**Role of Metacognitive Awareness in Enhancing Persistence in Solving Mathematical Problems Among Math Majors**

**Abstract**

This study investigated how metacognitive awareness contributes to the persistence of Davao Central College (Philippines) BSEd Mathematics majors in solving mathematical problems. Using a descriptive-correlational design, data were gathered from 100 math majors using the Metacognitive Awareness Inventory (MAI) and the Persistence in Mathematical Problem-Solving Scale. Results revealed very high metacognitive awareness (M=4.31) and high persistence (M=4.06), peaking during examinations (M=4.29) but lowest in take-home assignments (M=3.88). Pearson correlation showed a significant positive relationship (\*r\* = .528, \*p\* < .001), and regression analysis indicated metacognitive awareness explained 27.90% of the variance in persistence, suggesting additional factors influence persistence. The study concludes that students who plan, monitor, and regulate their thinking persist more effectively through challenges. It recommends integrating metacognitive strategy instruction into mathematics curricula to strengthen effort and resilience.

**Keywords**: *metacognitive awareness, persistence, mathematical problem-solving, knowledge about cognition, regulation of cognition*

**Introduction**

One critical issue in mathematics education is the lack of persistence among students when solving mathematical problems. Persistence, defined as the determination to stay focused on a task despite difficulty or prolonged effort (Shen et al., 2015), is crucial for achieving success in mathematics (Asoy, 2025). However, many students demonstrate insufficient persistence, which, combined with weak mathematical process skills, hinders their ability to grasp and apply mathematical concepts effectively (Kamid et al., 2024). This challenge undermines the learning process and limits the potential for meaningful knowledge transfer.

Rahmawati et al. (2024) found, in a study among vocational high school students in Jakarta, that persistence significantly improved students’ mathematical problem-solving abilities. A study conducted at the University of the East–Manila revealed that a Personal Instructing Agent (PIA) within a virtual learning tool significantly enhanced persistence in solving algebraic equations (Dela Cruz, 2024). Asoy and Picaza (2025) conducted a study involving first-year education students from three higher education institutions in Davao del Norte. Results showed a high level of persistence positively correlated with success in Mathematics in the Modern World. These findings underscore the importance of examining persistence in local educational contexts.

While numerous studies confirm the impact of metacognition on learning, limited research specifically explores how it supports persistence in solving complex mathematical problems, especially among math majors. Such gaps not only affect individual student outcomes but also compromise the quality of future educators, engineers, and researchers. Hence, it is urgent to investigate how metacognitive awareness can enhance persistence in mathematical problem-solving. The findings of this study will contribute valuable insights for educators and institutions seeking to strengthen learning strategies and improve mathematics achievement among math majors.

***Statement of the Problem***

The study aimed to investigate the role of metacognitive awareness in enhancing persistence in solving mathematical problems among math majors. Specifically, it seeks to answer the following questions:

1. What is the level of students' metacognitive awareness in terms of:

1.1. Knowledge about Cognition

1.2. Regulation of Cognition

1. What is the level of students’ persistence in solving mathematical problems in terms of:

2.1. Classroom exercises

2.2. Take-home assignments

2.3. Group tasks

2.4. Examinations

1. Is there a significant relationship between metacognitive awareness and persistence in solving mathematical problems?
2. Does metacognitive awareness significantly influence persistence in solving mathematical problems?

***Null Hypotheses***

Ho1: There is no significant relationship between metacognitive awareness and persistence in solving mathematical problems.  
Ho2: There is no significant influence of metacognitive awareness on persistence in solving mathematical problems.

***Theoretical/Conceptual Framework***

This study is based on Flavell’s (1979) theory of metacognition, which highlights the learner’s ability to monitor and control their thinking. Metacognitive awareness includes knowledge about cognition and regulation of cognition, helping students manage learning strategies and persist through difficult tasks. Pintrich (2002) emphasized the link between metacognition and motivation, showing that motivated and self-aware learners are more likely to persist. Dweck’s (2006) Mindset Theory also supports this, suggesting that students with a growth mindset are more likely to overcome challenges. These theories together explain how metacognitive awareness can strengthen persistence in solving mathematical problems.

|  |
| --- |
| **Metacognitive Awareness**   * Knowledge About Cognition * Regulation of Cognition |

|  |
| --- |
| **Persistence in Solving Mathematics Problem**   * Classroom exercises * Take home assignments * Group tasks * Examination |

***Figure 1. Conceptual Framework***

***Methodology***

This study utilized a descriptive-correlational research design to explore the relationship and influence of metacognitive awareness on students' persistence in solving mathematical problems. It was conducted at Davao Central College, located in Toril, Davao City, Philippines, during the academic year 2024–2025.

The participants consisted of 100 BSEd Mathematics majors, from first to fourth year, selected through purposive sampling. Only officially enrolled students were included in the study.

To gather the necessary data, two widely recognized instruments were used. The Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison (1994), consisting of 52 items rated on a 5-point Likert scale, is a well-established tool in educational research. It has demonstrated strong validity and high reliability, with a coefficient alpha of .95 for the entire instrument. The second tool, the Persistence in Mathematical Problem-Solving (MPS) Scale, adapted from Ogbu and Ugwu (2023), includes 28 items covering four academic contexts: classroom exercises, take-home assignments, group tasks, and examinations. Expert validation and pilot testing confirmed the reliability of the scale, with underlying factors showing strong reliability estimates of .78 and above. These results support the suitability of both instruments for use in this study.

The data gathering procedure involved obtaining approval from the school administration and the program head. Informed consent was secured from the respondents prior to the distribution of the survey instruments. After collecting the responses, the data were encoded and analyzed.

Descriptive statistics, such as mean and standard deviation, were used to determine the levels of metacognitive awareness and persistence. Pearson’s correlation coefficient was employed to identify the relationships between the two variables, and multiple regression analysis was conducted to determine the extent to which metacognitive awareness influences persistence.

**Results and Discussion**

**Table 1. Descriptive Table**

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| --- | --- | --- | --- |
| **Variables and Their Indicators** | **Standard Deviation** | **Mean** | **Verbal Description** |
| **Students Metacognitive Awareness** | **.372** | **4.31** | **Very High** |
| Knowledge Cognition | .415 | 4.30 | Very High |
| Regulation of Cognition | .377 | 4.32 | Very High |
| **Persistence in Solving Mathematics Problems** | **.467** | **4.06** | **High** |
| Classroom exercises | .547 | 4.02 | High |
| Take-home assignments | .676 | 3.88 | High |
| Group tasks | .621 | 4.06 | High |
| Examination | .482 | 4.29 | Very High |

Table 1 shows high mean scores for both metacognitive awareness and persistence in solving mathematical problems. The mean score for Knowledge of Cognition was 4.30, while Regulation of Cognition yielded a slightly higher average of 4.32. The relatively low standard deviations across these measures further suggest a strong consistency in students’ responses, reflecting a shared sense of self-efficacy in applying metacognitive approaches to learning. The overall mean of 4.31 indicates that students generally perceive themselves as highly aware of their learning processes and confident in their ability to manage and regulate their cognitive strategies.

On the other hand, students demonstrate a high degree of persistence in solving mathematics problems across different academic contexts. The highest mean score was garnered in mathematics examinations with a mean score of 4.29. The take-home assignments garnered the lowest mean score of 3.88. The standard deviations indicate moderate variability in students' responses. The overall mean of 4.06 suggests that students, on average, put a strong effort and remain resolute, specifically during exams, which shows the most persistence.

**Table 2. Test of Relationship**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Independent Variable** | **Persistence in Solving Mathematical Problems** | | | |
| **R-value** | **p-value** | **Decision on Ho** | **Remarks** |
| **Metacognitive Awareness** | .528 | .000 | Rejected | Significant |

Table 2 shows the statistical correlation between metacognitive awareness and students' persistence in solving mathematical problems. The results indicate a significant positive relationship, with a computed Pearson correlation coefficient (R-value) of .528 and a p-value of .000. Since the p-value is less than the standard significance level of 0.05, the null hypothesis is rejected, indicating that metacognitive awareness has a statistically significant relationship on students' persistence in mathematical tasks.

**Table 3. Regression Table**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Independent Variable** | **Persistence in Solving Mathematical Problems** | | | | |
| **R2-value** | **F-Value** | **p-value** | **Decision on Ho** | **Remarks** |
| **Metacognitive Awareness** | 27.90% | 37.9 | .000 | Rejected | Significant |

Table 3 presents the results of the regression, that metacognitive awareness is a significant predictor of students' persistence in solving mathematical problems. The R² value of 27.90%, nearly a third of the variation in persistence for students, can be attributed to their level of metacognitive awareness. With an F-value of 37.9 and a p-value of .000, the result is statistically significant, leading to rejection of the null hypothesis (Ho). This provides evidence that students with better metacognitive awareness concerning mathematics are more persistent in solving mathematical problems. However, the remaining 72.1% of the variance may be explained by other unexamined variables, underscoring the importance of exploring additional factors that influence mathematical performance.

The study revealed that students demonstrated very high levels of metacognitive awareness, both in terms of knowledge about cognition and regulation of cognition. This indicates their strong ability to monitor, control, and plan their thinking processes are essential skills in tackling complex learning tasks such as mathematical problem-solving. These findings support the work of Bakar and Ismail (2019), who found that metacognitive strategies positively influence student learning outcomes, and Guner and Erbay (2021), who emphasized that these skills are not innate but can be taught and developed through intentional instruction. In addition to metacognitive awareness, students also exhibited high persistence in solving mathematical problems, with the highest levels observed during examination settings. This suggests a strong sense of motivation and commitment to overcoming academic challenges. The findings are consistent with Sultanova et al. (2024), who emphasized the role of persistence as a critical component of academic resilience, and with Mazana (2019), who reported that persistent students tend to engage more deeply with learning tasks, ultimately improving their academic performance.

Correlation analysis revealed a significant positive relationship between metacognitive awareness and persistence, suggesting that students with higher metacognitive skills are more likely to sustain effort and adapt strategies when faced with difficult mathematical problems. This aligns with previous studies by Attami et al. (2020) and Kamid et al. (2023), who both reported that metacognition enhances students’ ability to persist through academic challenges. Additionally, Rahmawati et al. (2024) highlighted how metacognitive training not only improves cognitive regulation but also strengthens academic resilience, enabling learners to approach challenges with greater confidence and determination.

Regression analysis further confirmed that metacognitive awareness is a significant predictor of persistence, reinforcing earlier research that linked metacognitive development to mathematical resilience. As shown in the work of Agustin et al. (2022), resilient students tend to recognize their strengths and limitations, reflect on their learning experiences, and plan effective strategies accordingly. Moreover, Hutauruk et al. (2019) and Sahin and Kendir (2013) noted that metacognitive awareness fosters positive academic behaviors such as motivation, self-efficacy, and a growth mindset. These attributes collectively empower students to maintain effort, manage setbacks, and ultimately succeed in problem-solving tasks.

**Conclusion**

Since metacognitive awareness significantly influences Persistence in Solving Mathematical Problems, the theory of metacognition, by John Flavell (1979), is affirmed, which emphasizes the learner's ability to monitor and control their cognitive processes. Metacognitive awareness comprises two core components: knowledge about cognition and regulation of cognition. These skills enable students to manage their learning strategies effectively, contributing to enhanced persistence when faced with difficult mathematical tasks. When students are aware of their cognitive processes, they are more likely to persist, adapt strategies, and manage emotional responses to academic challenges. Consequently, math majors with higher metacognitive awareness showed greater persistence, especially during examinations. Statistical results showed that metacognitive awareness explained 27.9% of the variance in persistence. This implies that other factors may influence persistence in solving mathematical problems not covered in the present study.

**Recommendation**

Given these findings, it is essential to apply them to educational practice. Students are encouraged to regularly engage in metacognitive practices such as self-monitoring, goal-setting, and evaluating their own problem-solving approaches to enhance both persistence and mathematical performance. Teachers may incorporate explicit instruction on metacognitive strategies within mathematics lessons to help students become more aware of their thinking processes and promote greater autonomy in learning. Future researchers may explore other influencing variables, such as motivation, academic self-efficacy, and emotional regulation, that may also affect students’ persistence in mathematics. Moreover, similar studies may be conducted across different academic levels, disciplines, or institutions to validate and enrich the findings of this research.

**Ethical Approval and Consent:**

The researcher obtained the approval from the school administration and the program head. Informed consent was secured from the respondents prior to the distribution of the survey instruments. Ethical considerations were strictly observed throughout the research process. Confidentiality of responses was ensured, and participation was voluntary, with respondents free to withdraw at any point without penalty.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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