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MEDIATING EFFECT OF METACOGNITIVE AWARENESS ON THE RELATIONSHIP BETWEEN THE ACADEMIC MOTIVATION AND PROBLEM-SOLVING SKILLS OF STUDENTS IN MATHEMATICS

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ABSTRACT

This study determined the mediating effect of metacognitive awareness on the relationship between academic motivation and problem-solving skills of students in Mathematics. A descriptive- correlational research design was employed. The respondents of this research were 350 Grade 8 students from three (3) public secondary schools in Mati City, Davao Oriental. A stratified random sampling was utilized. This study used two adopted questionnaires and one researcher-made questionnaire. Mean, Pearson r, Standard Deviation, and Regression Analysis used as statistical tools. Students' problem-solving skills, in terms of understanding the problem, devising a plan, carrying it out, and looking back, are very low. The academic motivation in terms of intrinsic value, self-regulation, self-efficacy, utility value, and test anxiety is often evident in the students. Students' metacognitive awareness in terms of Declarative Knowledge, Procedural Knowledge, Conditional Knowledge, Planning, Monitoring, and Evaluation is often monitored. The results revealed a significant relationship between academic motivation and problem-solving skills, academic motivation and metacognitive awareness, and metacognitive awareness and problem-solving skills. Metacognitive awareness significantly mediates the relationship between academic motivation and problem-solving skills with partial mediation. The results show that academic motivation and metacognitive awareness are important for problem-solving skills, suggesting the use of and improving these factors in Mathematics Education. The curriculum and teaching methods need to be developed to help students stay motivated and aware of their own thinking. This will allow both teachers and students to improve students' problem-solving skills.

KEYWORDS: *Math Education, Academic Motivation, Metacognitive Awareness, Problem-Solving Skills, Descriptive And Correlational Design, Mediation Analysis, Davao Oriental , Philippines*

BACKGROUND OF THE STUDY

Problem-solving is an essential part component of 21st century skills because it helps people overcome obstacles (Graesser et al., 2023). Students learn how to solve problems in the real world through problem-solving (Sukariasih et al., 2020). Similarly, assert that individuals with advanced 21st century skills can quickly devise effective solutions to everyday challenges (Adeoye et al., 2023). Scholars emphasize that problem-solving is integral to mathematics education, underscoring its importance in understanding mathematical concepts and applying knowledge to real-life scenarios (Nilimaa, 2023). Through this capacity, students will understand and be able to use several methods to solve mathematical problems (Gavaz et al., 2021). Many students struggle to see the practical applications of mathematical concepts, leading to disengagement and a lack of problem-solving development (Riegel, 2021).

Three common mistakes students make in understanding mathematics are being inattentive while reading problems, struggling with solution steps, and failing to create assumptions from the given information, which hinders problem-solving (Saparwadi, 2022). Indonesian students still have trouble solving mathematical problems as evidenced by the 35% of 40 students who reported difficulties with reading problems, 37.5% with understanding problems, 20% with transformation, 25% with solving problems and 67.5% with writing responses (Yuliyani et al., in 2023). A recent study conducted in the Philippines found that respondents from Mindanao had poor problem-solving abilities with an average accuracy rate of when solving mathematical problems (Lambino et al., 2023). In Mandaluyong City, of the 55 students 29.10% or 16 people had trouble solving problems (Collado Jr., 2020). In Valencia City, Bukidnon, showed that every one of the 46 students who were polled or 100% of the sample said they had very little problem-solving ability. A below-average performance in this area is indicated by the mean score of 14. 20 (Ambasa et al., 2022). In a public secondary school within the Mati City Division, a performance task on problem-solving was administered to Junior High School students, revealing low achievement in Mathematics. The projected outcome indicates that 35 out of 40 students, which is 75%, possess low problem-solving skills, whereas just 10 out of 40, or 25%, have average problem-solving abilities. Students' confidence in mathematics is one of the many aspects that teachers must take into account in order to support effective mathematical learning (Azucena et al., 2022). In addition, students should be able to think critically

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and have enough information to solve problems, which are essential 21st century skills (Amanda et al., 2022). Moreover, mathematics is an essential topic taught in elementary and secondary education that gives students the basic knowledge and abilities they need to manage their lives (Ariyanti, 2020). Because problem-solving skills involve intricate processes including reading, processing, and resolving mathematical issues, they represent the pinnacle of thinking. (Nurhayanti et al., 2020).

OBJECTIVES

This study aimed to investigate if metacognitive awareness significantly mediates academic motivation and problem-solving- skills of students in mathematics. Specifically, the study answered the following questions:

1. To evaluate the level of Academic Motivation among students in terms of:
    1.1 Intrinsic Value,
    1.2 Self-regulation
    1.3 Self-efficacy;
    1.4. Utility Value, and
    1.5 Test Anxiety.
2. To determine the level of problem- solving skills among students in the field of mathematics specifically their ability to:
    2.1 Understand the problem.
    2.2 Devise a plan.
    2.3 Carry out the plan.
    2.4 Look back/Evaluate the solution.
3. To assess the level of Metacognitive Awareness among students in terms of:
    3.1 Knowledge of Cognition, and
    3.2 Regulation of Cognition.
4. To analyze the significant relationship between:
    4.1 Academic Motivation and the Problem- Solving skills in
    Mathematics;
    4.2 Academic Motivation and Metacognitive Awareness; and
    4.3 metacognitive awareness and problem solving-skills.
5. To test the mediating effect Metacognitive Awareness, determining if the influence
of Academic Motivation on Problem-Solving Skills is significantly channeled
through the students' metacognitive processes.

METHODOLOGY

This study employed a quantitative research specifically descriptive and correlational design with mediation analysis. The best method for determining relationships between variables and characterizing conditions as they are without changing the research setting is descriptive-correlational (Bhandari, 2022). Moreover, the descriptive-correlational design is used for characterizing research variables and investigating inherent relationships or associations between variables (Sousa et al., 2007). Furthermore, the descriptive-correlational design is used for characterizing research variables and investigating inherent relationships or associations between variables (Sousa et al., 2007). The respondents of this study were the Grade 8 students who were officially enrolled in three public secondary schools in Mati City, Davao Oriental, Philippines of the academic year 2025–2026. There were 184 responders in total of 55 from School A, 63 from School B and 66 from School C. The data of the study was gathered using two adopted research instruments and one questionnaire that the researcher created. The reliability of the three research instruments was assessed through pilot testing, and experts reviewed them for validation.

RESULTS

The level of academic motivation among students in terms of intrinsic value was high. The result is aligned with the findings of (Cartwright et al., 2020), which shows that students with a high degree of intrinsic value are more likely to give their academic work their all, improving comprehension and memory retention. Students' overall category mean for academic motivation in terms of self-regulation was 3. 51 with a descriptive equivalent of high. When it comes to self-regulation, which is essential for effective study and learning, this suggests that the students are highly motivated to learn. Students' overall category mean for self-regulation was 3.51, indicating a strong degree of academic drive. This implies that students' have a strong desire to practice the self-control necessary for efficient learning and study. The idea that self-regulated students are more likely to succeed academically because they actively seek to overcome obstacles supports these findings. Setting realistic goals and providing constructive criticism are two strategies that help people develop self-regulation and should be crucial for inspiring others (Theobalds, 2021). Additionally, students who use effective self-regulation strategies typically perform better academically and experience less anxiety (McLeod et al., 2021). Based on self-efficacy the analysis of students academic motivation level placed them in the moderate category with an overall mean score of 3.38. This implied that students academic motivation is occasionally apparent. Students levels of self-efficacy are comparatively moderate to highly variable, as indicated by the standard deviation value of 1.14. This shows that although some students are very confident in their academic skills, others might be less confident. Self-efficacy beliefs boost students commitment, hard work, and persistence, all of which improve academic performance and have an impact on task choice and persistence (Hayat et al., 2020). The overall category mean in terms of utility value is 3.76 reflects a high level of academic motivation among students. This implies that most students view academic assignments as important and closely related to their own objectives and aspirations for the future. Furthermore, the standard deviation value of 1.05 for students' academic motivation in terms of utility value indicates a moderate level of variability in their responses. In particular, emphasize that a learners commitment to employing effective cognitive strategies can be reinforced by perceived utility value, which is defined as the learners evaluation of a tasks utility and alignment with personal objectives (McDaniel et al., 2020). Students' overall academic motivation category mean for test anxiety was 3.56, indicating a high level. Explain that test anxiety is often marked by intense emotional responses such as

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fear and worry about failure (Cassady et al., 2020), while notes that it can also manifest physiologically through symptoms like sweating, nausea, and increased heart rate (Zeidner, 2020). In summary, the descriptive equivalent for students' academic motivation was high, with an overall category mean of 3.55. Their motivational responses demonstrate a slight level of variability, as suggested by the reported standard deviation of 1.12. While the overall average ratings across categories indicate that students typically show strong academic interest, noticeable individual differences are present. Certain students might display different levels of involvement, whereas others remain highly motivated at all times. This spread emphasizes the significance of tailored assistance in maintaining and boosting motivation across diverse learners. This is consistent with the study's findings, which showed that students were motivated in a variety of ways, such as their confidence in their ability to perform well and their belief in the value of mathematics (Howard et al., 2021) .

The overall category mean for students' problem-solving skills was very low, with an overall category mean of 4.37. This implies that the students were not very good at solving problems. The standard deviation of 6.43 indicates a significant degree of variation in the students abilities, despite the fact that their overall level of problem-solving skills is still low. The outcome parallels to the proposition that math problems are challenging for high school students. The problem is difficult for students to understand. Particularly a few students in a math class demonstrated poor problem-solving abilities (Sinaga et al., 2023).

Students declarative knowledge category mean for metacognitive awareness is 3.29 with a descriptive equivalent of moderate. The standard deviation of 1.02 in students' metacognitive awareness related to declarative knowledge indicates a moderate level of variability in their responses. Even though many students demonstrated excellent comprehension monitoring and adaptive learning strategies, it was found that there was variation across sub-dimensions, such as declarative knowledge, indicating uneven development of metacognitive skills (Salele et al., 2025). Furthermore, the results is consistent with viewpoint which highlights the importance of explicit instruction self-reflection and regular practice in the development of declarative knowledge (Chens, 2020). The category mean for students' metacognitive awareness in procedural knowledge was 3.37 and having a moderate descriptive equivalent. Additionally, the standard deviation of 1.06 in students' metacognitive awareness related to procedural knowledge indicates a moderate degree of variability in how students understand and apply learning strategies. Drew pointed out that people can easily perform daily tasks like tying shoelaces cooking or riding a bike thanks to procedural knowledge which is learned via practice and experience (Drews, 2023). The level of metacognitive awareness among students in terms of conditional knowledge is 3.57. This suggests that in their metacognitive processes, students typically demonstrate a high degree of competence in applying conditional knowledge. This outcome supports the finding that conditional knowledge is crucial for decision-making, problem-solving, and learning outcomes (Clifton et al., 2020). The category mean for students metacognitive awareness in terms of planning is 3.79 which is descriptively equivalent to high. This suggests that students metacognitive awareness is often observed. The standard deviation of 1.04 in students' metacognitive awareness related to planning indicates a moderate level of variability in how students prepare and organize their learning activities. This variation implies that some students may be less methodical or deliberate in their approach, even though many consistently exhibit strong planning behaviors. Students who possess metacognitive awareness in terms of planning are able to think critically and perform better because they know what to anticipate and prepare. To put it another way having strong planning skills can boost students confidence in their approach to a task and their expectations for its result (Lilian, 2022). Students' metacognitive awareness was often monitored, as evidenced by a mean score of 3.51 in monitoring, which is descriptively considered high. This implies that a large number of students actively monitor their cognitive performance and make well-informed choices to enhance learning results. The standard deviation of 1.10, however, indicates that students' use of these monitoring techniques varies from modest to high. The current literature supports the studys findings, which show that students have a high degree of metacognitive awareness when it comes to monitoring. Highlights how monitoring techniques act as internal cues that warn students of possible misconceptions or mistakes, encouraging them to reevaluate their ideas and modify their strategy accordingly (Price-Mitchell, 2020). In terms of evaluation, the category mean score for students level of metacognitive awareness is 3.57, with a descriptive equivalent of high, suggesting that students metacognitive awareness is often monitored. When students are assessed at the end of a task it indicates that they are aware of how much they have learned how long it took what conditions they were in and what needs to be adjusted (Frenken, 2021). Moreover, students can improve their work and apply what they have learned to new situations by analyzing parts of their work and learning about the nuances of their thought processes (Price-Mitchell 2020). In summary, students' total category mean for metacognitive awareness was 3.52, which is the descriptive equivalent of high. Students who are conscious of their thought processes typically tackle mathematical problems with more clarity and flexibility (Guner, 2021). Additionally, stress that metacognitive awareness helps students recognize their shortcomings, modify their approaches, and enhance their performance (Thi-Nga et al., 2024). Their findings support the study's conclusion that students are more likely to succeed academically, especially in mathematics, if they regularly track and assess their learning.

A mediation effect is suggested by the fact that motivation has a very large correlation (0.782) with metacognition but a modest correlation (0.209 with problem-solving. A high/strong positive correlation of 0.782 was found between Academic Motivation and Metacognitive Awareness ($r = 0.782$, $p < .001$). This implies that when students become more motivated, their metacognitive awareness and capacity to organize, track, and assess their own thought processes likely to rise dramatically.

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Students that are highly driven are more likely to devote the time and effort necessary to consider their methods of learning. Not only do they complete the task, but they also consider how they accomplish it. Additionally, the correlation between Metacognitive Awareness and Problem-Solving Skills ($r = 0.288$, $p<.001$). Interestingly, metacognition (0.288) is a slightly stronger predictor of problem-solving than motivation (0.209). This implies that knowing how to think is statistically more critical for solving tasks than simply wanting to succeed. Meanwhile, the correlation between Academic Motivation and Problem-Solving ($r = 0.209$, $p = .004$). Motivation by itself is a somewhat weak predictor of real problem-solving skills, despite a proven correlation. Even though a student is highly motivated to solve a problem, this motivation does not always result in the right answer if they lack the requisite cognitive skills or domain expertise.

Path a (IV → MV): 0.83; this is a very strong, positive relationship. It suggests that higher Academic Motivation leads to significantly higher Metacognitive Awareness. Path b (MV→DV): 3.18; this is an extremely high coefficient. In standardized terms, a value over 1.0 is unusual and often points to Multicollinearity (since MV and IV are so highly correlated at 0.83). It indicates that Metacognitive Awareness is a massive predictor of Problem-Solving Skills. Path c' (Direct Effect: IV→DV): -0.45; this is the leftover effect of Motivation on Problem-Solving after controlling for Metacognition. The association between academic motivation and problem-solving skills is totally mediated by metacognitive awareness, according to the model's considerable indirect effect. It's interesting to note that a suppression effect was found; whereas motivation greatly stimulates the metacognitive processes required for success, it has a detrimental direct influence that is independent of metacognition. This suggests that raw motivation without strategic thought may impede the completion of difficult tasks.

RECOMMENDATIONS

Problem-solving in mathematics should be practiced weekly using structured steps, with a focus on the looking back phase to reinforce reflection. Students should also track and prioritize daily academic tasks using planners and adopt one new learning strategy per month to broaden their metacognitive toolkit (set of strategies designed to help learners). Students should consistently apply high utility value strategies, such as setting clear academic goals and connecting tasks to personal relevance, to stay motivated. 2. Teachers should implement Polya's four-step problem-solving model in mathematics lessons and create a supportive, student-centered classroom environment. Teachers should spend time in each class helping students with self-monitoring and reflection exercises to increase metacognitive awareness. By using these techniques on a regular basis, students will develop into more autonomous learners, which will result in quantifiable gains in academic achievement and deeper conceptual comprehension. School administrators ought to assist teachers in prioritizing strategies that enhance motivation, such as utility value, self-efficacy, and problem-solving instruction. Future research should examine how students academic motivation and problem-solving abilities are influenced by physiological, cognitive, and environmental factors.

CONCLUSIONS

Students demonstrate a consistently high level of academic motivation. Students frequently engage in metacognitive awareness, suggesting they are active in monitoring and regulating their own learning processes.