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Metacognition, Attitude Towards Mathematics and Academic Performance of Grade - 9 Students in a District of Nueva Vizcaya

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Abstract

This study examined the levels of metacognition, attitude toward mathematics, and academic performance of Grade 9 students in Nueva Vizcaya, as well as the relationships and predictive influence among these variables. Anchored on Flavell's Theory of Metacognition (1976), Zimmerman's Self-Regulated Learning Theory (2002), and Bandura's Social Cognitive Theory (1986), the study adopted a quantitative approach using descriptive, comparative, correlational, and predictive research designs. Data were collected from Grade 9 students in public secondary schools through proportionate stratified random sampling. Standardized instruments, namely the Metacognitive Awareness Inventory (MAI), the Attitude Toward Learning Mathematics Scale (ATLM), and students' mathematics grades, were utilized. Statistical analyses included descriptive statistics, repeated measures ANOVA, correlation analysis, and stepwise multiple regression. Findings revealed that students demonstrated a high level of metacognition but showed inconsistencies in reflective and evaluative practices. Students exhibited a neutral attitude toward mathematics, characterized by strong recognition of its value but moderate levels of enjoyment, confidence, and motivation. Academic performance was generally satisfactory to very satisfactory. Results further indicated a significant but weak positive relationship between metacognition and academic performance, no significant relationship between attitude and performance, and a moderate significant relationship between metacognition and attitude. Regression analysis showed that metacognition significantly predicts academic performance, whereas attitude does not, with the model explaining only a small proportion of variance. The study concludes that metacognition plays a more direct role in academic achievement, while attitude functions as a supportive factor. It recommends strengthening metacognitive strategies in instruction and exploring additional variables influencing performance. This study aligns with SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth) by promoting improved learning outcomes and competencies essential for future workforce readiness. It contributes to educational and socio-economic sustainability by informing instructional practices and policies that enhance both cognitive and affective dimensions of mathematics learning.

Keywords: Academic performance, Attitude toward mathematics, Grade 9 students, Mathematics education, Metacognition, Self-regulated learning, Student achievement

1. Introduction

Mathematics is essential for developing logical reasoning, analytical thinking, and problem-solving skills, yet it remains a major challenge for many learners worldwide. Evidence from international, national, and local contexts indicates persistent difficulties in mathematical understanding, particularly in higher-order thinking. These challenges are strongly linked to both cognitive factors, such as metacognition, and affective factors, such as attitude toward mathematics. This study examines how metacognition and attitude toward mathematics interact to influence the academic performance of Grade 9 students in Nueva Vizcaya, providing a cognitive–affective perspective on mathematics learning.

1.1 Background of Metacognition, Attitude Toward Mathematics, and Academic Performance of Grade 9 Students

Mathematics plays a critical role in academic and real-world problem-solving; however, many learners experience persistent difficulty in mastering mathematical concepts. International assessments such as PISA and TIMSS show that students struggle particularly in applying mathematical knowledge to real-world contexts, indicating deficiencies in higher-order thinking skills. Park and Kim (2024) found that students across countries underperform in statistical and probabilistic reasoning, while Plavčan (2020) reported persistent gaps in mathematical literacy even in reformed education systems. These challenges extend beyond curriculum issues and reflect deeper cognitive and emotional factors. Nourozzade and Soleimani (2022) identified mathematics anxiety and low self-efficacy as key barriers to learning, while Aydın and Özgeldi (2024) demonstrated that anxiety negatively affects achievement unless mediated by metacognitive awareness. Ajisuksmo

and Saputri (2017) further emphasized that difficulties arise from limitations in learners' ability to regulate thinking and emotions, highlighting the need for a holistic understanding of mathematics learning.

1.2 Themes and Insights on Metacognition and Attitude Toward Mathematics in Relation to Academic Performance

Attitude toward mathematics is a major determinant of student engagement and performance. It includes emotional, motivational, and belief-based components such as confidence, perceived value, and enjoyment (Tapia & Marsh, 2004). Positive attitudes promote persistence, motivation, and deeper learning, whereas negative attitudes lead to anxiety, avoidance, and low achievement. Empirical evidence consistently supports this relationship. Mensah et al. (2013) identified confidence and perceived usefulness as predictors of achievement, while Ingram (2015) linked perceived relevance to the use of self-regulated learning strategies. Comahig and Abuzo (2024) found that attitude mediates the relationship between self-efficacy and motivation, and Laranang and Bondoc (2020) reported that confidence and enjoyment correlate with higher academic performance. Bendol, J., Jr. (2024) further emphasized the role of self-efficacy as a link between motivation and confidence. Attitudes are shaped by learning experiences and social interactions. Piaget (1970) and Vygotsky (1978) emphasized that learning involves both cognitive and emotional processes, while Attard (2012) noted that early experiences influence long-term engagement. These findings confirm that attitude is both a determinant and outcome of learning behavior.

1.3 Global, National, and Local Context of Mathematics Performance among Grade 9 Students

Globally, students continue to struggle with mathematical reasoning and application despite reforms (Park and Kim, 2024; Plavčan, 2020). Nationally, Filipino learners consistently perform below global standards, particularly in higher-order thinking tasks. Ganal and Guiab (2014) reported limited conceptual understanding among students. Recent studies reinforce these concerns. Layco (2020) found that anxiety and hopelessness predict low performance, although metacognitive skills can mitigate these effects. Cabilan and Peteros (2024) observed that performance is more strongly influenced by motivational and cognitive factors than by metacognitive strategies alone. Locally, results from the Rapid Mathematics Assessment (RMA) in Nueva Vizcaya indicate that students are generally not proficient across Grades 7 to 10. These findings highlight systemic challenges in conceptual understanding, procedural fluency, and problem-solving, emphasizing the need for targeted interventions.

1.4 Theoretical and Conceptual Foundations of Metacognition, Attitude, and Academic Performance

This study is grounded in Flavell's Theory of Metacognition (1976), Zimmerman's Self-Regulated Learning Theory (2002), and Bandura's Social Cognitive Theory (1986). Flavell (1976) conceptualized metacognition as awareness and regulation of cognition, enabling learners to plan, monitor, and evaluate their thinking. Desoete and De Craene (2019) and Thi-Nga et al. (2024) emphasized its role in promoting analytical reasoning and persistence, while Aydın and Özgeldi (2024) highlighted its mediating effect on anxiety and achievement. Zimmerman (2002) expanded this by integrating motivation and behavior, describing learning as a cyclical process involving planning, monitoring, and reflection. Thi-Nga et al. (2024) and Amal and Mahmudi (2020) demonstrated that self-regulated learners exhibit stronger metacognitive awareness, motivation, and problem-solving ability. Bandura (1986) explained learning through reciprocal interactions among personal, behavioral, and environmental factors, emphasizing self-efficacy. Mensah et al. (2013) showed that self-efficacy influences persistence and engagement in mathematics. Together, these theories establish that metacognition and attitude are interrelated constructs that jointly influence academic performance. Supporting this, Xue et al. (2021) found that metacognition moderates the effect of procrastination, while Miranda (2025) and Tak and Zulnaidi (2025) demonstrated that metacognition and attitude collectively predict achievement.

1.5 Research Gaps on the Combined Influence of Metacognition and Attitude Toward Mathematics on Academic Performance

Despite extensive research, gaps remain in understanding the combined effects of metacognition and attitude toward mathematics, particularly within the Philippine context. Existing studies often examine these variables independently, with limited focus on their interaction among junior high school students. Local evidence indicates persistent low proficiency and systemic learning challenges, yet there is insufficient research integrating cognitive and affective factors to explain academic performance. This study addresses this gap by examining how metacognition and attitude jointly influence the mathematics performance of Grade 9 students in Nueva Vizcaya.

1.6 Alignment of the Study with Sustainable Development Goals (SDGs) on Quality Education and Economic Growth

This study aligns with SDG 4 – Quality Education, as it focuses on improving learning outcomes and addressing barriers to effective mathematics education. By examining cognitive and affective determinants of learning, it contributes to enhancing educational quality and student achievement. It also supports SDG 8 – Decent Work and Economic Growth, as strong mathematical skills are essential for workforce readiness, problem-solving, and participation in a knowledge-based economy.

1.7 Multidisciplinary Sustainability Contributions of Metacognition and Attitude in Mathematics Education

This study contributes to educational sustainability by promoting improved teaching and learning strategies that address both cognitive and emotional aspects of mathematics. It supports socio-economic sustainability by strengthening students' competencies needed for future employment and decision-making. Additionally, it advances community and institutional sustainability by providing evidence-based insights that can guide curriculum development, instructional practices, and policy interventions. By integrating metacognition and attitude, the study fosters a holistic approach to learning that supports long-term academic success and sustainable development.

2. Material and methods

2.1 Research Design

The study utilized a quantitative research approach incorporating descriptive, comparative, correlational, and predictive designs. The descriptive design was used to determine the levels of metacognition, attitudes toward mathematics, and academic performance. The comparative design identified differences across metacognitive and attitudinal domains, while the correlational design examined relationships among the variables. The predictive design assessed whether metacognition and attitude could explain variations in students' mathematics performance. This approach was appropriate because the variables were measurable and could be analyzed statistically without manipulating the environment. It enabled an objective assessment of relationships among metacognition, attitude, and achievement, and allowed the researcher to determine the strength and direction of these relationships based on observed data.

2.2 Locale of the Study

The study was conducted in the Department of Education Schools Division Office of Nueva Vizcaya, specifically in the Bagabag I District, involving three public secondary schools. These schools vary in size classification based on enrollment as defined by DO 19, s. 2016. The district follows the national curriculum, where Grade 9 mathematics includes algebra, geometry, statistics, and trigonometry, requiring higher-order thinking and problem-solving skills. Variations in classroom conditions, such as student-teacher ratios and access to learning resources, provided a diverse context for examining differences in metacognitive and attitudinal patterns. The district's geographic and socioeconomic diversity contributed to a richer interpretation of students' cognitive regulation, beliefs, and academic performance.

2.3 Respondents of the Study

The respondents were Grade 9 students enrolled in public secondary schools in the Bagabag I District during the School Year 2025–2026. This group was selected because students at this level are expected to have developed foundational metacognitive skills and are transitioning to more abstract mathematical reasoning. Their developmental stage is critical in shaping future academic performance. Participation was voluntary, and only students with signed parental consent were included. Respondents completed two standardized questionnaires administered in classroom settings, with clear instructions provided to ensure proper understanding. Each questionnaire required approximately 20–30 minutes to complete, and all responses were treated with strict confidentiality.

2.4 Sample and Sampling Procedure

The total population of Grade 9 students was obtained from district records, and the sample size was determined using the Raosoft Sample Size Calculator with a 95% confidence level and a 5% margin of error. To ensure representativeness, proportionate stratified random sampling was employed based on the number of students in each participating school. The selection of respondents was facilitated through random procedures to promote fairness and minimize bias. This ensured that all eligible students had an equal chance of participation across the different schools.

2.5 Research Instrument

Three instruments were used to collect data. The first was the Metacognitive Awareness Inventory (MAI), which measured knowledge of cognition and regulation of cognition. Knowledge of cognition included declarative, procedural, and conditional knowledge, while regulation of cognition covered planning, information management, comprehension monitoring, debugging, and evaluation. Responses were rated on a five-point Likert scale ranging from very low to very high, and scores were averaged to determine overall and domain-specific levels. The second instrument was the Attitude Toward Learning Mathematics Scale (ATLM), which measured enjoyment, self-confidence, perceived value, and motivation. It used a five-point Likert scale ranging from very negative to very positive attitudes and has demonstrated strong reliability with Cronbach's alpha coefficients exceeding 0.80. The third instrument measured academic performance using students' average grades in mathematics for the first three quarters, obtained from official report cards. Grades were based on the Department of Education grading system using a 100-point scale. All instruments underwent content validation by experts in mathematics education and research to ensure clarity, accuracy, and cultural relevance.

2.6 Data Gathering Procedure

Formal approval was secured from the Schools Division Superintendent, District Supervisor, and school principals before data collection. Coordination with mathematics teachers facilitated the administration of the instruments. The process included preparation, data collection, and post-collection phases. During preparation, research permits were obtained and instruments were reviewed and validated. In the data collection phase, parental consent was secured prior to participation. The questionnaires were administered in printed form during scheduled sessions, with instructions provided to ensure accurate responses. Students completed the instruments within the allotted time, and their mathematics grades were retrieved from official records with proper authorization. In the post-collection phase, all data were encoded into a secure database. Respondents were assigned unique codes to maintain anonymity, and the data were checked for completeness and accuracy. Participation remained voluntary, and all information was treated confidentially and used solely for research purposes.

2.7 Data Analysis Techniques

Descriptive statistics, including mean and standard deviation, were used to analyze levels of metacognition, attitude toward mathematics, and academic performance. These measures provided quantitative and qualitative interpretations of students' cognitive and affective characteristics. Repeated Measures Analysis of Variance (ANOVA) was used to identify significant differences among domains of metacognition and attitude, determining areas where students were most and least engaged. Pearson Product-Moment Correlation Coefficient was applied to examine the strength and direction of relationships among metacognition, attitude, and academic performance. Stepwise Multiple Regression Analysis was employed to determine the extent to which metacognition and attitude predict academic performance. The model identified significant predictors and explained the proportion of variance in students' mathematics achievement, providing insight into the combined influence of cognitive and affective factors.

2.8 Ethical Considerations

Ethical standards were strictly observed throughout the study. The researcher ensured impartiality by not directly selecting respondents, with random selection facilitated by class advisers. Participation was voluntary, and informed consent was obtained from both students and their parents or guardians prior to data collection. Confidentiality and anonymity were maintained by assigning unique codes to respondents and excluding personal identifiers from all records. Data were securely stored and accessible only to the researcher, and all files were permanently deleted after completion of the study in compliance with the Data Privacy Act of 2012 (Republic Act 10173). The study posed no risk to participants, and their academic standing was not affected by participation. Ethical principles such as voluntary participation, informed consent, confidentiality, and data security were upheld in accordance with the Department of Education Research Management Guidelines (DepEd Order No. 16, s. 2017). The collected data were used solely for academic purposes to enhance understanding of metacognition, attitude, and academic performance in mathematics.

3. Results and Discussion

3.1 Metacognition, Attitude, and Academic Performance of Grade 9 Students

3.1.1 Level of Metacognition Among Students

The results show that students demonstrate a high overall level of metacognition, with frequent use of strategies related to both knowledge and regulation of cognition. Students generally exhibit strong awareness of their learning processes, including organizing information, recognizing strategies, motivating themselves, and understanding strengths and weaknesses. However, some aspects such as evaluating performance after tests, reviewing lessons, and summarizing learning are only moderately practiced, indicating inconsistencies in reflective and consolidative processes. This finding suggests that while students possess substantial metacognitive awareness, the application of specific strategies varies in consistency. This aligns with Cayetano and Ibarra (2024), who noted that metacognitive awareness predicts problem-solving abilities, and Sercenia and Prudente (2023), who emphasized its role in improving mathematics achievement. Similarly, Villaruz and Palma (2024) and Dizon (2025) confirmed that learners generally exhibit strong metacognitive awareness but may show uneven development across components. These findings indicate that metacognition is present but not uniformly applied, particularly in deeper reflective processes.

3.1.2 Extent of Attitude Toward Mathematics

The findings indicate that students exhibit an overall neutral attitude toward mathematics, suggesting a balanced or indifferent disposition. While students recognize the importance and usefulness of mathematics, their enjoyment, confidence, and motivation to pursue the subject remain moderate. Learners occasionally find mathematics interesting and feel somewhat confident, but they do not consistently demonstrate strong enthusiasm or commitment to continued engagement. This result implies that students' attitudes are influenced by situational and experiential factors rather than intrinsic motivation. This is consistent with Gjicali and Lipnevich (2021), who emphasized that attitudes affect engagement and performance, and Potužníková (2019), who highlighted the role of perceived difficulty and instructional context in shaping attitudes. Additionally, Weinhandl et al. (2023), Roni et al. (2025), and Fidan (2019) noted that enjoyment and

confidence influence persistence, while Hecht et al. (2019) and Magallon (2025) emphasized that recognizing value does not necessarily translate into sustained motivation. These findings suggest a disconnect between valuing mathematics and actively engaging with it.

3.1.3 Level of Academic Performance in Mathematics

The results reveal that students generally achieve satisfactory to high levels of academic performance, with most falling within the satisfactory, very satisfactory, and outstanding categories. A large proportion of learners demonstrate above-average achievement, while only a minimal number fall below expectations, indicating that most students are able to meet academic requirements in mathematics. This pattern suggests that while students are performing adequately, there remains variability in mastery levels. This aligns with Magallon (2025), who found that students tend to cluster in moderate to high achievement levels when supported by positive perceptions of mathematics. However, the presence of students in lower performance categories indicates the need for continued instructional support to enhance proficiency and ensure consistent achievement across all learners.

3.2 Relationship Among Metacognition, Attitude, and Academic Performance

3.2.1 Relationship Between Metacognition and Academic Performance

The results show a statistically significant but weak positive relationship between metacognition and academic performance, indicating that higher metacognitive awareness is associated with slight improvements in mathematics achievement. This suggests that metacognition functions as a supportive factor rather than a dominant determinant of performance. This finding is consistent with Cayetano and Ibarra (2024), who reported that metacognition predicts performance alongside other variables, and Cabrejas and Mendoza (2023), who emphasized the multifactorial nature of academic achievement. These results highlight that while metacognition contributes to learning, it operates in combination with other cognitive and contextual factors.

3.2.2 Relationship Between Attitude Toward Mathematics and Academic Performance

The findings indicate a weak and non-significant relationship between attitude toward mathematics and academic performance, suggesting that variations in students' attitudes do not correspond to meaningful differences in achievement. This implies that affective factors alone may not directly influence academic outcomes. This is supported by Laranang and Bondoc (2020), who found that positive attitudes do not always translate into higher performance without cognitive engagement. The result reinforces the idea that emotional disposition must be complemented by effective learning strategies to impact achievement.

3.2.3 Relationship Between Metacognition and Attitude Toward Mathematics

The results reveal a moderate and statistically significant positive relationship between metacognition and attitude toward mathematics, indicating that students with higher metacognitive awareness tend to exhibit more positive attitudes. This suggests an interaction between cognitive awareness and affective disposition. This aligns with Magallon (2025), who reported that cognitive beliefs are associated with attitudes, and Laranang and Bondoc (2020), who identified links between metacognitive-related constructs and attitude. These findings highlight that metacognition may influence how students perceive and engage with mathematics.

3.3 Predictors of Academic Performance

3.3.1 Predictive Influence of Metacognition and Attitude

The results indicate that metacognition and attitude collectively provide a statistically significant prediction of academic performance, although they explain only a small portion of the variance. Metacognition emerged as a significant predictor, while attitude was found to be non-significant. This suggests that metacognition plays a more direct role in influencing achievement compared to attitude. This finding is consistent with Cayetano and Ibarra (2024) and Cabrejas and Mendoza (2023), who emphasized the role of metacognitive strategies in performance, while Laranang and Bondoc (2020) and Magallon (2025) highlighted the limited direct impact of attitude. The low explained variance further indicates that academic performance is influenced by multiple factors beyond cognition and attitude, reinforcing the complexity of learning outcomes.

4. Conclusion & Recommendations

The study revealed that Grade 9 students demonstrate a high level of metacognition, indicating strong awareness and regulation of their learning processes, although reflective and evaluative practices such as reviewing and summarizing are less consistently applied. Students exhibit a neutral attitude toward mathematics, characterized by recognition of its value but only moderate levels of enjoyment, confidence, and motivation. Their academic performance is generally satisfactory to very satisfactory, suggesting that most learners meet expected competencies. The findings further show that metacognition is significantly related to both academic performance and attitude, while attitude toward mathematics has no significant direct relationship with performance. Moreover, metacognition significantly predicts academic performance,

whereas attitude does not, and student achievement is influenced by other factors beyond these variables.
It is recommended that the Schools Division Office strengthen capacity-building programs that focus on enhancing students' metacognitive skills, particularly in evaluation, reflection, and strategy application, while providing teachers with training and contextualized instructional materials. School leaders should reinforce instructional supervision by integrating metacognitive strategies into classroom practices and encouraging reflective and higher-order thinking activities. Mathematics teachers should consistently incorporate metacognitive strategies such as planning, monitoring, and evaluating learning, along with engaging and contextualized approaches to improve students' confidence, motivation, and overall engagement. Future researchers are encouraged to explore additional variables influencing academic performance and to conduct further studies across different contexts and designs to enhance the generalizability of findings.

The study is limited to Grade 9 students in selected public secondary schools in the Bagabag I District of Nueva Vizcaya, using specific variables such as metacognition, attitude toward mathematics, and academic performance. The scope is further confined to data gathered through self-reported questionnaires and students' grades within a single school year, which may not fully capture all factors influencing achievement. Additionally, the relatively low variance explained by the model indicates that other variables not included in the study may significantly affect academic performance.

Compliance with ethical standards

This study adhered to established ethical standards throughout its conduct. Formal permission was obtained from the appropriate educational authorities prior to data collection. Participation was voluntary, and informed consent was secured from both students and their parents or guardians. The confidentiality and anonymity of all participants were ensured through the use of coded identifiers, and no personal information was disclosed. All data were securely stored and used solely for academic purposes, in accordance with the Data Privacy Act of 2012 (Republic Act 10173) and the Department of Education Research Management Guidelines (DepEd Order No. 16, s. 2017). The study ensured that participants were not exposed to any physical, psychological, or social risk, and their academic standing was not affected by their participation.

REFERENCES

Ajisuksmo, C. R. P., & Saputri, G. R. (2017). The influence of belief about mathematics, self-efficacy, and mathematics anxiety on mathematics achievement. Creative Education, 8(1), 1433–1442. https://doi.org/10.4236/ce.2017.89102

Amal, M., & Mahmudi, A. (2020). Enhancing students' self-efficacy through metacognitive strategies in learning mathematics. Journal of Physics: Conference Series, 1613. https://doi.org/10.1088/1742-6596/1613/1/012061

Attard, C. (2012). Engagement with mathematics: What does it mean and what does it look like? Australian Primary Mathematics Classroom, 17(1), 9–13.

Aydın, U., & Özgeldi, M. (2024). What's metacognition got to do with the relationship between test anxiety and mathematics achievement? European Journal of Psychology of Education. https://doi.org/10.1007/s10212-024-00797-7

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Prentice-Hall.

Bendol, J., Jr. (2024). Self-efficacy as a mediator between motivation and confidence in mathematics. ASEAN Journal of Science and Engineering Education, 5(1), 47–58. https://ejournal.upi.edu/index.php/AJSEE/article/view/82230

Cabilan, J. B., & Peteros, E. D. (2024). Predictive analysis of independent learning bearing on students' mathematics performance in Davao de Oro, Philippines. Journal on Mathematics Education. https://doi.org/10.22342/jme.v15i4.pp1409-1432

Cabrejas, M. M., & Mendoza, R. O. (2023). College students' engagement and self-regulated learning strategies: Its influence to the academic performance in the flexible learning modality. British Journal of Multidisciplinary and Advanced Studies. https://doi.org/10.37745/bjmas.2022.0193

Cayetano, H., & Ibarra, F. P. (2024). Projecting learning styles and metacognitive awareness as predictors of problem-solving abilities in mathematics among elementary pre-service teachers. Journal of Higher Education Theory and Practice. https://articlegateway.com/index.php/JHETP/article/view/7462

Comahig, J. C., & Abuzo, E. P. (2024). The mediating effect of attitudes towards mathematics on the relationship between academic self-efficacy and motivation to learn mathematics. EPRA International Journal of Multidisciplinary Research (IJMR), 10(3), 1–10. https://eprajournals.com/IJMR/article/12599

Desoete, A., & De Craene, B. (2019). Metacognition and mathematics education: Moving forward to classroom interventions. Frontiers in Psychology, 10, 146. https://doi.org/10.3389/fpsyg.2019.01466

Dizon, M. (2025). Assessing the metacognitive awareness of freshman university students: Basis for the development of an instructional material in facilitating student-centered teaching. Social Science and Humanities Journal, 9(9), 9107–9122. https://doi.org/10.18535/sshj.v9i09.2048

Fidan, P. (2019). Math interest and identity as mediators of the relationship between self-efficacy and perceived teacher practices. Proceedings of the 2019 AERA Annual Meeting. https://doi.org/10.3102/1430718

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), The nature of intelligence (pp. 231–235). Lawrence Erlbaum Associates.

Ganal, N. N., & Guiab, M. R. (2014). Problems and difficulties encountered by students towards mastering learning competencies in mathematics. Researchers World: Journal of Arts, Science & Commerce, 5(4), 25–36.

Gjicali, K., & Lipnevich, A. A. (2021). Got math attitude? (In)direct effects of student mathematics attitudes on intentions, behavioral engagement, and mathematics performance. Contemporary Educational Psychology, 66, 102019. https://doi.org/10.1016/j.cedpsych.2021.102019

Hecht, C. A., Harackiewicz, J. M., Priniski, S. J., Canning, E. A., Tibbetts, Y., & Hyde, J. S. (2019). Promoting persistence in the biological and medical sciences: An expectancy-value approach to intervention. Journal of Educational Psychology, 111(8), 1462–1477. https://doi.org/10.1037/edu0000356

Ingram, N. (2015). Attitudes, beliefs, and motivation in mathematics education. In K. Beswick, T. Muir, & J. Wells (Eds.), Proceedings of the 39th Conference of the International Group for the Psychology of Mathematics Education (Vol. 3, pp. 153–160). PME.

Laranang, J. A. I., & Bondoc, J. (2020). Attitudes and self-efficacy of students toward mathematics. International Journal of English Literature and Social Sciences, 5(5), 1392–1423. https://ijels.com/detail/attitudes-and-self-efficacy-of-students-toward-mathematics/

Layco, E. P. (2020). The role of metacognition and its interaction on students' negative academic emotions towards their academic buoyancy and achievement in mathematics. Universal Journal of Educational Research, 8(12A), 7500–7510. https://doi.org/10.13189/ujer.2020.082534

Magallon, M. J. (2025). Numbers and notions: Exploring students' attitudes toward mathematics across confidence, value, and enjoyment. Multidisciplinary Reviews. https://doi.org/10.31893/multirev.2026007

Mensah, J. K., Okyere, M., & Kuranchie, A. (2013). Student attitude towards mathematics and performance: Does the teacher attitude matter? Journal of Education and Practice, 4(3), 132–139.

Miranda, M. A. (2025). The role of metacognitive awareness and affective engagement in mathematics learning among Filipino secondary students. Asian Journal of Education and Social Studies, 13(4), 67–79.

Nourozzade, V., & Soleimani, E. (2022). Investigating the structural equation model of the effect of metacognitive awareness, self-efficacy, and academic motivation on attitude towards mathematics by examining the mediating role of mathematical anxiety in students with special learning disabilities. Journal of Learning Disabilities. https://www.semanticscholar.org/paper/Investigating-the-Structural-Equation-Model-of-the-Nourozzade-Soleimani/a55a94c6b960c967f3e2e3dcb847f630182b9bbb

Park, K., & Kim, H. K. (2024). Comparison of achievement in mathematics content domains of TIMSS and PISA using the propensity score matching method. Korean Association for Learner-Centered Curriculum and Instruction. https://doi.org/10.22251/jlcci.2024.24.14.535

Piaget, J. (1970). Science of education and the psychology of the child. Orion Press.

Plavčan, P. (2020). The comparison of PIRLS, TIMSS, and PISA educational results in member states of the European Union. Politické súvislosti. https://www.semanticscholar.org/reader/dae7e8c127e4ae02b0a757789cbe0567efc94b60

Potužníková, E. (2019). Factors explaining the interest of Czech students in reading and mathematics. Orbis Scholae. https://doi.org/10.14712/23363177.2018.295

Roni, R., Muhamad, C., & Ngatman. (2025). Enhancing mathematics achievement through self-confidence: A correlational study of fifth-grade students in Indonesian public primary schools. Journal of Literacy Education. https://doi.org/10.64780/jole.v1i2.64

Sercenia, J. C., & Prudente, M. S. (2023). Effectiveness of the metacognitive-based pedagogical intervention on mathematics achievement: A meta-analysis. International Journal of Instruction, 16(4), 561–578.

Tak, C. W., & Zulnaidi, H. (2025). The mediating role of metacognitive awareness between mathematics anxiety and mathematics problem-solving performance among secondary students. International Journal of Instruction. https://www.scimath.net/article/mediating-role-of-metacognitive-awareness-between-attitude-and-mathematics-reasoning-in-pre-service-16116

Tak, N. A., & Zulnaidi, H. (2025). Mediating role of metacognitive awareness between attitude and mathematics reasoning. European Journal of Science and Mathematics Education. https://doi.org/10.30935/scimath/16116

Tapia, M., & Marsh, G. E. (2004). An instrument to measure mathematics attitudes. Academic Exchange Quarterly, 8(2), 16–21.

Thi-Nga, N., Thi-Thu-Hien, H., & Thi-Minh-Hang, D. (2024). Metacognitive regulation and mathematical problem-solving among high school students: The mediating role of motivation. Journal of Educational and Psychological Research, 12(2), 45–61.

Villaruz, J. M., & Palma, R. C. (2024). Metacognitive awareness of writing strategies, oral proficiency, and writing instructions: A structural equation model of academic writing skills in Filipino language. Asian Journal of Advanced Research and Reports, 18(7), 114–134. https://doi.org/10.9734/ajarr/2024/v18i7690

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

Weinhandl, R., Mayerhofer, M., Anđić, B., & Grosse, C. S. (2023). An interplay of enjoyment, engagement, and anxieties: The characteristics of upper secondary school mathematics students. Investigations in Mathematics Learning, 16(1), 36–51. https://doi.org/10.1080/19477503.2023.2267936

Xue, X., Wang, Y., Li, H., Gao, J., & Si, J. (2021). The association between mathematical attitudes, procrastination and achievement: Moderating effect of metacognition. Current Psychology. https://doi.org/10.1007/s12144-021-02133-4

Yarcia, L. D. (2024). Teachers' beliefs, attitudes, and instructional practices in mathematics education: An analysis of classroom implementation under the K to 12 curriculum. Philippine Journal of Education and Development Studies, 15(2), 89–104.

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory Into Practice, 41(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2