. <https://doi.org/10.4236/psych.2017.812125>
- Suharyono, E., & Rosnawati, R. (2020). Analisis buku teks pelajaran matematika SMP ditinjau dari literasi matematika. *Mosharafa: Jurnal Pendidikan Matematika*, 9(3), 451-462. <https://doi.org/10.31980/mosharafa.v9i3.628>
- Zakiah, N. E. (2020). Level kemampuan metakognitif siswa dalam pembelajaran matematika berdasarkan gaya kognitif. *Jurnal Riset Pendidikan Matematika*, 7(2), 132–147. <https://doi.org/10.21831/jrpm.v7i2.30458>
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into practice*, 41(2), 64-70. https://doi.org/10.1207/s15430421tip4102_2
- Zuhairini, L., Rahardi, R., & Irawati, S. (2023). Metakognisi Siswa MTs dalam Menyelesaikan Masalah Sistem Persamaan Linear Dua Variabel (SPLDV) Berdasarkan Gender. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(3), 3262-3274. <https://doi.org/10.31004/cendekia.v7i3.2462>