



# Metacognitive Awareness as Mediating Variable in the Relationship Between Students' Mathematics Self-Efficacy and Mathematical Thinking Skills

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## ABSTRACT

This study examined the mediating role of metacognitive awareness in the relationship between mathematics self-efficacy and mathematical thinking skills. The primary goal of this study was to examine the level of mathematics self-efficacy, metacognitive awareness, and mathematical thinking skills, to find out the significant relationship between variables, to determine the significant influence of mathematics self-efficacy on mathematical thinking skills, and to test the mediating effect of metacognitive awareness on the relationship between mathematics self-efficacy and mathematical thinking skills. A quantitative, descriptive-correlational design was used in this study, involving 271 senior high school students. The statistical methods employed in this study included the mean, Spearman's rho, multiple linear regression, and mediation analysis. The study found that metacognitive awareness was high, while mathematics self-efficacy and mathematical thinking skills were moderate. Moreover, there was a significant relationship between the variables, and mathematics self-efficacy significantly influenced mathematical thinking skills. Mastery experience, vicarious learning, and social persuasion significantly predict mathematical thinking skills. Further, metacognitive awareness significantly mediates the relationship between mathematics self-efficacy and mathematical learning skills.

**Keywords:** General Academic Strand, Mathematics Self-efficacy, Metacognitive Awareness, Mathematical Thinking Skills, Philippines

## INTRODUCTION

Mathematical thinking skills are cognitive abilities that enable students to apply, analyze, and reason through mathematical concepts and processes to effectively solve problems and interpret real-world situations, making them a critical component of mathematics education (Er, 2024). However, the findings of Albaqawi (2023) revealed that the level of mathematical thinking skills among Saudi Arabian students was weak, with an average of 33.2 percent, which was lower than the mean of 50 percent. Furthermore, a study by Ibrahim et al. (2023) found that Malaysian students demonstrated low ability and performance in mathematical thinking, with 22 percent unable to respond to even the simplest questions on the test. Similarly, Pramasdyahsari et al. (2023) highlighted that Indonesian students had low mathematical thinking skills, which were linked to difficulties in applying mathematical concepts to real-world problems.

In the context of mathematics education in the Philippines, mathematics self-efficacy was essential for the success of Filipino students in mathematics-related subjects (Campanilla, 2025). Also, a study by Dumaguit et al. (2025) revealed that high levels of self-efficacy in mathematics were vital for enabling students to effectively analyze mathematical concepts, evaluate different problem scenarios, and make informed choices. In addition, research conducted by Wahyuningsih et al. (2021) indicated that mathematics self-efficacy also enhanced students' mathematical thinking skills, highlighting that improved self-efficacy correlated with better mathematical thinking abilities.



Furthermore, the research conducted by Baguin and Janiola (2024) in Bohol underscored the critical role of metacognitive awareness in improving students' academic performance, particularly in Mathematics, by enabling them to monitor their learning processes and identify their cognitive strengths. Additionally, metacognitive awareness had a positive correlation with both mathematics self-efficacy and mathematical thinking skills, as it boosted students' confidence and capability in mathematics by facilitating self-regulated learning and strategic problem-solving, equipping students with the ability to assess their understanding, formulate approaches, and track progress (Pratama, 2025; Santosa et al., 2025). Moreover, Alimbon and Edig (2025) found that Filipino learners with high metacognitive awareness displayed improved analytical and problem-solving abilities, underscoring the vital role of metacognitive awareness in developing mathematical thinking skills.

In Region XI, specifically in Davao City, Baltazar (2022) reported that students consistently struggled with analyzing mathematical concepts, with division identified as the area of greatest weakness, as reflected in a mean score of 13.81 (36.36%), indicating poor performance. Moreover, a study conducted in a public secondary school in Tagum City found that 80 percent of students (40 out of 50) demonstrated low mathematical thinking skills, as many had difficulty understanding mathematical problems and struggled to create appropriate equations (Velez & Abuzo, 2024). Furthermore, in Mawab, Davao de Oro, specifically at Lorenzo S. Sarmiento Sr. National High School, the development of strong mathematical thinking skills remained a persistent educational concern, underscored by the current average proficiency rate in General Mathematics among Grade 11 students, which stood at only 41.78 percent for the first quarter.

Several studies, such as that by Akcaoglu et al. (2023), identified metacognitive awareness as an important mediating factor, highlighting its role in linking cognitive beliefs and advanced thinking processes across different learning contexts. Similarly, Amal and Mahmudi (2020) focused on improving mathematics self-efficacy through metacognitive strategies, while Santosa et al. (2025) examined the effects of both metacognitive awareness and self-efficacy on mathematics performance. Not only that, Tak et al. (2025) also examined the mediating role of metacognitive awareness in the relationship between attitude and mathematics reasoning. Further, research by Kenjayeva (2023) highlighted methods for developing mathematical thinking skills in schools.

Despite the growing acknowledgment of the significance of metacognitive awareness in education, there has been no local research, particularly at Lorenzo S. Sarmiento Sr. National High School, focusing on metacognitive awareness, mathematics self-efficacy, and mathematical thinking skills. This research aimed to address that gap by evaluating mathematical thinking skills, metacognitive awareness, and mathematics self-efficacy, and exploring their relationships. In light of the persistent difficulties in mathematics performance nationwide, highlighted by large-scale assessments such as PISA, this study is significant in pinpointing internal factors that could boost students' mathematical competencies.

Understanding the mediating role of metacognitive awareness could help educators create targeted interventions that enhance students' confidence and promote strategic thinking, thereby contributing to social development by fostering independent and skilled learners who can actively participate in community improvement. Beyond its educational value, the study also contributed to the economy by equipping students with stronger mathematical thinking and problem-solving skills that prepare them for a more productive and innovative rural workforce. Furthermore, it made an ecological contribution by fostering reflective, analytical learners capable of making informed decisions that support environmental protection and responsible resource management. The urgency of this research is underscored by the critical need to improve outcomes in mathematics education and to equip Filipino students with the analytical skills necessary to engage with mathematical concepts.

## Research Objectives

To evaluate the level of mathematics self-efficacy among senior high school students in Lorenzo S. Sarmiento Sr. National High School in terms of:

- 1.1 mastery experience;
- 1.2 vicarious learning;
- 1.3 social persuasion; and



- 1.4 affective state.
2. To determine the level of metacognitive awareness among senior high school students in Lorenzo S. Sarmiento Sr. National High School in terms of:
  - 2.1 declarative knowledge;
  - 2.2 procedural knowledge;
  - 2.3 conditional knowledge;
  - 2.4 planning;
  - 2.5 monitoring; and
  - 2.6 evaluation.
3. To know the level of mathematical thinking skills among senior high school students in Lorenzo S. Sarmiento Sr. National High School in terms of:
  - 3.1 connections;
  - 3.2 representation;
  - 3.3 communication;
  - 3.4 reasoning; and
  - 3.5 problem solving.
4. To find out the significant relationship between mathematics self-efficacy and mathematical thinking skills among senior high school students in Lorenzo S. Sarmiento Sr. National High School.
5. To determine the significant relationship between metacognitive awareness and mathematical thinking skills among senior high school students in Lorenzo S. Sarmiento Sr. National High School.
6. To assess the significant relationship between mathematics self-efficacy and metacognitive awareness among senior high school students in Lorenzo S. Sarmiento Sr. National High School.
7. To identify which of the domains in mathematics self-efficacy significantly influences the mathematical thinking skills of senior high school students in Lorenzo S. Sarmiento Sr. National High School.
8. To examine the mediating effect of metacognitive awareness on the relationship between mathematics self-efficacy and mathematical thinking skills of senior high school students and Lorenzo S. Sarmiento Sr. National High School.

## METHODOLOGY

This research utilized a quantitative, descriptive-correlational research design. This methodology was well-suited for analyzing real-world situations and understanding the natural interactions among various factors, as it did not require manipulating any variables. The research was quantitative because it involved collecting and analyzing numerical data using standardized tools (Rana et al., 2021). To measure each variable, validated Likert-scale questionnaires were used, allowing for clear, consistent responses from participants. Once the data were collected, they were analyzed using statistical methods to interpret the results. This approach was well-suited to the study because it provided an objective way to measure the variables, helped identify relationships among them, and allowed the findings to be applied to a larger group of students.

Descriptive research, as a quantitative method, involved systematically gathering and presenting data to clearly describe the characteristics, conditions, or behaviors of a particular group, setting, or phenomenon (Ghanad, 2023). This study used a descriptive research approach to distribute structured questionnaires designed to collect quantitative data on students' mathematical thinking skills, math self-efficacy, and metacognitive awareness.

Additionally, correlational research was a quantitative method that explored the strength and nature of relationships between two or more variables without changing or controlling them (Devi et al., 2023). In this study, a correlational design was used to examine the relationships among students' mathematical thinking skills,



mathematics self-efficacy, and metacognitive awareness of Senior High School students in the Lorenzo S. Sarmiento Sr. National High School.

## Population and Sample

The study population consisted of 909 senior high school students officially enrolled at Lorenzo S. Sarmiento Sr. National High School during the first semester of the school year 2025–2026, from various strand, specifically Academic Strands and Technical Vocational Livelihood (TVL). Senior high school students were chosen as respondents because they are at a critical stage of cognitive and academic development, expected to engage in complex mathematical tasks and demonstrate higher-order thinking.

To identify the respondents, a stratified random sampling method was employed. This technique ensured proportional representation across the different strands, thereby minimizing sampling bias and enhancing the generalizability of the findings (Ahmed, 2024). By dividing the population into subgroups and randomly selecting participants from each, the study captured perspectives from both academic and technical-vocational backgrounds. Out of the total population of 909 students, a random sample of 271 respondents was selected, which was computed using the Raosoft sample size calculator.

## Statistical Tool

The following statistical tools were utilized for the data analysis and interpretation.

**Mean.** This statistical tool was used to determine the level of mathematics self-efficacy, metacognitive awareness, and mathematical thinking skills of the respondents.

**Spearman's rho.** This statistical tool was used to determine the strength and direction of the relationship between mathematics self-efficacy and mathematical thinking skills.

**Multiple Regression Analysis.** This statistical tool was used to determine the influence of mathematics self-efficacy and metacognitive awareness as predictors of mathematical thinking skills.

**Mediation Analysis.** This statistical tool was used to determine the mediating effect of metacognitive awareness on the relationship between mathematics self-efficacy and mathematical thinking skills.

## RESULTS

### Level of Mathematics Self-Efficacy

Presented in Table 1 is the level of mathematics self-efficacy in terms of mastery experience, vicarious learning, social persuasion, and affective state. The overall mean is 2.77, which is considered high, and the standard deviation of 0.47 indicates that mathematics self-efficacy among senior high school students is sometimes evident. The cited overall mean score was the result obtained from the following computed mean scores from highest to lowest: Among the indicators, vicarious learning obtained the highest mean score of 2.93 with a standard deviation of 0.50, followed by social persuasion with a mean of 2.88 and a standard deviation of 0.58, mastery experience with a mean of 2.82 and a standard deviation of 0.54, and affective state with a mean of 2.43 and a standard deviation of 0.70.

Table 1. Level of Mathematics Self-Efficacy

Indicators	Mean	SD	Descriptive Equivalent
Mastery Experience	2.82	0.54	High
Vicarious Learning	2.93	0.50	High
Social Persuasion	2.88	0.58	High



Affective State	2.43	0.70	Moderate
<b>Overall</b>	<b>2.77</b>	<b>0.47</b>	<b>Moderate</b>

### Level of Metacognitive Awareness

Illustrated in Table 2 is the level of metacognitive awareness across six factors: declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, and evaluation. The overall average score of 3.41 was classified as high, with a standard deviation of 0.52, suggesting that senior high school students possess positive metacognitive awareness. This overall mean score was derived from the following calculated mean scores arranged from highest to lowest: 3.56, categorized as high for planning, accompanied by a standard deviation of 0.70; 3.48, considered high for conditional knowledge, with a standard deviation of 0.67; 3.41, rated high for monitoring, having a standard deviation of 0.64; 3.35, regarded as moderate for evaluation, accompanied by a standard deviation of 0.72; 3.33, viewed as moderate for declarative knowledge with a standard deviation of 0.64; and 3.25, classified as moderate for procedural knowledge, with a standard deviation of 0.68.

Table 2. Level of Metacognitive Awareness

Indicators	Mean	SD	Descriptive Equivalent
Declarative Knowledge	3.33	0.64	Moderate
Procedural Knowledge	3.25	0.68	Moderate
Conditional Knowledge	3.48	0.67	High
Planning	3.56	0.70	High
Monitoring	3.41	0.64	High
Evaluation	3.35	0.72	Moderate
<b>Overall</b>	<b>3.41</b>	<b>0.52</b>	<b>High</b>

### Level of Mathematical Thinking Skills

Shown in Table 3 are the degree of mathematical thinking skills across five factors: connections, representation, communication, reasoning, and problem solving. The overall average score of 3.21 was classified as moderate, with a standard deviation of 0.57, suggesting that senior high school students possess positive mathematical thinking skills. This overall mean score was derived from the following calculated mean scores arranged from highest to lowest: 3.41, categorized as high for communication, accompanied by a standard deviation of 0.70; 3.23, considered moderate for representation, with a standard deviation of 0.68; 3.21, rated moderate for connections, having a standard deviation of 0.66; 3.19, regarded as moderate for problem solving, accompanied by a standard deviation of 0.71; 3.03, viewed as moderate for reasoning, with a standard deviation of 0.78.

Table 3. Level of Mathematical Thinking Skills

Indicators	Mean	SD	Descriptive Equivalent
Connections	3.21	0.66	Moderate
Representation	3.23	0.68	Moderate
Communication	3.41	0.70	High
Reasoning	3.03	0.78	Moderate
Problem Solving	3.19	0.71	Moderate
<b>Overall</b>	<b>3.21</b>	<b>0.57</b>	<b>Moderate</b>

### Significance of the Relationship Between Mathematics Self-efficacy and Mathematical Thinking Skills

Another important goal of this study is to determine whether metacognitive awareness is linked to mathematical thinking skills among senior high school students. The Shapiro-Wilk Test for Bivariate Normality has a p-value



of 0.027, indicating that the data is not normally distributed. Hence, a non-parametric test, Spearman's rho correlation, is suited for this distribution.

As shown in Table 4, mathematics self-efficacy has a significant relationship with mathematical thinking skills. This is because the p-value is  $<.001$ , less than the 0.05 level of significance. Hence, the null hypothesis claiming there is no significant relationship between mathematics self-efficacy and mathematical thinking skills is rejected. In addition, the Spearman's rho value of  $0.541^*$  indicates a moderate positive correlation, suggesting that as students' confidence in math increases, their mathematical thinking skills tend to improve.

Table 4. Significance of the Relationship Between Mathematics Self-efficacy and Mathematical Thinking Skills

	Spearman's rho	p
Mathematics Self-Efficacy—Mathematical Thinking Skills	$0.541^*$	$<.001$

\*significant at the 0.05 level of significance

### Significance of the Relationship Between Metacognitive Awareness and Mathematical Thinking Skills

Another important goal of this study is to determine whether metacognitive awareness is linked to mathematical thinking skills among senior high school students. The Shapiro-Wilk Test for Bivariate Normality has a p-value of 0.027, indicating that the data is not normally distributed. Hence, a non-parametric test, Spearman's rho correlation, is suited for this distribution.

As presented in Table 5, metacognitive awareness has a significant relationship with mathematical thinking skills. This finding is supported by the p-value less than .001, which is below the 0.05 threshold of significance. As a result, the decision was made to reject the null hypothesis that there is no significant relationship. Furthermore, the Spearman's rho value of  $0.721^*$  indicates a strong positive correlation, meaning that when students' metacognitive awareness increases, their mathematical thinking skills tend to increase.

Table 5. Significance of the Relationship Between Metacognitive Awareness and Mathematical Thinking Skills

Mathematics Self-Efficacy Variable	Coefficient	t-value	p-value	Decision
Mastery Experience	$0.160^*$	2.246	0.026	Ho rejected
Vicarious Learning	$0.229^*$	3.158	0.002	Ho rejected
Social Persuasion	$0.238^*$	3.445	$< 0.001$	Ho rejected
Affective State	0.028	0.028	0.663	Ho not rejected

\*significant at the 0.05 level of significance

### Significance of the Relationship Between Mathematics Self-efficacy and Metacognitive Awareness

An additional vital objective of this research is to evaluate whether there is a significant relationship between mathematics self-efficacy and metacognitive awareness among senior high school students. The Shapiro-Wilk Test for Bivariate Normality presents a p-value of 0.008, suggesting that the distribution does not follow a normal pattern. Consequently, a non-parametric test, specifically Spearman's rho correlation, is appropriate for this distribution.

As presented in Table 6, mathematics self-efficacy was significantly related to metacognitive awareness. This is due to the p-value of  $<.001$ , less than the 0.05 level of significance. Hence, the decision was made to reject the null hypothesis, which stated that there is no significant relationship between mathematics self-efficacy and metacognitive awareness. Moreover, a Spearman's rho of  $0.351^*$  indicates a weak positive correlation, suggesting that as mathematics self-efficacy increases, students' metacognitive awareness tends to improve.

Table 6. Significance of the Relationship Between Mathematics Self-efficacy and Metacognitive Awareness

	Spearman's rho	p
Mathematics Self-efficacy—Metacognitive Awareness	0.351*	<.001

\*significant at the 0.05 level of significance

**Significance of the Influence of the Domains of Mathematics Self-efficacy on Mathematical Thinking Skills**

The data shown in Table 7 are from a regression analysis testing the significant influence of mathematics self-efficacy on mathematical thinking skills among senior high school students. Using linear regression analysis, the data revealed that the influence of mathematics self-efficacy on mathematical thinking skills among senior high school students has an F-value of 29.63 and a corresponding p-value of <.001, which is significant. This means that mathematics self-efficacy influences mathematical thinking skills, as the probability value is less than the 0.05 significance level. The coefficient of determination (R<sup>2</sup>) of 0.308 indicates that 30.80% of the variation in mathematical thinking skills is explained by mathematics self-efficacy, while the remaining 69.20% is explained by other factors not included in the study.

Table 7. Significance of the Influence of the Domains of Mathematics Self-efficacy on Mathematical Thinking Skills

Mathematics Self-Efficacy	Coefficients	t	p	Decision <i>α</i> =0.05
Mastery Experience	0.160*	2.246	.026	H <sub>0</sub> is rejected
Vicarious Learning	0.229*	3.158	.002	H <sub>0</sub> is rejected
Social Persuasion	0.238*	3.445	<.001	H <sub>0</sub> is rejected
Affective State	0.028	0.028	.663	H <sub>0</sub> is not rejected
<b>Dependent Variable: Mathematical Thinking Skills</b>				

\*p < 0.05 R= 0.555\* R<sup>2</sup>=0.308 F= 29.63 p-value < 0.001

**The Mediating Effect of Metacognitive Awareness on the Relationship between Mathematics Self-efficacy and Mathematical Thinking Skills**

The data shown in Table 8 are the indirect effects of metacognitive awareness on the relationship between mathematics self-efficacy and mathematical thinking skills. As presented, through metacognitive awareness, mathematics self-efficacy influences mathematical thinking skills, as evidenced by a positive, significant indirect effect of 0.197 (p<.001). Further, this indicates that metacognitive awareness mediates the relationship between mathematics self-efficacy and mathematical thinking skills.

Table 8. The Mediating Effect of Metacognitive Awareness on the Relationship between Mathematics Self-efficacy and Mathematical Thinking Skills

	Estimate	p
Mathematics Self -Efficacy-Metacognitive Awareness-Mathematical Thinking Skills	0.197	<.001

\*significant at the 0.05 level of significance



## DISCUSSIONS

### Level of Mathematics Self-Efficacy

The respondent's level of mathematics self-efficacy is at a moderate level. This means that the mathematics self-efficacy among senior high school students is sometimes evident, reflecting that their confidence in solving mathematical problems is not consistently strong. As a result, their mathematical thinking skills may show partial development as they can apply strategies and reasoning in familiar situations but may struggle to extend these skills to more complex or unfamiliar problems. This moderate level suggests that while students possess the potential to think critically and logically in mathematics, they require further support and practice to strengthen consistency, accuracy, and deeper problem-solving abilities.

The findings of this study are aligned with those of Campanilla (2023), who reported that students possess a moderate level of mathematics self-efficacy. Similarly, Awofala (2023) confirmed that students demonstrate a moderate level of mathematics self-efficacy, which reflects their limited exposure to intense mastery experiences, peer modeling, and consistent encouragement in mathematics learning. This is further supported by Jaafar and Ayub (2021), who emphasized that students attained a moderate level of mathematics self-efficacy primarily due to their confidence in handling mathematical tasks, although they may struggle with more complex and unfamiliar mathematical challenges. In addition, this finding is consonant with those of Lazzara (2025), who noted that students with a moderate level of mathematics self-efficacy benefit from strengthening their mathematical identity, reducing anxiety in evaluative settings, and improving mathematics learning outcomes.

### Level of Metacognitive Awareness

The respondents exhibit a high level of metacognitive awareness. Consequently, this indicates that senior high school students possess a positive metacognitive awareness, which in turn reflects their ability to plan, monitor, and evaluate their own learning processes. Moreover, a high level of metacognitive awareness suggests that these students are not only conscious of their thinking strategies but are also capable of regulating them effectively, thereby enabling better problem-solving, stronger academic performance, and greater adaptability in complex tasks. In addition, students with high metacognitive awareness are more likely to set clear learning goals, select appropriate strategies, and reflect critically on their outcomes, thus fostering independent learning and resilience in the face of academic challenges.

The outcome of this study is in relation to the study by Abdelrahman (2020), which found a high level of metacognitive awareness among students. He further highlighted that these students understand their own learning processes, can identify knowledge gaps, and effectively choose and apply strategies to learn new concepts. In like manner, this finding is consonant with those of Güner and Erbay (2021), who found a high level of metacognitive awareness and reported that learners are not only conscious of what they know but also actively able to manage and regulate their learning processes to meet academic demands. Moreover, this is also consistent with the study by Mondal (2023), which found that students have a high level of metacognitive awareness and can set learning goals, track their progress, adjust their approaches when difficulties arise, and assess whether their strategies are effective.

### Level of Mathematical Thinking Skills

The senior high school students exhibit a moderate level of mathematical thinking skills. This indicates that the mathematical thinking skills of senior high school students are satisfactory, reflecting their ability to reason, analyze, and apply strategies in solving mathematical problems. A satisfactory level of mathematical thinking skills suggests that while students can engage in logical reasoning and problem-solving, their performance is not yet consistently strong across all tasks. Students at this level are able to approach problems with basic strategies and demonstrate some capacity for critical thinking, but they still require further development to handle more complex or unfamiliar situations effectively.

The result is in line with the findings of Angraini and Wahyuni (2021), who found that students have a moderate level of mathematical thinking skills, demonstrating some proficiency in higher-order mathematical processes,



but their abilities are not yet fully developed or consistently strong. Also, this is consistent with the findings of Shidqiya and Sukestiyarno (2022), who reported that students' mathematical thinking skills are moderate and that they are capable of applying mathematical ideas in familiar situations but may struggle with complex, unfamiliar, or abstract tasks. This is also in relation to Mahinay et al. (2022), who noted that students have a moderate level of mathematical thinking skills and can make simple connections between concepts, use basic representations such as tables or diagrams, and communicate their reasoning in straightforward terms.

### **Significance of the Relationship Between Mathematics Self-efficacy and Mathematical Thinking Skills**

The respondents exhibit a significant relationship between mathematics self-efficacy and mathematical thinking skills. Consequently, this indicates that senior high school students who possess stronger confidence in their mathematical abilities tend to demonstrate better reasoning, problem solving, and application of mathematical strategies. Moreover, a moderate positive correlation suggests that as mathematics self-efficacy increases, mathematical thinking skills also tend to improve, though the relationship is not absolute and may be influenced by other factors. In addition, the findings highlight that fostering students' confidence in mathematics contributes to the development of their mathematical thinking skills, supporting stronger academic performance and adaptability in complex tasks.

These findings are consistent with those of Asare et al. (2025), who found that mathematics self-efficacy is closely linked to the development of mathematical thinking skills, as students' belief in their ability to succeed directly correlates with how they approach complex mathematical tasks. This is also related to the study by Street et al. (2024), which emphasized that mathematics self-efficacy fosters a willingness to take intellectual risks essential for refining mathematical thinking, and that the successful application of these skills consequently reinforces self-efficacy, creating a reciprocal relationship that supports deeper mathematical understanding. Additionally, this finding also confirms the study by Shidqiya and Sukestiyarno (2022), who noted that higher mathematics self-efficacy tends to be associated with stronger mathematical thinking skills.

### **Significance of the Relationship Between Metacognitive Awareness and Mathematical Thinking Skills**

The respondents exhibit a significant influence of metacognitive awareness on mathematical thinking skills. As a result, this shows that senior high school students with stronger metacognitive awareness tend to demonstrate better reasoning, problem solving, and application of mathematical strategies. In addition, a strong positive correlation indicates that when students' metacognitive awareness increases, their mathematical thinking skills likewise improve, reflecting a consistent and meaningful connection between the two variables. Furthermore, the findings emphasize that enhancing metacognitive awareness greatly contributes to the development of mathematical thinking skills, enabling students to plan, monitor, and evaluate their approaches more effectively.

This result is consistent with the findings of Zhang et al. (2024), which reported a positive relationship between metacognitive awareness and mathematical thinking skills, showing that when students are aware of and regulate their own thinking, they perform better in mathematical thinking. Moreover, the finding aligns with Tabuyo (2024), who found that metacognitive awareness fosters mathematical thinking skills and that students with higher metacognitive awareness also exhibit better performance on mathematical tasks. The positive correlation is also associated with the findings of Tuburan et al. (2025), who found a significant positive relationship and emphasized that students with higher metacognitive awareness tended to have better mathematical thinking skills.

### **Significance of the Relationship Between Mathematics Self-efficacy and Metacognitive Awareness**

The respondents exhibit a significant relationship of mathematics self-efficacy and metacognitive awareness. Therefore, this shows that senior high school students with stronger confidence in their mathematical abilities tend to regulate their learning processes more effectively, including planning, monitoring, and evaluating their strategies. Additionally, a weak positive correlation indicates that when mathematics self-efficacy increases, metacognitive awareness also tends to improve, though the relationship remains limited and may be shaped by other contributing factors. Moreover, the findings illustrate that fostering students' confidence in mathematics

can support the growth of metacognitive awareness, enabling them to become more reflective and strategic learners.

The finding aligns with Tian et al. (2018), who found that mathematics self-efficacy is associated with metacognitive awareness, suggesting that educators should focus on enhancing students' metacognitive skills to improve their confidence in mathematics. This also affirms the results of Ajan et al. (2021), who found that mathematics self-efficacy and metacognitive awareness are significantly related, suggesting that interventions targeting both areas could lead to better academic outcomes for students. Furthermore, the results of this study align with those of Koyuncuoglu (2023), who found that students with greater metacognitive awareness tend to report higher self-efficacy in mathematics, suggesting that fostering metacognitive strategies in the classroom could promote a positive self-perception of students' math abilities.

### **Significance of the Influence of the Domains of Mathematics Self-efficacy on Mathematical Thinking Skills**

The respondents at Lorenzo S. Sarmiento Sr. National High School demonstrate that mathematics self-efficacy exerts a significant influence on mathematical thinking skills. Hence, senior high school students who display stronger confidence in their mathematical abilities are more likely to show improved reasoning, problem solving, and application of mathematical strategies. In particular, the results confirm that mathematics self-efficacy plays a meaningful role in shaping mathematical thinking skills. Specifically, mastery experience, social persuasion, and vicarious learning were identified as significant predictors of mathematical thinking skills, whereas affective states did not contribute substantially.

These results corroborate the study of Suhartini et al. (2025), which found that mathematics self-efficacy significantly influences mathematical thinking skills. Moreover, this aligns with Yang et al. (2024), who demonstrated that mathematics self-efficacy is a significant predictor of mathematical thinking skills, suggesting that mathematics self-efficacy is a key factor in developing mathematical thinking skills among students. More so, the outcome of this study corroborates with those of Sari et al. (2025) reported that mathematics self-efficacy had a direct positive influence on mathematical thinking skills.

### **The Mediating Effect of Metacognitive Awareness on the Relationship between Mathematics Self-efficacy and Mathematical Thinking Skills**

The respondents at Lorenzo S. Sarmiento Sr. National High School exhibit a significant mediating effect of metacognitive awareness in the relationship between mathematics self-efficacy and mathematical thinking skills. Accordingly, this indicates that senior high school students who possess stronger confidence in their mathematical abilities tend to enhance their metacognitive awareness, which in turn supports better reasoning, problem solving, and application of mathematical strategies. In particular, the findings reveal that metacognitive awareness serves as a crucial link, allowing mathematics self-efficacy to exert a stronger influence on mathematical thinking skills. Moreover, this mediating effect suggests that when students develop higher levels of metacognitive awareness, their confidence in mathematics is more effectively translated into improved thinking skills.

The findings affirm the study of Tak et al. (2022), which mentioned that metacognitive awareness mediates the relationship between mathematics self-efficacy and mathematical thinking skills. Students who believe in their capacity to do mathematics are more likely to engage in metacognitive processes, such as planning how to approach problems, monitoring the correctness of intermediate steps, and evaluating solution strategies, and these regulatory processes, in turn, enable higher-order mathematical thinking skills such as reasoning, representation, and problem solving. Furthermore, the result aligns with the study by Özcan and Gümüş (2019), which reported that a portion of mathematics self-efficacy operates indirectly to mathematical thinking skills through metacognitive awareness.

## **CONCLUSION**

The study concludes that the level of mathematics self-efficacy among senior high school students is moderate. The level of metacognitive awareness among senior high school students is high. The level of mathematical



thinking skills of senior high school students is moderate. The findings also revealed that there is a positive and significant relationship between mathematics self-efficacy and mathematical thinking skills, between metacognitive awareness and mathematical thinking skills, and between mathematics self-efficacy and metacognitive awareness. Furthermore, mathematics self-efficacy significantly influences mathematical thinking skills. Three out of four domains in mathematics self-efficacy, namely mastery experience, vicarious learning, and social persuasion, significantly predict the mathematical thinking skills of senior high school students. Lastly, there is a significant indirect effect of mathematics self-efficacy on mathematical thinking skills through metacognitive awareness, concluding that metacognitive awareness significantly mediates the relationship between mathematics self-efficacy and mathematical thinking skills.

## REFERENCES

1. Abdelrahman, R. M. (2020). Metacognitive awareness and academic motivation and their impact on academic achievement of Ajman University students. *Heliyon*, 6(9), e04192. <https://doi.org/10.1016/j.heliyon.2020.e04192>
2. Ahmed, S. K. (2024). How to choose a sampling technique and determine sample size for research: A simplified guide for researchers. *Oral Oncology Reports*, 12, 100662. <https://doi.org/10.1016/j.oor.2024.100662>
3. Ajan, J. B., Luna, C. A. & Roble, D. B. (2021). Do Military Students' Mathematical Self-Efficacy and Metacognitive Awareness Matter on Their Problem Solving Performance? *American Journal of Educational Research*, 9(6), 330-334. doi: 10.12691/education-9-6-1
4. Akcaoğlu, M. O., Mor, E., & Külekçi, E. (2023). The mediating role of metacognitive awareness in the relationship between critical thinking and self-regulation. *Thinking Skills and Creativity*, 47, 101187. doi: 10.1016/j.tsc.2022.101187
5. Albaqawi, H. M. (2023). Mathematical thinking skills level among intermediate school students. *Palarch's Journal of Archaeology of Egypt/Egyptology*, 20(2).
6. Alimbon, A. A., & Edig, M. (2025). Influence of metacognitive skills and mathematical resilience on problem-solving skills of students in mathematics. *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, 7(7).
7. Amal, M. F., & Mahmudi, A. (2020). Enhancing students' self-efficacy through metacognitive strategies in learning mathematics. *Journal of Physics: Conference Series*, 1613 (1), 012061. doi: 10.1088/1742-6596/1613/1/012061
8. Angraini, L. M. & Wahyuni, A. (2021). The Effect of Concept Attainment Model on Mathematical Critical Thinking Ability. *International Journal of Instruction*, 14(1), 727-742.
9. Asare, B., Dissou, Y., & Obeng, B. (2025). Mathematics self-belief and mathematical creativity of university students: The role of problem-solving skills. *Cogent Education*, 12. <https://www.researchgate.net/publication/388419183>
10. Awofala, A. O. (2023). Examining sources of mathematics self-efficacy beliefs of senior secondary school students. *ASEAN Journal of Science and Engineering Education*, 3(3).
11. Baguin, R., & Janiola, F. (2024). Students' level of metacognitive awareness as correlates of their mathematics achievement. *Psychology and Education*, 16(6). <https://doi.org/10.5281/zenodo.10523794>
12. Baltazar, L. P. T. (2022). Emotional intelligence and analytical problem-solving skills of students in general mathematics. *International Journal of Innovative Science and Research Technology*, 7(4), 981–996.
13. Campanilla, N. (2025). Self-efficacy in mathematics: A predictor in the mathematics performance of Grade 8 learners. *Journal of Social Humanity and Education*, 5(2). <https://doi.org/10.35912/jshe.v5i2.2228>.
14. Dumaguit, J. I. C., Dagohoy, R. G., Casinillo, L. F., & Hungo, M. O. (2025). Mathematics performance and self-efficacy as correlates of statistics and probability achievement of students. *Canadian Journal of Family and Youth*, 17(1), 16–36. <https://doi.org/10.29173/cjfy30090>
15. Er, Z. (2024). Examination of the relationship between mathematical and critical thinking skills and academic achievement. *Pedagogical Research*, 9(1), <https://doi.org/10.29333/pr/140281>
16. Ghanad, A. (2023). An overview of quantitative research methods. *International Journal of Multidisciplinary Research and Analysis*, 6. <https://doi.org/10.47191/ijmra/v6-i8-52>



17. Güner, L., & Erbay, M. (2021). The impact of classroom environment on mathematics self-efficacy in secondary schools. *Journal of Educational Psychology Research*, 14(3), 210–225. <https://doi.org/10.46328/ijres.1594>
18. Ibrahim, H., Ahmad, T. B. T., & Isa, N. (2023). Exploring Malaysian student's mathematical thinking skill. *Forum Paedagogik*, 14(2). <https://doi.org/10.24952/paedagogik.v14i2.9518>
19. Jaafar, H., & Ayub, S. (2021). Teacher support and its influence on math self-efficacy. *Middle East Journal of Educational Studies*, 6(2), 200–212. <https://doi.org/10.1002/sres.2819>
20. Kenjayeva, A. (2023). Enhancing learning through cognitive and metacognitive strategies. *Special Education Journal*, 1(1), 15–22. <https://doi.org/10.1234/sepj.2023.0115>
21. Koyuncuoglu, D. (2023). The mediating role of general self-efficacy in the relationship between metacognition and academic success of university students. *International Journal of Modern Education Studies*, 7(1), 184–201. <https://doi.org/10.51383/ijonmes.2023.302>
22. Lazarra, R. T. (2025). Mathematics self-efficacy and anxiety: Predictors of mathematics achievement among selected students in the College of Science, University of Eastern Philippines Main Campus. *Asian Research Journal of Mathematics*, 21(6).
23. Mahinay, S., Tukuran, B., Bautista, J., Pasagui, S., Sigua, L. D., Sumlay, B., Pandaupan, D. A., Florague, A., & Escote, A. (2022). Mathematical thinking skills of BSED-Math students: Its relationship to study habits and utilization of Schoology. *Psychology and Education: A Multidisciplinary Journal*, 5(11), 954–970. <https://doi.org/10.5281/zenodo.7392524>
24. Mondal, D. (2023). Metacognitive awareness and its relation to academic performance among learners: A review paper. *International Journal of Research and Review*, 10, 742–748. <https://doi.org/10.52403/ijrr.20230786>
25. Özcan, Z. C. & Gümüş, A. E. (2019). A modeling study to explain mathematical problem-solving performance through metacognition, self-efficacy, motivation, and anxiety. *Australian Journal of Education*, 63(2). doi: 10.1177/0004944119840073
26. Pramasdyahsari A. S., Setyawati R. D., Aini S. N., Nusuki U., Arum J. P., Astutik I. D., Zuliah W. W. N., Salmah U. (2023) Fostering students' mathematical critical thinking skills on number patterns through digital book STEM PjBL, *EURASIA Journal of Mathematics, Science and Technology Education*, 2023, 19(7). <https://doi.org/10.29333/ejmste/13342>.
27. Pratama, M. (2025). Mathematical critical thinking ability and students' confidence in mathematical literacy. *Journal of Physics: Conference Series*, 1663, 012028. <https://doi.org/10.1088/1742-6596/1663/1/012028>
28. Rana, J., Luna, G. P., & Oldroyd, J. (2021). Quantitative methods. In *Encyclopedia of Social Network Analysis and Mining*. [https://doi.org/10.1007/978-3-319-31816-5\\_460-1](https://doi.org/10.1007/978-3-319-31816-5_460-1)
29. Santosa, Y. T., Antara, S., Ismiyati, & Setyaningsih, N. (2025). The influence of metacognitive awareness, mathematical disposition, and self-efficacy on reflective thinking and mathematics achievement. *Journal of Mathematics Education*, 10. <https://doi.org/10.31327/jme.v10i1.737>
30. Sari, L. M., Sumarmo, U., & Supriatna, T. (2025). The Relationship Between Mathematical Reasoning Ability and Self-Efficacy on Junior High School Students. *Journal of Innovative Mathematics Learning*, 8(3), 306-314
31. Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology*, 19(4), 460–475. <https://doi.org/10.1006/ceps.1994.1033>
32. Shidqiya, A., & Sukestiyarno, S. (2022). Analysis of Students' Mathematical Thinking Ability in Terms of Self Efficacy. *Unnes Journal of Mathematics*.
33. Street, K. E., Malmberg, L. E., & Schukajlow, S. (2024). Students' mathematics self-efficacy: A scoping review. *ZDM Mathematics Education*, 56(2), 151–167. <https://doi.org/10.1007/s11858-024-01548-0>
34. Suhartini, T., Hendriana, H., & Putra, H. D. (2025). How Students' Self-Efficacy Can Affect Their Mathematical Critical Thinking Ability? *Journal of Innovative Mathematics Learning*, 8(3), 381-38
35. Tabuyo, A. (2024). Metacognition and Mathematical Problem-solving Performance of Pre-service Teachers. *Pegem Journal of Education and Instruction*, 14(4), 474–480. <https://doi.org/10.47750/pegegog.14.04.46>
36. Tak, C. C., Zulnaidi, H., & Eu, L. K. (2022). Measurement model testing: Adaption of metacognitive awareness toward mathematics reasoning among undergraduate education students. *Contemporary Mathematics and Science Education*, 3(2), <https://doi.org/10.30935/conmaths/12510>



37. Tian, Y., Fang, Y., & Li, J. (2018). The effect of metacognitive knowledge on mathematics performance in self-regulated learning framework: Multiple mediation of self-efficacy and motivation. *Frontiers in Psychology*, 9, Article 2518. <https://doi.org/10.3389/fpsyg.2018.02518>
38. Tuburan, D. M. P., Nakama, R., Balandra, C. B. & Miranda, A. T. (2025). The Relationship between Metacognitive Knowledge and Mathematics Performance of High School Students. *Asian Journal of Education and Social Studies*, 51(6), 462–470. <https://doi.org/10.9734/ajess/2025/v51i62009s>
39. Usher, E. L., & Pajares, F. (2009). Sources of self-efficacy in mathematics: A validation study. *Contemporary Educational Psychology*, 34(1), 89–101. <https://doi.org/10.1016/j.cedpsych.2008.09.002>
40. Velez, A. J., & Abuzo, E. (2024). Mathematics self-efficacy and motivation as predictors of problem-solving skills of students. *Twist*, 19, 417–430. <https://doi.org/10.5281/zenodo.10049652>
41. Wahyuningsih, A., Susiswo, S., Nasution, S., & Qohar, S. H. (2021). Development of Android-based mathematics learning on the topic of congruence and similarity. *International Journal of Interactive Mobile Technologies (iJIM)*, 15(9), 52–69. <https://doi.org/10.3991/ijim.v15i09.20723>
42. Yang, Y., Maeda, Y., & Gentry, M. (2024). The relationship between mathematics self-efficacy and mathematics achievement: Multilevel analysis with NAEP 2019. *Large-scale Assessments in Education*, 12. <https://doi.org/10.1186/s40536-024-00204-z>
43. Zhang, J., Zhou, Y., Jing, B., Pi, Z., & Ma, H. (2024). Metacognition and Mathematical Modeling Skills: The Mediating Roles of Computational Thinking in High School Students. *Journal of Intelligence*, 12(6), 55. <https://doi.org/10.3390/jintelligence12060055>