

Students' Mathematical Problem-Solving Processes Across Self-Efficacy Levels in High School

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Abstract. *Mathematical problem-solving ability is an essential competency influenced by cognitive and affective factors, including self-efficacy. This study aims to analyze the characteristics of high school students' mathematical problem-solving ability across high, moderate, and low levels of self-efficacy. The research method used was a mixed-methods approach with a sequential explanatory design involving 108 eleventh-grade students at a high school in Indonesia. The research instruments included a self-efficacy questionnaire and a mathematical problem-solving test on SLETV material developed based on Polya's indicators. The results indicate a gradation of abilities aligned with self-efficacy levels. Students in the high category were able to systematically and flexibly manage all stages of Polya's model. Students in the moderate category began to encounter obstacles in completing algebraic manipulations, while those in the low category faced fundamental challenges from the modeling stage onward. A key finding revealed a common pattern across all levels: low metacognitive awareness regarding the "review" indicator. The conclusion of this study emphasizes the importance of synergy between strengthening psychological aspects and fostering the habit of self-evaluation in mathematics learning.*

Keywords: *mathematical problem-solving, self-efficacy, polya stages*

INTRODUCTION

The process of learning mathematics is not solely focused on mastering formulas; it also involves developing students' ability to solve mathematical problems. Through this ability, students learn to understand problem situations, select appropriate representations, devise solution strategies, carry out procedures systematically, and reflect on the solutions obtained. The National Council of Teachers of Mathematics (2020) emphasizes that problem solving is one of the primary process standards that must be continuously developed at all levels of mathematics education. In line with this, the OECD (2023), through the Programme for International Student Assessment (PISA), identifies mathematical problem-solving ability as a key competency reflecting students' readiness in mathematical literacy within a global context. The 2022 PISA results indicate that the majority of students in participating countries remain at the basic proficiency level, meaning that only a small proportion can flexibly model complex problems using

mathematical concepts and tools. This gap between global competency demands and students' abilities suggests that the development of mathematical problem-solving skills is not merely about meeting curriculum targets but an urgent necessity for preparing students to face academic and real-life challenges in an increasingly complex era.

Observations in the classroom indicate that the implementation of mathematics instruction has not yet fully aligned with the ideal expectations for developing mathematical problem-solving skills, as various cognitive barriers persist across all stages of the problem-solving process. These barriers emerge from the very beginning of the problem-solving process—specifically when students read the information, identify the given elements, and determine what the question is asking. Research by Lagria and Pañares (2023) indicates that most students struggle to understand the problem as the initial step in problem-solving. This difficulty is exacerbated by students' limited understanding of symbols, definitions, and geometric representations, leading them to hesitate in formulating systematic solution steps (Juman et al., 2022). Weaknesses in understanding the essence of the problem at this early stage directly affect the low quality of problem-solving strategies and students' overall mathematics learning outcomes (Sinaga et al., 2023).

In addition, procedural obstacles were also found in solving other math word problems, where students still frequently misinterpreted information, made incorrect choices regarding arithmetic operations, and were not yet accustomed to checking their answers (Qori & Hidayati, 2022; Rahmatiya & Miatun, 2020). Beyond technical factors, students' learning characteristics also influence the problem-solving process. A study by Yunaeti et al. (2021) indicates that differences in learning styles lead some students to rely on teachers' solutions rather than develop independent alternative strategies. These cognitive barriers align with the findings of the 2022 PISA reported by the OECD (2023), which indicate that students' mathematics achievement in Indonesia remains below the average of OECD member countries and has declined compared to the previous cycle.

These low national achievement levels indicate that obstacles in mathematical problem-solving are not only influenced by limited conceptual understanding but also by affective factors originating within students themselves. In line with this, the study by Utami and Wutsqa (2017) identified several factors contributing to low mathematical

problem-solving ability, including students' lack of familiarity with solving non-routine problems, a tendency to give up easily when facing difficulties, carelessness in their work, low engagement in asking questions, and the use of teaching methods that are not yet optimal in encouraging active student participation. These findings align with those of Kamsurya et al. (2022), which indicate that mathematical self-efficacy is positively associated with various indicators of mathematical ability, including problem-solving skills. Students with high self-efficacy tend to be more persistent in trying various solution strategies and are less likely to give up when facing challenging problems (Faozan & Kusno, 2023). However, Klorina and Juandi (2022) found that many students still have low self-efficacy and tend to view mathematics as a difficult and intimidating subject. The gap between the complexity of the material and students' low self-efficacy is believed to be one of the factors contributing to the wide variation in students' mathematical problem-solving abilities. Therefore, in addition to conceptual mastery, affective factors such as self-efficacy are important considerations in efforts to develop students' ability to tackle and solve mathematical problems.

Several studies in Indonesia have examined the relationship between self-efficacy and students' mathematical problem-solving abilities. The study by Imaroh et al. (2021) showed that students with high self-efficacy in three-variable linear systems of equations tended to use more planned problem-solving strategies than students with lower self-efficacy. Furthermore, Putri and Juandi (2022) identified, through a systematic literature review, that research on self-efficacy and mathematical problem-solving ability in Indonesia is still dominated by correlational studies or research examining the influence of instructional models on these two variables. Several other studies also highlight the relationship between self-efficacy and mathematical literacy as well as students' persistence in solving challenging word problems (Kamsurya et al., 2022; Zakariya, 2022). These findings indicate that students' perceptions of their own abilities play a crucial role in determining the extent to which they strive to fully understand and solve mathematical problems (Qori & Hidayati, 2022; Rahmatiya & Miatusun, 2020; Yunaeti et al., 2021).

Nevertheless, most existing studies still focus on analyzing relationships between variables or the effects of specific instructional treatments (e.g., Kamsurya et al., 2022;

Putri & Juandi, 2022). Although some researchers have begun to explore qualitative profiles, they often focus on different educational levels. For instance, Riyadi and Fitriani (2025) investigated these processes among elementary school students, while Damianti and Afriansyah (2022) focused on junior high school participants. However, studies that specifically examine students' mathematical problem-solving ability profiles based on the characteristics of their thinking processes within the high, moderate, and low self-efficacy categories remain relatively scarce. This gap serves as a crucial foundation for this study to conduct a more in-depth analysis of students' mathematical problem-solving processes by positioning self-efficacy as the primary perspective for understanding the variations in the solution strategies students employ.

Several studies indicate that students with low self-efficacy tend to avoid problems they perceive as difficult, are more prone to anxiety, and are less likely to express their ideas, even when they possess sufficient conceptual understanding (Ningsih & Warmi, 2021; Juman et al., 2022). Conversely, students with high levels of self-efficacy tend to be better prepared to face challenges, more open to collaboration, and more proactive in seeking feedback during the problem-solving process, thereby increasing their likelihood of arriving at correct solutions (Kamsurya et al., 2022; Schukajlow et al., 2021). These differences suggest that variations in self-efficacy influence how students process information and formulate strategies when solving mathematical problems. Without a deeper understanding of how students in each self-efficacy category engage with the stages of problem solving, efforts to improve mathematical problem-solving skills may fail to address the root causes effectively. Therefore, research is needed that not only focuses on final problem-solving outcomes but also examines, in greater depth, students' thinking patterns at each stage of the problem-solving process based on their level of self-efficacy.

Based on the preceding discussion, this study aims to analyze students' mathematical problem-solving abilities in relation to their self-efficacy levels. The analysis focuses on mapping the characteristics of students' problem-solving processes within each self-efficacy category, thereby providing a more comprehensive understanding of variations in students' thinking when solving mathematical problems. The findings are expected to enrich theoretical perspectives on the relationship between

affective factors and cognitive abilities in mathematics learning, particularly in problem-solving. Furthermore, from a practical standpoint, this study is expected to inform teachers in designing instruction that fosters students' self-efficacy by creating a supportive classroom climate and promoting reflection on the thinking processes involved in solving mathematical problems.

RESEARCH METHOD

This study aims to analyze high school students' mathematical problem-solving skills in relation to their self-efficacy levels. A mixed-methods approach with a sequential explanatory design was employed, beginning with quantitative analysis followed by qualitative analysis to provide a deeper explanation of the findings (Creswell, 2018). The study involved 108 eleventh-grade students from a high school in Indonesia, selected through purposive sampling (Creswell & Creswell, 2018), with all students at that grade level included to capture a range of problem-solving strategies across varying levels of self-efficacy. Participation was based on approval from the homeroom and mathematics teachers, as well as students' voluntary consent.

The researcher serves as an investigator who designs and conducts data collection and analyzes and interprets the information obtained. The data used were derived from several main instruments, namely (1) a self-efficacy questionnaire adapted from Gustia and Nugraheni (2025) to classify students into high, moderate, and low categories; and (2) a mathematical problem-solving ability test on the topic of Systems of Linear Equations with Three Variables (SLETV) developed based on Polya's indicators. Like the questionnaire used, this test instrument was also adapted from the instrument developed by Gustia and Nugraheni (2025). Data collection involved the administration of a validated mathematical problem-solving test and a Likert-scale self-efficacy questionnaire, followed by semi-structured interviews to triangulate the quantitative results. Subsequently, the data were analyzed using descriptive and inferential statistics, while qualitative insights were scrutinized through thematic analysis to ensure a comprehensive synthesis of the students' cognitive and affective profiles. The self-efficacy questionnaire was developed based on three main dimensions, namely magnitude/level, generality, and strength, as presented in Table 1.

Table 1. Self-Efficacy Questionnaire Items

Dimension	Description	Indicator
<i>Level</i>	Regarding the relationship between an individual's efficacy and the difficulty level of a task	1) Efficacy in the strategy being used 2) Belief in one's ability to overcome obstacles in tasks of varying difficulty
<i>Strength</i>	Regarding the extent to which individuals' beliefs influence their performance of tasks	1) Believe in and recognize the strengths you possess 2) Persevere in solving problems under various conditions
<i>Generalitty</i>	Regarding an individual's ability to transfer their efficacy in one task to a variety of other tasks	1) Handling different situations effectively and maintaining a positive mindset 2) Efficacy throughout the entire learning process

Self-efficacy was measured using a Likert scale (1-4) with closed-ended statements, both positive and negative. The scores obtained from 108 students were statistically analyzed to determine the mean and standard deviation, which served as the basis for grouping subjects into high (score ≥ 60), moderate ($40 \leq \text{score} \leq 60$), and low (score < 40) categories. After the classification of self-efficacy levels was completed, the researcher proceeded to the qualitative stage by administering a mathematical problem-solving ability test on SLETV material. The problem-solving ability indicators used in this study refer to Polya's stages. Details of the indicators and the assessment descriptions used as a reference for data analysis are presented in Table 2.

Table 2. Indicators of Mathematical Problem-Solving Skills

Indicator	Description
Understanding the problem	Students can gather and identify known and unknown elements of a problem
Devise a plan	Students can identify connections between known concepts to solve problems based on the concepts that have been taught
Carry out the plan	Students can perform accurate calculations based on problems they have understood and solution plans they have developed
Looking back	Students can review the accuracy of the previous steps and write down the conclusion of their answer

The data analysis process in this study was conducted systematically using a phenomenological approach (Creswell, 2018). This approach was used to describe the

general meanings attributed by several individuals to life experiences related to a concept or phenomenon, particularly those that naturally emerge during students' problem-solving. Furthermore, themes for each indicator were developed based on the unique characteristics and thinking patterns demonstrated by students at each level of self-efficacy. The validity of the findings was strengthened through data triangulation, comparing students' response patterns across self-efficacy categories to ensure the resulting profile descriptions were representative (Creswell, 2018).

RESULT AND DISCUSSION

Classification of Student Self-Efficacy Categories

The results of the self-efficacy assessment of 108 eleventh-grade students revealed a varied distribution of self-efficacy levels. Based on the questionnaire scores, the students were classified into three categories: high, moderate, and low. The distribution of students' self-efficacy levels is presented in Table 3. The researchers then used these classification results as a basis for analyzing students' mathematical problem-solving profiles at each level.

Table 3. Categorization of the Self-Efficacy Questionnaire Results

Level of Self-Efficacy	Number of Students	Percentage
High	44	40,74%
Medium	61	56,48%
Low	3	2,78%

Mathematical Problem-Solving Skills in the High Self-Efficacy Category

Based on the students' responses to the SLETV problems involving block dimensions, several phenomena related to their problem-solving abilities were identified. Table 4 presents the themes observed among participants with high self-efficacy. Specifically, these phenomena illuminate the disparate cognitive trajectories students navigate when translating geometric constraints into algebraic representations, revealing critical gaps in their structural understanding of linear systems.

Table 4. Contextual Problem Solving: Dimensions of a Rectangular Prism

Theme		Percentage (%)	
Correct		86,36	
	Modeling	86,36	
	Accurate modeling	86,36	
	Implementation of the plan	86,36	
	Right method	84,09	
	Formal strategy		75,01
	Informal strategies		9,09
	Inappropriate method	2,27	
	Without proof	2,27	
	Re-examination	86,36	
False	Not listed	86,36	
		9,09	
	Modeling	9,09	
	Accurate modeling	9,09	
	Implementation of the plan	9,09	
	Not finished	4,55	
	Formal strategy		4,55
	Without a procedure	4,55	
	Re-examination	9,09	
	Not listed	9,09	
Blank		4,55	

Based on Table 4, a trend emerged: the majority of students with high self-efficacy demonstrated excellent problem-solving skills. Regarding the indicators of problem comprehension and modeling, all students who answered correctly accurately transformed information about the perimeter of a rectangular prism into the SLETV mathematical model. During the plan implementation stage, most students in this category preferred systematically organized formal strategies. The most prominent trend was the use of elimination and substitution methods. In this problem-solving pattern, students generally begin by eliminating two equations to derive a new auxiliary equation, which is then followed by a step-by-step substitution process to precisely determine the values of the variables for length, width, and height. Although formal strategies were dominant, a small number of students also used informal strategies to solve the problem. In this case, students did not list the procedural steps or stages of the solution on the answer sheet.

On the other hand, a consistent phenomenon observed in the re-evaluation indicator was the students' lack of habit in providing evidence for their evaluations. Although they

completed the calculations and arrived at the correct final solution, students who answered correctly still did not include any verification steps or back-substitution in their responses. This indicates that, even among students with high self-efficacy, the ability to perform complex technical procedures independently has not yet been accompanied by the habit of verifying the validity of the answers they have obtained.

Furthermore, based on students' responses to the SLETV problem involving shopping contexts and price comparisons to determine the unit price of an item and verify the accuracy of a statement, various phenomena were also observed in their problem-solving steps. Table 5 presents the themes observed among participants with high self-efficacy in solving this problem.

Table 5. Contextual Problem Solving: Price Comparison

Theme		Percentage (%)	
Correct		88,64	
	Modeling	88,64	
	Accurate modeling		88,64
	Implementation of the plan	88,64	
	Right method		88,64
	Formal strategy		79,55
	Informal strategies		9,09
	Re-examination	88,64	
	Accurate verification		15,91
False	Not listed		72,73
		9,09	
	Modeling	9,09	
	Accurate modeling		6,82
	Inaccurate modeling		2,27
	Implementation of the plan	9,09	
	Not finished		4,55
	Formal strategy		4,55
	Without a procedure		4,54
Re-examination		9,09	
	Not listed		9,09
Blank		2,27	

Table 5 shows that the majority of students in this category were able to identify the relationships between item prices with great accuracy. During the implementation phase, most students preferred formal strategies, systematically combining elimination and substitution methods to precisely determine the unit price of an item before testing the given price comparison statements. Although formal strategies were dominant, a small number of students also used informal strategies. In this case, students accurately

transformed the word problem into an SLETV mathematical model, but did not first determine the nominal unit price of the goods. Students used a verification strategy by substituting known comparison ratios into the equation to test the consistency of the price variable with the known total price. Through this step, students successfully demonstrated the accuracy of the price-comparison statement in the problem without having to find the unit price. Meanwhile, regarding the re-checking indicator, although a small number of students began to include accurate checks, the majority of students who answered correctly still did not show evidence of verification or back-substitution on their answer sheets. This suggests that the tendency to immediately conclude an answer without reviewing the solution remains prevalent among participants with high self-efficacy.

Mathematical Problem-Solving Ability in the Moderate Self-Efficacy Category

Based on the students' responses to the SLETV questions regarding the dimensions of a block, several phenomena related to their problem-solving abilities were identified. Table 6 presents the themes observed among participants with moderate self-efficacy.

Table 6. Contextual Problem Solving: Dimensions of a Rectangular Prism

Theme		Percentage (%)	
Correct		63,93	
	Modeling	63,93	
	Accurate modeling	63,93	
	Implementation of the plan	63,93	
	Right method	63,93	
	Formal strategy		55,74
	Informal strategies		8,20
	Re-examination	63,93	
	Not listed	63,93	
False		29,51	
	Modeling	29,51	
	Accurate modeling		8,20
	Inaccurate modeling		1,64
	Not listed		19,67
	Implementation of the plan	29,51	
	Not finished		8,20
	Formal strategy		8,20
	Without a procedure		21,31
	Re-examination	29,51	
	Not listed	29,51	
Blank		6,56	

Based on Table 6, a trend was observed that a significant number of students with moderate levels of self-efficacy demonstrated the ability to meet the indicators of understanding the problem and initiating problem-solving with appropriate modeling. During the plan implementation stage, the majority of students in this category predominantly used formal strategies, systematically organizing elimination and substitution methods. In this problem-solving pattern, students generally begin by performing elimination on the equations to derive new auxiliary equations, which are then followed by substitution to accurately determine the values of the variables length, width, and height. Although formal strategies dominated, a small proportion of students also used informal strategies to solve the problem. In this case, students did not list the procedural steps or stages of the solution on the answer sheet.

On the other hand, for the group of students who provided incorrect answers, the main obstacle was evident in the incomplete execution of the plan. In this phenomenon, students did not list the solution steps in full; they tended to stop after obtaining a certain side length without completing the final instruction to calculate the difference as requested. A consistent phenomenon observed in the re-examination indicator was the absence of evaluation activities. Similar to the previous category, none of the students who answered correctly included a verification step or a back-substitution on their answer sheets. This indicates that, in the moderate self-efficacy category, students are not yet accustomed to verifying the validity of the solutions they have obtained.

Furthermore, the students' responses to the SLETV problem which integrates a shopping context and price comparisons to determine unit prices reveal various complex phenomena in their systematic problem-solving steps. These observed patterns provide critical insights into how learners navigate the transition from contextualized linguistic information to abstract mathematical modeling during the verification of numerical statements. Consequently, analyzing these diverse approaches illuminates the specific cognitive hurdles encountered by students as they attempt to reconcile real-world scenarios with formal algebraic constraints. Table 7 presents the themes that emerged among participants with moderate self-efficacy in solving this problem.

Table 7. Contextual Problem Solving: Price Comparison

Theme		Percentage (%)	
Correct		67,21	
	Modeling	67,21	
	Accurate modeling		67,21
	Implementation of the plan	67,21	
	Right method		67,21
	Formal strategy		63,93
	Informal strategies		3,28
	Re-examination	67,21	
	Accurate verification		21,31
	Not listed		45,90
False		26,23	
	Modeling	26,23	
	Accurate modeling		24,59
	Inaccurate modeling		1,64
	Implementation of the plan	26,23	
	Not finished		19,67
	Formal strategy		19,67
	Without a procedure		6,56
	Re-examination	26,23	
	Accurate verification		1,64
	Not listed		24,59
Blank		6,56	

Based on Table 7, more than half of the students in this category met the indicator for implementing a plan using the correct method. During the problem-solving process, most students used formal strategies, combining systematic elimination and substitution to determine the item's unit price accurately. Although formal strategies dominated, very few students used informal strategies for this problem. Regarding the evaluation indicator, although the number of students who correctly wrote down the verification increased compared to the previous problem, the majority of students in this intermediate category still tended to immediately conclude their answers without reviewing their solutions. Students who successfully met the re-checking indicator did so by providing evidence of substituting variable values into the original equation to ensure the accuracy of the results. However, the practice of not including a final evaluation still dominated students' answer sheets in this group. This tendency suggests a lack of reflective thinking or metakognitive monitoring, where students prioritize procedural completion over the verification of logical consistency in their mathematical models.

Mathematical Problem-Solving Skills in the Low Self-Efficacy Category

Based on the students' responses to the SLETV questions regarding the dimensions of a block, several phenomena related to their problem-solving abilities were identified. Table 8 presents the themes observed among participants with low self-efficacy.

Table 8. Contextual Problem Solving: Dimensions of a Rectangular Prism

Theme		Percentage (%)	
False		33,33	
	Modeling	33,33	
	Inaccurate modeling	33,33	
	Implementation of the plan	33,33	
	Not finished	33,33	
	Formal strategy		33,33
	Re-examination	33,33	
	Not listed	33,33	
Blank		66,67	

Based on the data in Table 8, students with low self-efficacy exhibited significant difficulties from the very beginning of the task. The most prominent phenomenon observed in this group was leaving the answer sheet blank with no evidence of work. For some students who attempted to respond, the primary challenge was the incorrect formulation of the modeling indicators. This caused the problem-solving process during plan implementation to become irrelevant to the question's objective or to stall midway, leaving it without a final solution. Although efforts were made to use formal strategies, students often failed to complete the calculations needed to formulate a valid mathematical model. Furthermore, consistent with the obstacles encountered in the early stages, no trace of fulfillment of the re-checking indicators was found on the answer sheets in this category. This phenomenon indicates that low self-efficacy in this category severely limits students' efforts to engage further in complex problem-solving activities.

Furthermore, based on the students' responses to the SLETV problem involving a shopping context and price comparisons to determine the unit price of an item and verify the accuracy of a statement, various phenomena were also observed in their problem-solving steps. Table 9 presents the themes that emerged among participants with low self-efficacy in solving this problem.

Table 9. Contextual Problem Solving: Price Comparison

Theme		Percentage (%)
False		66,67
Modeling		66,67
	Accurate modeling	33,33
	Inaccurate modeling	33,33
Implementation of the plan		66,67
	Not finished	33,33
	Formal strategy	33,33
	Without a procedure	33,33
Re-examination		66,67
	Not listed	66,67
Blank		33,33

Based on the data in Table 9, the response patterns for this problem were dominated by students' failure to arrive at the correct solution. The most notable finding was the high percentage of students who were unable to complete the implementation plan, although some students met the modeling indicators. Additionally, one-third of the students in this group left the answer sheet blank or did not fill in any answers. Specific obstacles in this category include students' inability to correctly write down known components in accordance with the problem's context. Students tended to immediately write down numbers without forming the SLETV mathematical model required to solve the problem. This situation prevented the planning and implementation stages from being carried out, resulting in no evidence of meeting the re-checking indicators on the answer sheets in this low-performing category.

Based on the findings, there appears to be a trend in which problem-solving performance in the high category is significantly higher than in the moderate category, and the moderate category outperforms the low category. This indicates a correlation between self-efficacy and students' success in solving mathematical problems. This finding confirms that students' self-efficacy is not merely an additional affective aspect but a determining factor that guides how students manage their cognitive strategies when solving complex problems (Bandura, 1977; Umbara, 2022). These research results reinforce the findings of Pajares and Miller (1994), Marasabessy (2020), and Umbara et al. (2022), which show that self-efficacy plays a significant role in students' achievement in solving mathematical problems. Furthermore, consistent with the study by Nicolaidou and Philippou (2003), although attitude and self-efficacy are both correlated with

academic achievement, self-efficacy has proven to be a stronger predictor of students' success in solving challenging mathematical tasks.

Students in the high self-efficacy category demonstrated strong and consistent dominance across nearly all of Polya's problem-solving indicators. Referring to the data in Tables 2 and 3, the majority of students in this group were able to transform word problems into accurate mathematical models, reflecting an excellent "strength" dimension, in which students felt confident in their ability to overcome obstacles in complex problems. This finding is supported by Alifia and Rakhmawati (2018), who demonstrated that students with high self-efficacy tend to apply systematic thinking patterns and exhibit perseverance when facing complex problems. The use of such organized strategies aligns with Pajares and Miller's (1994) view that students in this category tend to be better, thereby maximizing their cognitive functions. The cognitive flexibility of this group is evident through the informal strategies that emerge in contextual problems involving block dimensions, as shown in Figure 1 below:

Penyelesaian :

① Dik = k. ABCD = 72 cm
 k. DCGH = 44 cm
 k. BCFG = 60 cm

Dit = Selisih Panjang rusuk terpanjang dan terpendek?

Jawab: $k. ABCD = \frac{72}{2} = 36$
 $k. DCGH = \frac{44}{2} = 42$
 $k. BCFG = \frac{60}{2} = 30$

$\Rightarrow 42 - 30 = 12 \text{ cm}$

Figure 1. Informal Problem-Solving of Contextual Problems Involving the Dimensions of a Rectangular Prism

Based on Figure 1, a unique phenomenon was observed: students made a logical leap. Rather than following the formal procedure of variable elimination and substitution, they directly guessed that the longest and shortest edges corresponded to the quotient without first proving the length of each edge. Although they relied on quick intuition to determine the longest and shortest sides without proving the values one by one, the results obtained were still accurate. This boldness in making efficient strategic decisions also emerged in Problem 2 through the trial-and-error method or price ratio proof. This

phenomenon reinforces Bandura's (1997) theory that individuals with high self-efficacy view difficult tasks as challenges to be mastered rather than threats to be avoided. Thus, the high self-efficacy in this group not only impacts the accuracy of the results but also the students' ability to select and explore more varied and efficient problem-solving strategies.

Students in the moderate self-efficacy category tend to demonstrate a good initial understanding but often encounter difficulties with lengthy calculation procedures or complex algebraic manipulations (Damianti & Afriansyah, 2022). This characteristic is clearly evident in the results of this study, where most students were able to begin their work with appropriate modeling. However, the final results were suboptimal because the solution process terminated before addressing the problem's final instruction (Table 4 and Table 5). This phenomenon of incomplete answers indicates that, although students understand the indicators of problem comprehension, they encounter technical obstacles and experience a decline in self-efficacy when entering the implementation stage of the plan.

Dik: kll. ABCD = 22, a = 30
 kll. DCGH = 24, a = 42
 kll. BEFG = 60, a = 30
 Dit: Seberapa panjang rusuk terpanjang dan terpendek
 eliminasi pers 1 dan 3 $\Rightarrow p + t = 36$
 $t + e = 30$
 $p - t = 6$

eliminasi p. menggunakan pers 2 dan 4 $\Rightarrow p + t = 42$
 $p - t = 6 \text{ cm}$
 $2t = 36 \text{ cm}$
 $t = 18$

Substitusi pers 2:
 $p + t = 42 \text{ cm}$
 $p + 18 = 42$
 $p = 42 - 18$
 $p = 24$

substitusi pers 3:
 $p + t + e = 36$
 $24 + 18 + e = 36$
 $= 56 - 24$
 $e = 32$

1) Azharidi: $2x + y + 2z = \text{Rp } 504.000,00$ x3
 Roni: $4y + 3z = \text{Rp } 648.000,00$ x1
 Fajol: $3x + 2y + z = \text{Rp } 552.000,00$ x2

$6x + 3y + 6z = 3.012.000,00$
 $6x + 4y + 2z = 1.104.000,00$
 $y + 4z = 1.908.000,00$ x4
 $4y + 16z = 7.632.000,00$
 $4y + 3z = 648.000,00$
 $13z = 6.984.000,00$

ket = celana (x)
 baju (y)
 sepatu (z)

Figure 2. Moderate Self-Efficacy Category Student Responses in Problem 1 and Problem 2

Based on Figure 2, it is evident that students often stop after identifying one or two variables without completing the final instruction to calculate the difference or fully demonstrating the price comparison. In line with Handayani's (2025) findings, students in this category tend to easily doubt the correctness of their steps when encountering technical obstacles midway through the process. This consistently emerging

incompleteness indicates that their generality remains limited to simple situations and unstable when faced with more complex problems.

Meanwhile, students in the low self-efficacy category face fundamental obstacles that begin as early as the initial stages of problem-solving. This low self-efficacy is often linked to math anxiety, leading students to feel helpless even before attempting a problem (Umbara et al., 2022). This phenomenon is clearly evident in the results of this study, where the majority of student responses left answer sheets blank or contained only irrelevant data, without proper modeling (Tables 6 and 7). This cognitive block prevents students from logically identifying relationships among variables, making it impossible to carry out the planning and implementation stages (Imaroh et al. 2021).

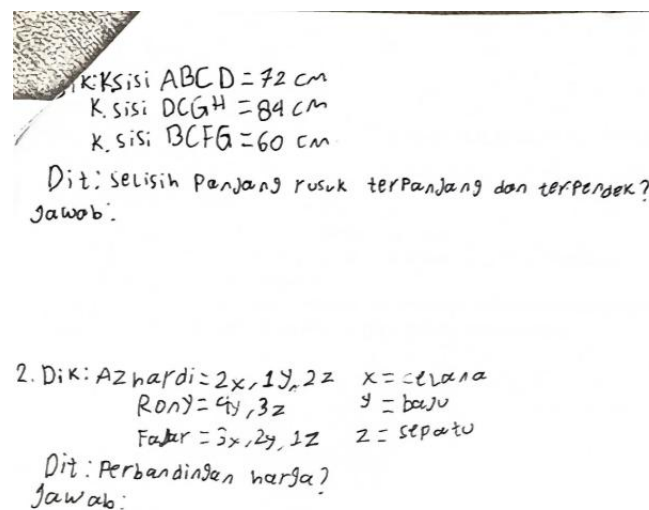


Figure 3. Problem-Solving Among Students with Low Self-Efficacy

Based on Figure 3, students do not appear to engage in systematic problem-solving processes after reading contextual problems. The absence of modeling attempts or even basic calculations suggests that, without sufficient foundational efficacy, students lack the motivation to engage in complex problem solving. This condition reflects a very low level of resilience, where even minor obstacles are enough to halt the thinking process entirely. It indicates that, in the low self-efficacy category, the required intervention extends beyond technical mathematical support to include strengthening self-efficacy so that students develop the persistence needed to tackle challenging tasks. Overall, the results across the three categories reveal a gradation in problem-solving ability that

corresponds to students' levels of self-efficacy. Consistent patterns of similarities and differences in problem-solving approaches are evident across categories when responding to problem instructions.

A consistent phenomenon observed across all categories is the low performance on the re-examination indicators. As seen in the students' work across all self-efficacy groups, the majority of respondents tended to jump to conclusions without including verification evidence or substituting the variable values back into the original equation. This phenomenon confirms that a high level of self-efficacy does not necessarily equate to the development of students' metacognitive awareness. This finding is supported by the analysis by Imaroh et al. (2021), which notes that students often view the re-checking stage as an additional burden or merely a formality that adds no value to the final result. The lack of practice in writing conclusions and verifying answers by substituting values back into the original equation is the primary reason this indicator consistently ranks lowest. In fact, according to Polya's (1973) principles, this stage is the key to minimizing procedural errors and reinforcing a comprehensive understanding of concepts.

The fundamental difference lies in the completeness of procedures and cognitive endurance when dealing with complex problems. High-performing students can complete all stages of implementing a plan accurately and flexibly, including exploring informal strategies. Meanwhile, students in the moderate category begin to encounter obstacles with the completeness of algebraic manipulations, causing their work to stall midway frequently. On the other hand, low-performing students face fundamental challenges from the problem-modeling stage onward, leading to a lack of relevant work traces. Based on these profile differences, this study recommends differentiated instruction: strengthening metacognitive aspects for high-performing students, and providing technical scaffolding and motivational support to enhance the strength dimension for moderate and low-performing students.

Overall, the findings across the three categories reveal a progression in problem-solving ability that aligns with students' levels of self-efficacy, suggesting a relationship between self-efficacy and success in solving mathematical problems. This implies that improving problem-solving skills cannot rely solely on cognitive training. Educators need to integrate the strengthening of self-efficacy with the development of metacognitive

skills, enabling students to engage in self-evaluation. Given that high self-efficacy does not necessarily lead to the "looking back" stage, students should be trained to view this stage not as an additional burden but as an essential step in verifying the validity of their solutions. Thus, students are expected not only to perform calculations confidently but also to critically evaluate their own thinking processes.

This study has several limitations, including a small sample from a single school and a narrow scope of content that focused solely on SLETV; therefore, the findings should be interpreted with caution. In addition, the study did not examine other external factors that may influence students' self-efficacy during testing. Future research is recommended to involve a broader sample and to incorporate in-depth interviews to understand better the obstacles encountered at each stage of Pólya's model. Further studies could also focus on designing instructional interventions to foster both self-efficacy and problem-solving skills across mathematical topics with varying levels of abstraction.

CONCLUSION

This study shows that high school students' mathematical problem-solving abilities exhibit distinct characteristics that vary with their self-efficacy levels. Students with high self-efficacy tend to demonstrate excellent mathematical understanding, accurately represent mathematical models, and apply systematic and flexible problem-solving strategies. In the moderate self-efficacy category, students demonstrated fairly good comprehension and modeling abilities, but often encountered obstacles in fully executing their plans to reach the final solution. Meanwhile, students with low self-efficacy have not demonstrated understanding of written problems. They are unable to develop appropriate mathematical models, resulting in most answer sheets being left blank. Although there are significant differences in procedural completion and cognitive endurance, this study found a consistent pattern across all levels of self-efficacy: low achievement on the re-checking indicator. This phenomenon suggests that a high level of self-efficacy does not guarantee the emergence of metacognitive awareness to verify answers. Therefore, this study's implications emphasize that developing problem-solving skills cannot be achieved solely through partial reinforcement of cognitive aspects and

self-efficacy. There is a need to integrate the development of self-efficacy with the systematic practice of reviewing work in the learning process, so that students are not only confident in performing calculations but also possess the precision and critical thinking skills necessary to ensure the validity of their final results.

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