Metacognitive Awareness, Attitude and Academic Performance of Students in Mathematics

Janelle B. Javellana, Iris V. Taburada, Sharon L. Apohen, PhD

La Carlota City College, La Carlota City, Philippines

DOI: https://doi.org/10.47772/IJRISS.2026.100700778

Received: 01 August 2026; Accepted: 06 August 2026; Published: 12 August 2026

ABSTRACT

This study examined the relationship between metacognitive awareness, attitude toward mathematics, and academic performance in mathematics among Grade 11 students in a senior high school in the Division of Bacolod City during the SY 2025-2026. A quantitative-descriptive correlational research design was employed involving 124 Grade 11 students. Data were gathered using a Metacognitive Awareness Inventory, an Attitude toward Mathematics Scale, and students' mathematics grades to measure academic performance. The findings revealed that students demonstrated high levels of metacognitive awareness and positive attitudes toward mathematics, while their academic performance was rated very satisfactory. The study further found significant positive relationships between metacognitive awareness and academic performance, as well as between attitude toward mathematics and academic performance. These findings indicate that students with higher metacognitive awareness and more positive attitudes toward mathematics tend to perform better academically. The results underscore the importance of developing students' metacognitive skills and fostering positive attitudes toward mathematics to enhance academic achievement.

INTRODUCTION

Mathematics remains one of the most essential yet challenging subjects, as many learners continue to experience difficulties in problem-solving, critical thinking, and conceptual understanding that adversely affect academic performance (Azizah et al., 2026; Chand et al., 2021). Metacognitive awareness, defined as learners' ability to plan, monitor, and evaluate their learning processes, has been consistently associated with improved mathematics achievement because it enables the use of effective learning and problem-solving strategies (Thi-Nga et al., 2024; Baguin & Janiola, 2024; Abdelrahman, 2020; Muncer et al., 2021). Likewise, students' attitudes toward Mathematics—including confidence, interest, motivation, and feelings toward the subject—significantly influence academic performance by fostering greater engagement and persistence (Wen & Dubé, 2022). International studies further confirmed that metacognitive awareness positively predicts mathematics achievement by enhancing self-regulation, strategic thinking, and adaptability, while positive attitudes toward Mathematics promote active participation, confidence, and persistence that contribute to better learning outcomes (Alivio & Tan, 2025; Özçakmak, 2021; Akbayir & Topçul, 2021; He et al., 2024; Güner & Erbay, 2021; Hassan et al., 2022; Yz, 2022; Rehman et al., 2025). In the Philippine context, many students continue to struggle with mathematical reasoning and higher-order thinking because of limited reflective learning strategies and negative perceptions of Mathematics (Rivera & Canoy, 2025; Ansari et al., 2021; Lapinid et al., 2022; Barete & Taja-on, 2024). Local research likewise demonstrated that metacognitive awareness and positive attitudes toward Mathematics significantly enhance students' achievement, confidence, participation, engagement, and persistence in learning (Anore et al., 2025; Asignacion et al., 2021; Benedicto & Andrade, 2022; Catador, 2024; Kurdal & Kaplan, 2023; Malimban, 2025; Tuburan et al., 2025; Bendol & Dalayap, 2025). Despite these findings, limited studies have simultaneously examined the relationships among metacognitive awareness, attitude toward Mathematics, and academic performance among Grade 11 students, prompting this study to determine the levels of these variables and examine their significant relationships.

Framework

Flavell's Theory of Metacognition and Ajzen's Theory of Planned Behavior provide the theoretical foundation for this study by explaining how students' metacognitive awareness and attitudes toward Mathematics influence academic performance. Flavell (1979) described metacognition as "thinking about thinking," emphasizing learners' ability to plan, monitor, and evaluate their cognitive processes, while Ajzen (1991) explained that positive attitudes shape intentions and behaviors that promote achievement (Mughal, 2025). Metacognition consists of metacognitive knowledge and metacognitive regulation, enabling learners to become active participants who improve comprehension, problem-solving, and learning outcomes through planning, monitoring, and evaluation (Alam, 2023; Rivas et al., 2022; Bhardwaj et al., 2025). Likewise, the Theory of Planned Behavior highlights that students with positive attitudes toward Mathematics are more likely to engage actively, demonstrate confidence, persist in solving problems, and strengthen academic engagement (Roslan et al., 2021; Du et al., 2025). In mathematics education, strong metacognitive awareness enables students to identify effective learning strategies, regulate their thinking, recognize errors, and apply appropriate problem-solving methods, while positive attitudes reduce mathematics anxiety and encourage motivation and persistence (Ozturk, 2024; Zhang et al., 2024; Tay et al., 2024; L. Wang et al., 2022; Kadonsi, 2025). Together, these theories emphasize that cognitive regulation and favorable attitudes work simultaneously to enhance mathematics achievement and academic success.

The relevance of these theories to the present study lies in their explanation of how metacognitive awareness and attitudes toward Mathematics contribute to students' academic performance. Flavell's theory supports the assumption that learners who actively regulate their thinking achieve better mathematical understanding, while Ajzen's Theory of Planned Behavior explains that positive perceptions of Mathematics encourage active participation, persistence, and confidence in learning (Ozturk, 2024; Srivastava, 2024; Fadillah et al., 2021; Scheibe et al., 2023; Wakhata et al., 2022). These perspectives are further supported by evidence that metacognitive awareness improves learning regulation and mathematics achievement, whereas positive attitudes foster motivation, persistence, and engagement in learning tasks (Belgaroui & Shili, 2025; Wang et al., 2024; Boaler et al., 2024; Armah et al., 2026). Moreover, both metacognitive awareness and attitudes toward Mathematics can be strengthened through appropriate instructional practices and meaningful learning experiences (Reyes & Reyes, 2024; Sercenia & Prudente, 2023). Accordingly, Flavell's Theory of Metacognition provides the conceptual basis for examining the relationship between metacognitive awareness and academic performance, whereas the Theory of Planned Behavior explains the role of attitudes toward Mathematics in shaping achievement. Taken together, these complementary theories offer a comprehensive framework for examining the relationships among metacognitive awareness, attitude toward Mathematics, and academic performance among Grade 11 students.

Methods

This study employed a quantitative descriptive-correlational research design to examine the relationship between metacognitive awareness, attitude toward Mathematics, and academic performance among Grade 11 HUMSS students in one secondary school under the Schools Division of a particular city in Negros Occidental. Quantitative research enabled the systematic collection and statistical analysis of numerical data, while the descriptive component determined the levels of metacognitive awareness, attitude toward Mathematics, and academic performance, and the correlational component examined the strength and direction of the relationships among these variables without manipulation (Deckert & Wilson, 2023; Casteel & Bridier, 2021; Bhandari, 2021; Ghanad, 2023). The study population consisted of 178 Grade 11 students enrolled during School Year 2025–2026, from which 124 respondents were selected using Yamane's Formula with a 95% confidence level and 5% margin of error. Stratified random sampling proportionate was employed by grouping students according to their sections or strands, followed by simple random sampling through the fishbowl method to ensure fair representation, minimize sampling bias, and enhance the reliability of the findings. These respondents were selected because they were enrolled in Mathematics subjects requiring critical thinking, problem-solving, and self-regulated learning.

Data were collected using three research instruments: the Metacognitive Awareness Inventory adopted from Li et al. (2024), the Attitude toward Mathematics instrument adopted from Naungayan (2022), and the respondents' average Mathematics grades as the measure of academic performance. Since both instruments were fully adopted from previously validated studies, no additional validity and reliability testing was conducted by the researcher. The Metacognitive Awareness Inventory demonstrated strong validity and reliability, with the five-point Likert version showing the strongest validity evidence and Cronbach's alpha coefficients ranging from 0.805 to 0.844, while the version used by Li et al. (2024) reported an excellent reliability coefficient of 0.963 (Cale et al., 2025; Li et al., 2024). Likewise, the attitude toward Mathematics instrument exhibited good to excellent reliability, with Cronbach's alpha values ranging from 0.88 to 0.95, and the version validated by Naungayan (2022) obtained a content validity rating of 4.30 and a Cronbach's alpha of 0.92 (Wen & Dubé, 2022; Naungayan, 2022). These findings support the suitability of both instruments for assessing metacognitive awareness and attitudes toward Mathematics in educational research.

The researcher followed established ethical and procedural guidelines by obtaining a recommendation from the Dean of the Graduate School of La Carlota City College, securing approval from the Schools Division Superintendent, and requesting authorization from the public-school district supervisor with the assistance of the school principal before conducting the study. Participation was voluntary, confidentiality and anonymity were assured, academic performance was measured using the 4th Quarter Division Assessment of Learning Examination, and the metacognitive awareness and attitude questionnaires were administered through Google Forms, with respondents given 20–30 minutes to complete them under the researcher's supervision. The gathered data were analyzed using the mean and standard deviation to determine the levels of metacognitive awareness, attitude toward Mathematics, and academic performance, with interpretations based on a 5-point Likert scale and the grading scale prescribed in DepEd Order No. 8, s. 2015. Spearman's rho Correlation Coefficient was used to determine the significant relationship between metacognitive awareness and academic performance, as well as between attitude toward Mathematics and academic performance. These statistical procedures ensured the objective analysis and accurate interpretation of the study's findings.

RESULTS AND DISCUSSION

This chapter presents, analyzes, and explains the gathered data. To address the problem statement, the data are carefully organized using the relevant statistical tools.

Table 1 Level of Metacognitive Awareness of Students

Statements	Mean	SD	Interpretation
Declarative Knowledge	**3.93**	**0.34**	**High**
1. I understand my intellectual strengths and weaknesses.	3.81	0.42	High
2. I know what kind of information is most important to learn.	3.85	0.40	High
3. I am good at organizing information.	3.81	0.39	High
4. I know what the teacher expects me to learn.	4.03	0.69	High
5. I am good at remembering information.	4.02	0.68	High
6. I have control over how well I learn.	4.09	0.58	High
7. I am a good judge of how well I understand something.	4.02	0.66	High
8. I learn more when I am interested in the topic.	3.85	0.36	High
Procedural Knowledge	**3.81**	**0.28**	**High**
1. I try to use strategies that have worked in the past.	3.84	0.37	High
2. I have a specific purpose for each strategy I use.	3.77	0.42	High
3. I am aware of what strategies I use when I study.	3.82	0.38	High

4. I find myself using helpful learning strategies automatically.	3.81	0.42	High
Conditional Knowledge	**3.96**	**0.40**	**High**
1. I learn best when I know something about the topic.	4.09	0.65	High
2. I use different learning strategies depending on the situation.	4.02	0.63	High
3. I can motivate myself to learn when I need to.	3.81	0.39	High
4. I use my intellectual strengths to compensate for my weaknesses.	3.78	0.43	High
5. I know when each strategy I use will be most effective.	4.08	0.75	High
Knowledge About Cognition	**3.91**	**0.32**	**High**
Planning	**3.99**	**0.39**	**High**
1. I pace myself while learning in order to have enough time.	4.10	0.62	High
2. I think about what I really need to learn before I begin a task.	4.04	0.68	High
3. I set specific goals before I begin a task.	4.04	0.64	High
4. I ask myself questions about the material before I begin.	3.85	0.38	High
5. I think of several ways to solve a problem and choose the best one.	3.81	0.40	High
6. I read instructions carefully before I begin a task.	4.02	0.68	High
7. I organize my time to best accomplish my goals.	4.07	0.68	High
Information Management Strategies	**4.06**	**0.44**	**High**
1. I slow down when I encounter important information.	4.08	0.63	High
2. I consciously focus my attention on important information.	4.10	0.67	High
3. I focus on the meaning and significance of new information.	4.05	0.68	High
4. I create my own examples to make information more meaningful.	4.09	0.66	High
5. I draw pictures or diagrams to help me understand while learning.	4.06	0.65	High
6. I try to translate new information into my own words.	4.01	0.67	High
7. I use the organizational structure of the text to help me learn	4.06	0.59	High
8. I ask myself if what I'm reading is related to what I already know.	4.03	0.70	High
9. I try to break studying down into smaller steps.	4.10	0.66	High
10. I focus on overall meaning rather than specifics.	4.02	0.69	High
Comprehension Monitoring	**4.06**	**0.46**	**High**

1. I ask myself periodically if I am meeting my goals.	4.01	0.62	High
2. I consider several alternatives to a problem before I answer.	4.12	0.68	High
3. I ask myself if I have considered all options when solving a problem.	4.02	0.71	High
4. I periodically review to help me understand important relationships.	4.04	0.62	High
5. I find myself analyzing the usefulness of strategies while I study.	4.10	0.66	High
6. I find myself pausing regularly to check my comprehension.	4.06	0.65	High
7. I ask myself questions about how well I am doing while learning something new.	4.07	0.69	High
Debugging Strategies	**4.01**	**0.47**	**High**
1. I ask others for help when I don't understand something.	4.02	0.65	High
2. I change strategies when I fail to understand.	3.98	0.63	High
3. I re-evaluate my assumptions when I get confused	3.98	0.67	High
4. I stop and go back over new information that is not clear.	4.02	0.70	High
5. I stop and reread when I get confused.	4.06	0.66	High
Evaluation	**4.07**	**0.43**	**High**
1. I know how well I did once I finish a test.	4.15	0.66	High
2. I ask myself if there was an easier way to do things after I finish a task.	4.07	0.65	High
3. I summarize what I've learned after I finish.	4.00	0.64	High
4. I ask myself how well I accomplish my goals once I'm finished.	4.09	0.64	High
5. I ask myself if I have considered all options after I solve a problem.	4.03	0.64	High
6. I ask myself if I learned as much as I could have once, I finish a task.	4.07	0.65	High
Regulation of Cognition	**4.04**	**0.40**	**High**
Metacognitive Awareness as a Whole	**4.00**	**0.36**	**High**
Legend: (4.21-5.00)-Very High; (3.41-4.20)-High; (2.61-3.40)-Moderate; (1.81-2.60)-Low; (1.00-1.80)- Very Low n=124			

The findings revealed that students demonstrated a high level of metacognitive awareness in terms of knowledge about cognition (M = 3.91, SD = 0.32), indicating a strong awareness of their cognitive processes and consistent responses across respondents. Among its dimensions, conditional knowledge obtained the highest mean (M = 3.96, SD = 0.40), followed by declarative knowledge (M = 3.93, SD = 0.34), while procedural knowledge recorded the lowest, though still within the high level (M = 3.81, SD = 0.28); indicator-level results likewise showed stronger performance in selected declarative and conditional knowledge items, with relatively lower scores in some procedural indicators. These findings suggest that students understand what they know, how to use learning strategies, and particularly when and why such strategies should be applied, reflecting well-developed metacognitive knowledge that supports effective learning (Tay et al., 2023; García-Pérez et al., 2020; Weinert & Kluwe, 2026; Abdelshiheed et al., 2023). Although procedural knowledge was comparatively lower, it may indicate that students are less confident in executing strategies than in recognizing or selecting them, highlighting the need for greater emphasis on strategy implementation and guided practice (Braithwaite & Sprague, 2021; Zepeda & Nokes-Malach, 2023; Wang et al., 2024; ElSayad, 2024; Cheng & Chan, 2021; Peng et al., 2025). Overall, the findings support metacognitive frameworks that conceptualize knowledge about cognition as comprising declarative, procedural, and conditional components, suggesting that strengthening procedural knowledge may further enhance self-regulated learning and mathematics achievement (Zheng, 2025; Chen, 2024; Dennis & Somerville, 2022; Ali, 2025).

The results further showed that students exhibited a high level of regulation of cognition (M = 4.04, SD = 0.40), indicating strong abilities to regulate and manage their learning processes, with evaluation obtaining the highest mean (M = 4.07, SD = 0.43), followed by information management strategies and comprehension monitoring (M = 4.06), while planning recorded the lowest mean (M = 3.99, SD = 0.39), although all dimensions remained high. Indicator-level findings revealed only slight variations, suggesting consistently strong metacognitive regulation across planning, information management, comprehension monitoring, debugging strategies, and evaluation. These results imply that students actively plan, monitor, evaluate, and modify their learning strategies, demonstrating effective self-regulated learning behaviors that support academic success, particularly through reflective evaluation and continuous monitoring of understanding (Raković et al., 2021; Tuononen et al., 2022; Wolters & Brady, 2020; Evendi & Verawati, 2021; Hellberg & Fauskanger, 2022; Harvey & Goudvis, 2023; Sholeh, 2023). Although planning obtained the lowest mean, students still regularly engage in goal setting and strategy selection, while their high debugging skills indicate an ability to identify errors and adjust ineffective approaches during learning (J. Wong et al., 2021; Rivers, 2020; Park & Cheon, 2024). These findings reinforce metacognitive theories emphasizing regulation of cognition as a key component of effective learning and highlight the importance of instructional practices that promote reflective thinking, self-monitoring, strategic planning, and self-assessment to further strengthen students' regulatory skills (Doo et al., 2023; Edisherashvili et al., 2022; Tee et al., 2020; Arvatz et al., 2025; Eriyantika & Hidayati, 2025; Dinsmore et al., 2008; Comings et al., 2023).

Overall, students demonstrated a high level of metacognitive awareness (M = 4.00, SD = 0.36), indicating that they are generally aware of and capable of regulating their cognitive processes, with consistent responses across the group. The findings suggest that students consciously plan, monitor, evaluate, and adjust their learning strategies, enabling them to become reflective, intentional, and self-regulated learners who effectively manage their academic tasks (Drigas & Mitsea, 2021; McGuire et al., 2023b; Basu & Dixit, 2021; Özçakmak, 2021). Such a high level of metacognitive awareness has been associated with improved problem-solving, self-regulation, learning effectiveness, and academic success, indicating that the respondents possess characteristics commonly observed among successful learners (Santangelo et al., 2021; Maksum et al., 2021; Morosanova et al., 2022). From an educational perspective, the results underscore the value of sustaining instructional practices that foster reflective thinking, self-assessment, goal setting, think-aloud activities, and other metacognitive strategies to further strengthen students’ independent learning and lifelong learning skills (Zohar & Ben-Ari, 2022; Russell et al., 2020; DeJaeghere et al., 2023; Zarepour et al., 2024; Kontostavlou & Drigas, 2021). Furthermore, the findings support theoretical perspectives emphasizing metacognition as a critical determinant of academic success and provide a basis for future studies examining its relationship with academic performance, learning strategies, motivation, critical thinking, and mathematics achievement (Koyuncuoglu, 2023; Swanson et al., 2024; Srivastava, 2024; Gambo & Shakir, 2022; Soroosh & Pourhosein, 2024).

Table 2. Level of Attitude towards Mathematics of Grade 11 students when taken as a whole.

Statements	Mean	SD	Interpretation
1. I get a great deal of satisfaction out of solving a mathematics problem.	4.11	0.71	Very High
2. I have usually enjoyed studying mathematics in school.	3.98	0.58	Very High
3. Mathematics is fun and exciting.	4.09	0.70	Very High
4. I like to solve new problems in mathematics.	4.02	0.64	Very High
5. I would prefer to do an assignment in math than to write an essay	4.09	0.71	Very High
6. I like mathematics.	4.02	0.69	Very High
7. I am happier in a math class than in any other class.	3.98	0.72	Very High
8. Mathematics is a very interesting subject.	4.02	0.69	Very High
9. I am comfortable expressing my ideas on how to look for solutions to a difficult problem in math	3.96	0.71	Very High
10. I am comfortable answering questions in math class.	4.09	0.60	Very High
11. Mathematics is a very worthwhile and necessary subject.	4.01	0.68	Very High
12. I want to develop my mathematical skills.	4.02	0.58	Very High
13. Mathematics helps develop the mind and teaches a person to think.	4.05	0.62	Very High
14. Mathematics is important in everyday life.	4.12	0.72	Very High
15. Mathematics is one of the most important subjects for people to study.	4.06	0.65	Very High
16. High school math courses would be very helpful no matter what I decide to study.	4.13	0.66	Very High
17. I can think of many ways that I use math outside of school.	4.04	0.74	Very High
18. I think studying advanced mathematics is useful.	4.07	0.65	Very High
19. I believe studying math helps me with problem-solving in other areas	4.08	0.67	Very High
20. A strong math background could help me in my professional life.	4.00	0.69	Very High
21. Mathematics is not one of my most dreaded subjects.	4.10	0.66	Very High
22. I can think clearly when working with mathematics.	4.02	0.62	Very High
23. Studying mathematics does not make me feel nervous.	4.04	0.63	Very High
24. Mathematics makes me feel comfortable.	4.00	0.66	Very High
25. I am never under a terrible strain in math class.	4.10	0.67	Very High

26. When I hear the word mathematics, I have a feeling of enjoyment.	4.06	0.59	Very High
27. It makes me excited to even think about doing a mathematics problem.	3.81	0.40	Very High
28. Mathematics does not scare me at all.	3.79	0.45	Very High
29. I have a lot of self-confidence when it comes to mathematics.	3.85	0.36	Very High
30. I can solve mathematics problems without too much difficulty.	3.84	0.39	Very High
31. I expect to do fairly well in any math class I take.	3.85	0.35	Very High
32. I am never confused in my mathematics class.	3.85	0.38	Very High
33. I feel a sense of security when attempting mathematics.	3.81	0.44	Very High
34. I learn mathematics easily.	3.88	0.33	Very High
35. I believe I am good at solving math problems.	3.77	0.44	Very High
36. I am confident that I could learn advanced mathematics.	3.78	0.43	Very High
37. I would like to continue using mathematics in college.	4.01	0.73	Very High
38. I am willing to take more than the required amount of mathematics.	4.09	0.66	Very High
39. I plan to take as much mathematics as I can during my education.	4.06	0.65	Very High
40. The challenge of math appeals to me.	3.99	0.67	Very High
Overall Mean Attitude towards Mathematics	**3.99**	**0.37**	**Very High**
Legend: (4.21-5.00)-Very High; (3.41-4.20)-High; (2.61-3.40)-Moderate; (1.81-2.60)-Low; (1.00-1.80)-Very Low n=124			

The findings revealed that the respondents exhibited a high level of attitude toward Mathematics (M = 3.99, SD = 0.37), indicating that Grade 11 students generally possess a favorable and consistent disposition toward the subject, with indicator 16 obtaining the highest mean (M = 4.13, SD = 0.66) and indicator 35 the lowest (M = 3.77, SD = 0.44). This result supports the view that students hold positive beliefs, feelings, and predispositions toward learning Mathematics, enabling them to perceive the subject as valuable, relevant, and worthwhile (Perera-Rodríguez, 2026; Russo et al., 2023). Students with positive attitudes are also more likely to demonstrate confidence, interest, willingness to engage in mathematical tasks, and persistence in overcoming learning challenges, which contribute to improved motivation, engagement, and academic experiences (Sucahyo et al., 2021; Madrilejos, 2025; Boaler, 2022). From an educational perspective, these findings suggest that the respondents' learning environment and instructional experiences may be fostering positive perceptions of Mathematics, which can serve as a foundation for improved academic performance through enhanced motivation, self-efficacy, and persistence (Madrilejos, 2025; Salani & Shimmy Sethukge, 2024). Teachers can further strengthen this positive disposition by implementing student-centered instruction, collaborative and problem-solving activities, and real-world mathematical applications, while educational stakeholders may develop programs that reinforce meaningful mathematical experiences and sustained engagement (Akmad, 2025; Agbata et al., 2024). Moreover, the findings support theoretical perspectives emphasizing the importance of affective factors in shaping students' learning behaviors and academic outcomes in Mathematics (Travero & Japos, 2024; Kiwanuka et al., 2020). Future studies may further examine the relationship between attitude toward Mathematics and variables such as learning strategies, mathematical self-efficacy, and problem-solving skills to deepen understanding of factors influencing mathematics achievement and promote continued academic success (Misajon, 2025; Harefa, 2023; Langoban et al., 2023).

Table 3. Level of academic performance of Grade 11 students in Mathematics.

Level of Academic Performance	f	Mean	SD	Interpretation
Outstanding	7	87.74	4.94	Very Satisfactory
Very Satisfactory	106			
Satisfactory	11			
Fairly Satisfactory	0			
Did Not Meet Expectations	0			
Total	124			

Legend:(90-100)-Outstanding; (85-89)-Very Satisfactory; (80-84)-Satisfactory; (75-79)-Fairly Satisfactory; (Below 75)-Did Not Meet Expectation n=124

The findings revealed that Grade 11 students achieved a very satisfactory level of academic performance in Mathematics (M = 87.74, SD = 4.94), with 7 students rated Outstanding, 106 Very Satisfactory, and 11 Satisfactory, indicating that most respondents attained relatively high achievement with only moderate variation in grades. This suggests that students generally possess the knowledge, skills, and competencies required to meet Mathematics learning standards, demonstrating strong conceptual understanding and the ability to apply mathematical concepts, while only a small proportion may require additional academic support. Academic performance serves as a key indicator of learning outcomes and educational attainment, and the overall very satisfactory rating reflects competence, academic readiness, and the effectiveness of existing instructional practices, curriculum implementation, and learning support mechanisms (Bukhari et al., 2024; Suthish, 2025). The findings are also consistent with theoretical perspectives that view academic achievement as the product of cognitive, metacognitive, motivational, and environmental factors working together to support student success (Neyah & Vijayakumar, 2025; Ozcan, 2021). From an educational perspective, teachers and school administrators should continue implementing strategies that strengthen conceptual understanding, critical thinking, and problem-solving while providing enrichment opportunities for high-performing students and targeted interventions for those needing additional support (Naz & Qayyum, 2025; Dietrichson et al., 2021; Juliaha & Thaiba, 2025). Furthermore, these results provide a basis for future research examining how variables such as learning strategies, self-efficacy, and classroom environment contribute to mathematics achievement and inform evidence-based educational interventions (Alali & Wardat, 2024; Clement et al., 2024). Overall, the findings indicate that Grade 11 students are successfully meeting academic expectations in Mathematics, underscoring the importance of sustaining effective instructional practices while promoting continuous improvement for both high-achieving and struggling learners (Ziernwald et al., 2022).

Table 4. Relationship between the Metacognitive Awareness and Academic Performance in Mathematics.

Variable	Test Statistics (r_s)	p-value	Decision for H_o	Interpretation
Metacognitive Awareness Inventory (MAI) vs	0.602**	<0.001	Reject H_o	Significant
Academic Performance in Mathematics				

The Spearman's rank-order correlation analysis revealed a statistically significant, moderately strong positive relationship between metacognitive awareness and academic performance in Mathematics ($\rho = 0.602$, $p < 0.001$), leading to the rejection of the null hypothesis and indicating that higher metacognitive awareness is associated with better academic performance among Grade 11 students. This finding suggests that learners who effectively plan, monitor, evaluate, and regulate their cognitive processes are more likely to achieve higher mathematics performance because they are better able to select appropriate learning strategies and reflect on their understanding (Zuo et al., 2024; An et al., 2024; Alivio & Tan, 2025; Scorțan, 2023). The results support metacognitive and self-regulated learning theories, which emphasize that students who actively regulate their cognition are better equipped to overcome learning difficulties, solve complex mathematical problems, and achieve academic success (Winne & Azevedo, 2022; Hamzah et al., 2023; Anthonysamy et al., 2024; Zhang et al., 2026). From an educational perspective, the findings highlight the importance of integrating metacognitive instruction into mathematics classrooms through activities that promote planning, self-monitoring, evaluation, reflection, strategic thinking, and self-assessment to strengthen students' self-regulated learning and academic achievement (Yilmaz, 2022; Silver et al., 2023; Pokhrel et al., 2024; Astuti & Rozikin, 2024). The results also contribute to the growing body of literature identifying metacognitive awareness as a significant predictor of academic performance and provide empirical support for previous studies reporting similar associations (He et al., 2024; Bae & Kwon, 2019). However, the observed relationship does not establish causation, as academic performance is influenced by multiple factors, including motivation, attitude, prior knowledge, instructional quality, and the learning environment (Asvio, 2022). Overall, the findings underscore the importance of fostering metacognitive awareness in mathematics education and encourage future research to examine its interaction with other variables or its potential role as a mediator or predictor of mathematics achievement (Davor et al., 2026; Syaiful et al., 2022).

Table 5. Relationship between the Attitude Towards Mathematics and Academic Performance in Mathematics.

Variable	Test Statistics (r_s)	p-value	Decision for H_o	Interpretation
Attitude Towards Mathematics Inventory (ATMI)vs Academic Performance in Mathematics	0.606	<0.001	Reject H_o	Significant

The Spearman's rank-order correlation analysis revealed a statistically significant, moderately strong positive relationship between students' attitude toward Mathematics and their academic performance ($\rho = 0.606$, $p < 0.001$), leading to the rejection of the null hypothesis and indicating that students with more positive attitudes tend to achieve higher mathematics performance. This finding suggests that attitude toward Mathematics is an important factor associated with academic success, as positive attitudes reflect favorable beliefs, confidence, interest, enjoyment, and perceived value of the subject, whereas less favorable attitudes may be linked to lower achievement (Harun & Manaf, 2021; Chen, 2021; Shone et al., 2023; Segarra & Julià, 2021; Aguilar, 2021). From an educational perspective, the results highlight the importance of fostering positive learning experiences that enhance students' confidence, interest, and appreciation of Mathematics through active participation, collaborative learning, real-world applications, and meaningful problem-solving activities (Hashim et al., 2021; Vale & Barbosa, 2023). Likewise, creating supportive classroom environments that reduce mathematics anxiety and strengthen students' motivation and confidence may further improve academic performance, while school administrators and curriculum developers may integrate programs that reinforce these affective qualities (Poudel, 2023; Berdos, 2025). The findings also contribute to the growing body of literature emphasizing the role of affective factors in mathematics achievement by providing evidence that attitude toward Mathematics is significantly associated with academic performance and may serve as an important predictor of learning outcomes (Gjicali & Lipnevich, 2021; Dake et al., 2021). However, although the relationship is statistically significant, it does not imply causation because academic performance is also influenced by cognitive abilities, learning strategies, instructional quality, and environmental factors (Mulaudzi, 2025). Overall, the findings underscore the importance of cultivating positive attitudes toward Mathematics and encourage future studies to examine how attitude interacts with other variables or predicts academic performance using more advanced statistical approaches (De La Hera et al., 2023; Núñez et al., 2024).

CONCLUSION

Based on the findings, it is concluded that Grade 11 students generally exhibit a high level of metacognitive awareness, demonstrating strong abilities to understand, monitor, and regulate their cognitive processes in learning Mathematics. The respondents also possess positive attitudes toward Mathematics, reflecting favorable perceptions, interest, and dispositions toward the subject. Moreover, students achieved a very satisfactory level of academic performance, indicating a strong level of mathematical achievement. The study further established that higher levels of metacognitive awareness are significantly associated with better academic performance in Mathematics. Likewise, students with more positive attitudes toward Mathematics tend to demonstrate higher levels of academic performance, highlighting the importance of both cognitive and affective factors in mathematics learning.

RECOMMENDATIONS

This research, as per the investigation, recommends the following:

Based on the findings, the Schools Division Superintendent may strengthen policies, professional development programs, learning enhancement initiatives, and monitoring mechanisms that promote the integration of metacognitive awareness in Mathematics instruction across senior high schools. Education Supervisors may provide technical assistance and instructional supervision that emphasize reflective learning, self-monitoring, problem-solving, motivational teaching practices, and regular monitoring to ensure effective implementation. School Principals may sustain students' high levels of metacognitive awareness and positive attitudes by fostering supportive learning environments, collaborative learning, Mathematics enrichment programs, and school-based professional development focused on improving academic performance. Mathematics teachers are encouraged to integrate explicit metacognitive strategies, such as goal setting, self-questioning, reflective journaling, think-aloud activities, self-assessment, and progress monitoring, while using engaging, learner-centered, and real-life mathematical applications to strengthen students' interest, confidence, and achievement. Students should continue developing positive attitudes toward Mathematics by embracing challenges, participating actively in learning activities, and seeking assistance when needed to further enhance their academic performance. Future researchers may replicate the study with larger and more diverse populations, examine additional variables such as motivation, self-efficacy, learning strategies, parental involvement, and classroom environment, and employ longitudinal, experimental, or mixed-method designs to better understand how metacognitive awareness and attitudes toward Mathematics influence academic success over time.

REFERENCES

A. Books

1. McGuire, S., McGuire, S. Y., & Angelo, T. (2023). Teach students how to learn. https://doi.org/10.4324/9781003447313
2. Meece, J. L. (2023). The role of motivation in self-regulated learning. In Self-regulation of learning and performance (pp. 25-44). Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203763353-2/role-motivation-self-regulated-learning-judith-meece
3. Mohan, R. (2023). Measurement, evaluation and assessment in education. PHI Learning Pvt. Ltd.. https://l1nk.dev/gill9zx
4. Neyah, R., & Vijayakumar, M. (2025). The integrative perspective on the psychological basis of academic achievement. In Advances in psychology, mental health, and behavioral studies (APMHBS) book series (pp. 1–18). https://doi.org/10.4018/979-8-3693-8709-2.ch001
5. Nilson, L. B., & Zimmerman, B. J. (2023). Creating Self-Regulated Learners. https://doi.org/10.4324/9781003443803
6. Schunk, D. H. (2023). Self-regulation of self-efficacy and attributions in academic settings. In Self-regulation of learning and performance (pp. 75-99). Routledge. https://doi.org/10.4324/9780203763353
7. Schunk, D. H., & Zimmerman, B. J. (2022). Self-regulation of learning and performance. https://doi.org/10.4324/9780203763353

8. Silver, N., Kaplan, M., LaVaque-Manty, D., & Meizlish, D. (Eds.). (2023). Using reflection and metacognition to improve student learning: Across the disciplines, across the academy. Taylor & Francis. https://surl.li/kxygxx
9. Verma, M. A. (2023). Chapter-19 Reflective Thinking: Meta-Cognition and Self-Assessment. The Art of Critical Thinking: Exploring Ideas in Liberal Arts, 161. https://surl.li/nuabkz
10. Weinert, F. E., & Kluwe, R. H. (2026). Metacognition, motivation, and understanding. https://doi.org/10.4324/9781003758167
11. Winne, P. H., & Azevedo, R. (2022). Metacognition and Self-Regulated learning. In Cambridge University Press eBooks (pp. 93–113). https://doi.org/10.1017/9781108888295.007
12. Yun, T. (2025). Declarative Knowledge. (pp. 370-371). Singapore: Springer Nature Singapore. https://link.springer.com/rwe/10.1007/978-981-97-7874-4_1079
13. Zimmerman, B. J., Greenberg, D., & Weinstein, C. E. (2023). Self-regulating academic study time: A strategy approach. In Self-regulation of learning and performance (pp. 181-199). Routledge. https://surl.li/hojaiy

B. Journals/Articles/Magazines/Publication

14. Abdelrahman, R. M. (2021). Metacognitive awareness and academic motivation and their impact on academic achievement of Ajman University students. Heliyon, 6(9). https://www.cell.com/heliyon/fulltext/S2405-8440(20)31036-7
15. Abidin, Z. (2024). Effective classroom management as a quick solution to improve student participation and motivation in the learning process. Zabags International Journal of Education, 2(2), 75–88. https://doi.org/10.61233/zijed.v2i2.22
16. AbouHashesh, M. R. I., Ahmed, M. a. S. A., & Kahouf, S. a. E. (2025). The effect of the interaction between learning style (surface / deep) and content presentation mode (conditional / flexible) in an adaptive learning environment on acquiring computer maintenance skills and developing analytical thinking among educational technology students. Ebscohost. https://doi.org/10.5281/zenodo.11322595
17. Agarwal, M., & Agarwal, N. (2021). Defining and measuring academic performance of Hei students-a critical review. Turkish Journal of Computer and Mathematics Education, 12(6), 3091-3105. https://surl.li/iihxzst
18. Agbata, B. C., Obeng-Denteh, W., Abraham, S., Asante-Mensa, F., Okpako, S. O., Amoah-Mensah, J., & Arivi, S. S. (2024). Advancing mathematics education in Africa: Challenges, strategies, and prospects. Science World Journal, 19(3), 808-818. https://scienceworldjournal.org/article/view/24034
19. Aguilar, J. J. (2021). High School Students’ Reasons for disliking Mathematics: The Intersection Between Teacher’s Role and Student’s Emotions, Belief and Self-efficacy. International Electronic Journal of Mathematics Education, 16(3), em0658. https://doi.org/10.29333/iejme/11294
20. Akbarilakeh, M., & Sharifi¬Fard, T. (2021). The Relationship between Metacognitive Awareness and Academic Success of Medical students at Shahid Beheshti University of Medical Sciences. Journal of Medical Education and Development. https://doi.org/10.18502/jmed.v16i3.7902
21. Akbayir, K., & Topçul, İ. (2021). The effect of middle school students’ metacognitive awareness and logical thinking skills on success in mathematics course. Education Quarterly Reviews, 4(2). https://doi.org/10.31014/aior.1993.04.02.272
22. Akmad, Z. E. (2025). Innovative Student-Centered Learning: A Curriculum Framework For Mathematics In The Modern World. International Journal Of Apllied Mathematics, 38(8s), 934–982. Https://Doi.Org/10.12732/Ijam.V38i8s.619
23. Akpur, U. (2024). Metacognitive Awareness And Academic Achievement: A Meta-Analysis Study. Elektronik Sosyal Bilimler Dergisi, 23(91), 1276–1293. https://doi.org/10.17755/esosder.1433740
24. AlAli, R., & Wardat, Y. (2024). Exploring students’ mathematical literacy: The role of Self-efficacy and learning environment. Environment and Social Psychology, 9(8), 1-15. https://tinywebs.site/tbQXURt
25. Alam, M. A. (2023). Analysis of Historical Development of Metacognitive Theories. Harvest: An International Multidisciplinary and Multilingual Research Journal, 3(1), 42-48. https://surl.li/vrkqux
26. Ali, S. M. (2025). Metacognitive strategies in education. Journal of Interdisciplinary Studies in Education, 15(1), 45–72. https://doi.org/10.32674/3hd5e589

27. Almarzouki, H. S., Khan, M. A., Al-Mansour, M., Al-jifree, H. M., Abuznadah, W., & Althubaiti, A. (2023). Effectiveness of cognitive strategies on short-term information retention: An experimental study. Health Professions Education, 9(3), https://hpe.researchcommons.org/cgi/viewcontent.cgi?article=1043&context=journal
28. Amy, C. M. (2021). Examining the Effects of Self-Regulated Learning and Growth Mindset instruction for Underprepared students in CoreQuisite College Algebra - ProQuest.https://www.proquest.com/openview/539be637da11b474579e9b498b3b7f14/1?pq-origsite=gscholar&cbl=18750&diss=y
29. An, D., Ye, C., & Liu, S. (2024). The influence of metacognition on learning engagement the mediating effect of learning strategy and learning behavior. Current Psychology, 43(40), 31241–31253. https://doi.org/10.1007/s12144-024-06400-y
30. Anggo, M., Masi, L., & Haryani, M. (2021). The use of metacognitive strategies in solving mathematical problems. Journal of Physics Conference Series, 1752(1), 012078. https://doi.org/10.1088/1742-6596/1752/1/012078
31. Anore, M. A., Cordevilla, R., Nabor, E., Lumbay, A., & Uy, A. (2025). Grit, metacognitive awareness, and mathematics achievement among junior and senior high school students. Psychology and Education a Multidisciplinary Journal, 49(7), 880–892. https://doi.org/10.70838/pemj.490703
32. Ansari, B. I., Saleh, M., Nurhaidah, N., & Taufiq, T. (2021). Exploring students’ learning strategies and Self-Regulated learning in solving mathematical Higher-Order Thinking problems. European Journal of Educational Research, volume–10–2021(volume–10–issue–2–april–2021), 743–756. https://doi.org/10.12973/eu-jer.10.2.743
33. Anthonysamy, L., Sugendran, P., Wei, L. O., & Hoon, T. S. (2024). An improved metacognitive competency framework to inculcate analytical thinking among university students. Education and Information Technologies, 29(17), 22475–22497. https://doi.org/10.1007/s10639-024-12678-z
34. Armah, P. H., Armah, R. B., Yeboah, D. O., & Adusei, M. S. (2026). Extended theory of planned behavior: a contextual framework for school mathematics reform. International Journal of Evaluation and Research in Education (IJERE), 15(1), 725. https://doi.org/10.11591/ijere.v15i1.36495
35. Arsiya, M. A., & Naseeha, M. J. (2025). Global Perspectives On Math Education: A Comparative Analysis Of Cultural Approaches. Contemporary Techniques in Math Education. https://surl.li/xscsmx
36. Arvatz, A., Peretz, R., & Dori, Y. J. (2025). Self-regulated learning and reflection: a tool for teachers and students. Metacognition and Learning, 20(1). https://doi.org/10.1007/s11409-025-09415-3
37. Asignacion, A. P., Gutlay, O. L., Menorca, E. L., & Orleans, A. V. (2021). Influence of Metacognitive Self-Regulation Learning (SRL) strategies and Regulation of Cognition (ROC) on student’s ability to solve math problems. International Multidisciplinary Research Journal, 3(3), 81–86. https://doi.org/10.54476/iimrj238
38. Astuti, A. D., & Rozikin, A. Z. (2024). The role of self-regulated learning in strengthening students' independent learning character: Literature review. English Language in Focus (ELIF), 7(1), 1-10. https://jurnal.umj.ac.id/index.php/ELIF/article/view/24031
39. Azizah, M. A. N., Asrul, A., & Kumalasari, L. (2026). Understanding Mathematics Learning Difficulties in Elementary Education: An Analysis of Contributing Factors and Teacher Intervention Strategies. Journal of Innovation and Research in Primary Education, 5(1), 1372-1385. https://ejournal.papanda.org/index.php/jirpe/article/view/3036
40. Bae, H., & Kwon, K. (2019b). Developing metacognitive skills through class activities: what makes students use metacognitive skills? Educational Studies, 47(4), 456–471. https://doi.org/10.1080/03055698.2019.1707068
41. Bae, H., & Kwon, K. (2021). Developing metacognitive skills through class activities: what makes students use metacognitive skills? Educational Studies, 47(4), 456–471. https://doi.org/10.1080/03055698.2019.1707068
42. Balashov, E., Pasichnyk, I., & Kalamazh, R. (2021). Metacognitive Awareness and Academic Self-Regulation of HEI Students. International Journal of Cognitive Research in Science Engineering and Education, 9(2), 161–172. https://doi.org/10.23947/2334-8496-2021-9-2-161-172
43. Barete, M. G., & Taja-On, E. (2024). Students’ perception in learning the course mathematics in the modern world: A qualitative study. East Asian Journal of Multidisciplinary Research, 3(7), 2721-2738. https://surl.lt/edvcvn

44. Basu, S., & Dixit, S. (2021). Role of metacognition in explaining decision-making styles: A study of knowledge about cognition and regulation of cognition. Personality and Individual Differences, 185, 111318. https://doi.org/10.1016/j.paid.2021.111318
45. Belgaroui, R., & Shili, A. (2025). Extending the theory of planned behaviour to understand entrepreneurial intention among female university students in student academic performance: the role of entrepreneurship education. Journal of Posthumanism, 5(5), 4226-4246. https://www.ceeol.com/search/article-detail?id=1360647
46. Bendol, R. L., & Dalayap Jr, R. H. (2025). Students' confidence in mathematics: A comprehensive literature review. Indonesian Journal of Multidiciplinary Research, 5(1), 187-196. https://ejournal.upi.edu/index.php/IJOMR/article/view/82065/30688
47. Benedicto, P. N., & Andrade, R. (2022). Problem-Based learning strategies and critical thinking skills among Pre-Service teachers. International Journal of Science Technology Engineering and Mathematics, 2(2), 1–28. https://doi.org/10.53378/352885
48. BERDOS, F. B. (2025). Strengthening Math Instructions Through Supervisory Support of School Head in Implementing Collaborative Learning Strategies and Academic Performance of Key Stage 2 Learners. https://www.ijams-bbp.net/wp-content/uploads/2025/07/7-IJAMS-JULY-2025-551-567.pdf
49. Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: student-centered strategies for academic and personal growth. Frontiers in Education, 10. https://doi.org/10.3389/feduc.2025.1518602
50. Boaler, J. (2022). Mathematical mindsets: Unleashing students' potential through creative mathematics, inspiring messages and innovative teaching. John Wiley & Sons. https://acesse.one/v0ud6dl
51. Boaler, J., Jones, L. L., Lai, Y., Nardo, J., & Schultens, J. (2024). Metacognition in the mathematics classroom. Notices of the American Mathematical Society, 71(01), 1. https://doi.org/10.1090/noti2843
52. Bosch, E., Seifried, E., & Spinath, B. (2021). What successful students do: Evidence-based learning activities matter for students' performance in higher education beyond prior knowledge, motivation, and prior achievement. Learning and Individual Differences, 91, 102056. https://doi.org/10.1016/j.lindif.2021.102056
53. Bozgün, K., & KöstereliOğlu, M. A. (2023). Self-Confidence as the predictor of metacognitive awareness in high school students. Participatory Educational Research, 10(1), 375–388. https://doi.org/10.17275/per.23.20.10.1
54. Braithwaite, D. W., & Sprague, L. (2021). Conceptual knowledge, procedural knowledge, and metacognition in routine and nonroutine problem solving. Cognitive Science, 45(10), e13048. https://doi.org/10.1111/cogs.13048
55. Busari, I. O., Oladeji, A. F., & Sulaimon, T. O. (2023). Examining the impact of teachers' attitudes on college students' attitudes in a mathematics classroom. Busari | Journal of Education and Practice. https://iiste.org/Journals/index.php/JEP/article/view/60669
56. Cale, A. S., Agosto, E. R., Ganeng, B. K. A., Kruskie, M. E., McNulty, M. A., Robertson, K. A., Vetter, C. J., Woods, S. C., Karim, M. N., & Wilson, A. B. (2025). Meta2: A meta-analysis and psychometric evaluation of the Metacognitive Awareness Inventory (MAI) in the context of health professions education. Anatomical Sciences Education, 18(8), 786–801. https://doi.org/10.1002/ase.70085
57. Cascu, A. G., & Stan, C. (2025). Students' motivation and interest in learning mathematics. Educatia 21, 31, 381–393. https://doi.org/10.24193/ed21.2025.31.41
58. Casteel, A., & Bridier, N. L. (2021). Describing populations and samples in doctoral student research. International journal of doctoral studies, 16(1). https://surl.li/ejeztr
59. Catador Jr, J. A. (2024). Examining the correlation and predictive power of metacognitive domains on mathematics performance among senior high school students. Journal of Interdisciplinary Perspectives, 2(7), 1-1. https://ejournals.ph/article.php?id=23949
60. Celik, B. (2022). The effect of metacognitive strategies on Self-Efficacy, motivation and academic achievement of university students. Canadian Journal of Educational and Social Studies, 2(4). https://doi.org/10.53103/cjess.v2i4.49
61. Chand, S., Chaudhary, K., Prasad, A., & Chand, V. (2021). Perceived causes of students' poor performance in mathematics: a case study at BA and Tavua Secondary Schools. Frontiers in Applied Mathematics and Statistics, 7. https://doi.org/10.3389/fams.2021.614408

62. Chen, X. (2021). The effects of individual- and class-level achievement on attitudes towards mathematics: An analysis of Hong Kong students using TIMSS 2019. Studies in Educational Evaluation, 72, 101113. https://doi.org/10.1016/j.stueduc.2021.101113
63. Chen, Y. (2024). Integrating translation crowdsourcing into metacognitive translator training: raising awareness of conditional knowledge and its monitoring functions. The Interpreter and Translator Trainer, 18(1), 19–39. https://doi.org/10.1080/1750399x.2023.2296263
64. Cheng, E. C. K., & Chan, J. K. M. (2021). Developing metacognitive teaching strategies through lesson study. https://doi.org/10.1007/978-981-16-5569-2
65. Clemente, J., Kilag, O. K., Ypon, A., Groenewald, E., Groenewald, C. A., & Ubay, R. (2024). Enhancing mathematics self-efficacy: Intervention strategies and effectiveness–A systematic review. International Multidisciplinary Journal of Research for Innovation, Sustainability, and Excellence (IMJRISE), 1(2), 274-280. https://tinywebs.site/wVwXrt
66. Comings, J., Garner, B., & Smith, C. (2023). Review of Adult Learning and Literacy, Volume 5. https://doi.org/10.4324/9781003417958
67. Dagdag, J. D., & Calimag, N. A. (2023). Scale development and investigation of self-directed learning readiness in Mathematics among Filipino college students. Journal of Research Policy & Practice of Teachers & Teacher Education, 13(1), 61–75. https://doi.org/10.37134/jrpptte.vol13.1.5.2023
68. Daker, R. J., Gattas, S. U., Sokolowski, H. M., Green, A. E., & Lyons, I. M. (2021). First-year students' math anxiety predicts STEM avoidance and underperformance throughout university, independently of math ability. Npj Science of Learning, 6(1), 17. https://doi.org/10.1038/s41539-021-00095-7
69. Davor, I., Boateng, F. O., Osei-Wusu, F., Bosompem, A. O., Osei-Tutu, P., & Hamenu, J. (2026). The role of metacognitive awareness as mediator and moderator in the nexus between self-regulated learning and mathematics achievement. Cogent Education, 13(1). https://doi.org/10.1080/2331186x.2026.2661434
70. De La Hera, J. M. H., Morales-Rodríguez, F. M., Rodríguez-Gobiet, J. P., & Martínez-Ramón, J. P. (2023). Attitudes toward mathematics/statistics, anxiety, self-efficacy and academic performance: an artificial neural network. Frontiers in Psychology, 14, 1214892. https://doi.org/10.3389/fpsyg.2023.1214892
71. Deckert, J., & Wilson, M. (2023). Descriptive research methods. Research methods in the dance sciences, 153-165. https://surl.li/ujyywk
72. DeJaeghere, J., Duong, B., & Dao, V. (2023). Quality of teaching and learning: the role of metacognitive teaching strategies in higher-performing classrooms in Vietnam. Educational Research for Policy and Practice, 22(2), 239–258. https://doi.org/10.1007/s10671-023-09330-x
73. DeJaeghere, J., Duong, B., & Dao, V. (2023b). Quality of teaching and learning: the role of metacognitive teaching strategies in higher-performing classrooms in Vietnam. Educational Research for Policy and Practice, 22(2), 239–258. https://doi.org/10.1007/s10671-023-09330-x
74. Demir, A., Kiziloglu, M., Budur, T., & Heshmati, A. (2022). Elaborating on the links between declarative knowledge, procedural knowledge, and employee performance. SN Business & Economics, 3(1). https://doi.org/10.1007/s43546-022-00402-3
75. Demir, C. G., & Önal, N. (2021). The effect of technology-assisted and project-based learning approaches on students' attitudes towards mathematics and their academic achievement. Education and Information Technologies, 26(3), 3375–3397. https://doi.org/10.1007/s10639-020-10398-8
76. Dennis, J. L., & Somerville, M. P. (2022). Supporting thinking about thinking: examining the metacognition theory-practice gap in higher education. Higher Education, 86(1), 99–117. https://doi.org/10.1007/s10734-022-00904-x
77. Department of Education. (2015). Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program (DepEd Order No. 8, s. 2015). https://www.deped.gov.ph/wp-content/uploads/2015/04/DO_s2015_08.pdf
78. Dietrichson, J., Filges, T., Seerup, J. K., Klokker, R. H., Viinholt, B. C. A., Bøg, M., & Eiberg, M. (2021). Targeted school-based interventions for improving reading and mathematics for students with or at risk of academic difficulties in Grades K-6: A systematic review. Campbell Systematic Reviews, 17(2), e1152. https://doi.org/10.1002/cl2.1152

79. Dinsmore, D. L., Alexander, P. A., & Loughlin, S. M. (2023). Focusing the conceptual lens on metacognition, self-regulation, and self-regulated learning. Educational Psychology Review, 20(4), 391–409. https://doi.org/10.1007/s10648-008-9083-6
80. Disciplulo, L. G., & Bautista, R. G. (2022). Students' cognitive and metacognitive learning strategies towards hands-on science. International Journal of Evaluation and Research in Education (IJERE), 11(2), 658. https://doi.org/10.11591/ijere.v11i2.22018
81. Doo, M. Y., Bonk, C. J., & Heo, H. (2023). Examinations of the relationships between self-efficacy, self-regulation, teaching, cognitive presences, and learning engagement during COVID-19. Educational Technology Research and Development, 71(2), 481–504. https://doi.org/10.1007/s11423-023-10187-3
82. Drigas, A., & Mitsea, E. (2021). 8 Pillars X 8 Layers Model of Metacognition: Educational Strategies, Exercises &Trainings. International Journal of Online and Biomedical Engineering (iJOE), 17(08), 115–134. https://doi.org/10.3991/ijoe.v17i08.23563
83. Du, W., Wijaya, T. T., Cao, Y., & Li, X. (2025). What factors influence secondary students' active participation in mathematics classrooms: A theory of planned behavior perspective. Acta Psychologica, 253, 104694. https://doi.org/10.1016/j.actpsy.2025.104694
84. Edisherashvili, N., Saks, K., Pedaste, M., & Leijen, Ä. (2022). Supporting Self-Regulated Learning in Distance learning contexts at Higher Education Level: Systematic literature review. Frontiers in Psychology, 12, 792422. https://doi.org/10.3389/fpsyg.2021.792422
85. Ekemezie, G. N., & Okigbo, E. C. (2026). Achievement Beliefs, Creativity And Academic Motivation As Predictors Of Academic Achievement Of Secondary School Students In Mathematics In Anambra State, Nigeria. Unizik Journal Of Stm Education, 9(1), 12-27. https://surl.lu/zdqndb
86. ElSayad, G. (2024). Drivers of undergraduate students' learning perceptions in the blended learning environment: The mediation role of metacognitive self-regulation. Education and Information Technologies. https://doi.org/10.1007/s10639-024-12466-9
87. Eriyantika, N., & Hidayati, K. (2025). How Intervention of Self-Assessment on Self-Regulated Learning and Problem-solving Skills in Mathematics? A Systematic Literature review. International Journal of Scientific Research and Management (IJSRM), 13(03), 590–599. https://doi.org/10.18535/ijsrm/v13i03.m01
88. Evendi, E., & Verawati, N. N. S. P. (2021). Evaluation of student learning outcomes in Problem-Based Learning: study of its implementation and reflection of successful factors. Jurnal Penelitian Pendidikan IPA, 7 (SpecialIssue), 69–76. https://doi.org/10.29303/jppipa.v7ispecialissue.1099
89. Fadillah, R., Budiyono, & Nurhasanah, F. (2021). The Analysis of Students' Metacognition in Solving math Problems Based on Self-Efficacy. Journal of Physics Conference Series, 1808(1), 012062. https://doi.org/10.1088/1742-6596/1808/1/012062
90. Gambo, Y., & Shakir, M. Z. (2022). Evaluating students' experiences in self-regulated smart learning environment. Education and Information Technologies, 28(1), 547–580. https://doi.org/10.1007/s10639-022-11126-0
91. Gao, X., & Hew, K. F. (2023). A flipped systematic debugging approach to enhance elementary students' program debugging performance and optimize cognitive load. Journal of Educational Computing Research, 61(5), 1064–1095. https://doi.org/10.1177/07356331221133560
92. García-Pérez, D., Fraile, J., & Panadero, E. (2020). Learning strategies and self-regulation in context: how higher education students approach different courses, assessments, and challenges. European Journal of Psychology of Education, 36(2), 533–550. https://doi.org/10.1007/s10212-020-00488-z
93. Ghanad, A. (2023). An overview of quantitative research methods. International journal of multidisciplinary research and analysis, 6(08), 3794-3803. https://surl.lt/jyohba
94. Güner, P., & Erbay, H. N. (2021). Metacognitive skills and Problem-Solving. International Journal of Research in Education and Science, 7(3), 715–734. https://doi.org/10.46328/ijres.1594
95. Harefa, D. (2023). The Relationship Between Students' Interest In Learning And Mathematics Learning Outcomes. Afore Jurnal Pendidikan Matematika, 2(2), 112–122. https://doi.org/10.57094/afore.v2i2.1054
96. Harvey, S., & Goudvis, A. (2023). Strategies that work. https://doi.org/10.4324/9781032682525
97. Hashim, S., Masek, A., Mahthir, B. N. S. M., Rashid, A. H. A., & Nincarean, D. (2021). Association of interest, attitude and learning habit in mathematics learning towards enhancing students' achievement.

Indonesian Journal of Science and Technology, 6(1), 113-122. https://ejournal.upi.edu/index.php/ijost/article/view/31526/13757

98. Hashim, S., Masek, A., Mahthir, B. N. S. M., Rashid, A. H. A., & Nincarean, D. (2021). Association of interest, attitude and learning habit in mathematics learning towards enhancing students' achievement. Indonesian Journal of Science and Technology, 6(1), 113-122. https://ijost.upi.edu/index.php/ijost/article/view/290
99. He, G., Chen, S., Lin, H., & Su, A. (2024). The association between initial metacognition and subsequent academic achievement: a meta-analysis of longitudinal studies. Educational Psychology Review, 36(3). https://doi.org/10.1007/s10648-024-09922-w
100. He, G., Chen, S., Lin, H., & Su, A. (2024b). The association between initial metacognition and subsequent academic achievement: a meta-analysis of longitudinal studies. Educational Psychology Review, 36(3). https://doi.org/10.1007/s10648-024-09922-w
101. He, G., Lin, H., & Su, A. (2024). Longitudinal and reciprocal links between metacognition, mathematical modeling competencies, and mathematics achievement in grades 7–8: A cross-lagged panel analysis. Metacognition and Learning, 19(3), 967–995. https://doi.org/10.1007/s11409-024-09397-8
102. Hellberg, R., & Fauskanger, E. (2022). Learning of quality improvement theory – experiences with reflective learning from a student perspective. International Journal of Lean Six Sigma, 14(6), 1207–1226. https://doi.org/10.1108/ijlss-04-2022-0090
103. Hidayat, H., Harmanto, D., Mohd Isa, M., Tanucan, J., Ahlunnazak, A., Ifdil, I. & Ardi, Z. (2024). Importance of Metacognitive Awareness in Learning and Instruction for Engineering Students' Education. Journal of Social Studies Education Research, 15(1), 149-186. Retrieved May 10, 2026 from https://surl.li/hnpbvg
104. Hurrell, D. (2021). Conceptual knowledge or procedural knowledge or conceptual knowledge and procedural knowledge: Why the conjunction is important to teachers. Australian Journal of Teacher Education (Online), 46(2), 57-71. https://search.informit.org/doi/abs/10.3316/informit.757709794375494
105. Idris, K., Khazila, K., Agustina, A., & Lisa, L. (2021). High school students' attitudes toward mathematics and its relation to mathematics learning achievement. Jurnal Riset Pendidikan Matematika, 8(1), 33–45. https://doi.org/10.21831/jrpm.v8i1.37002
106. Ilma, S., Muhdhar, M. H. I. A., Rohman, F., & Sari, M. S. (2022). Promoting students' metacognitive awareness and cognitive learning outcomes in science education. International Journal of Evaluation and Research in Education (IJERE), 11(1), 20. https://doi.org/10.11591/ijere.v11i1.22083
107. Inot, C. (2025). Evaluating the association between pedagogical approaches and mathematics performance of grade VI learners in Naval district, Philippines. Al-Jabar Jurnal Pendidikan Matematika, 16(1), 107–116. https://doi.org/10.24042/ajpm.v16i1.26148
108. Ishak, M., Oderinde, I., & Ahmad, S. (2025). The role of Metacognitive Strategies in Enhancing learning Outcomes and Educational Efficiency: A Systematic review of Quantitative, Qualitative and Mixed-Method studies. International Journal of Academic Research in Business and Social Sciences, 15(4). https://doi.org/10.6007/ijarbss/v15-i4/24964
109. Kadonsi, K. (2025). Developing Mathematical Resilience: Effective Strategies to Alleviate Mathematics Anxiety among Secondary School Students in Kalomo District, Zambia. International Journal of Research and Innovation in Social Science, IX(VI), 1630–1665. https://doi.org/10.47772/ijriss.2025.906000131
110. Kallio, H., Kallio, M., Virta, K., Iiskala, T., & Hotulainen, R. (2021). Teachers' support for learners' metacognitive awareness. Scandinavian Journal of Educational Research, 65(5), 802–818. https://doi.org/10.1080/00313831.2020.1755358
111. Kiwanuka, H. N., Van Damme, J., Van Den Noortgate, W., & Reynolds, C. (2020). Temporal relationship between attitude toward mathematics and mathematics achievement. International Journal of Mathematical Education in Science and Technology, 53(6), 1546–1570. https://doi.org/10.1080/0020739x.2020.1832268
112. Kontostavlou, E. Z., & Drigas, A. (2021). How metacognition supports giftedness in leadership. International Journal of Advanced Corporate Learning (iJAC), 14(2), 4–16. https://doi.org/10.3991/ijac.v14i2.23237

113. Kordjamshidi, P., Roth, D., & Kersting, K. (2022). Declarative Learning-Based Programming as an interface to AI systems. Frontiers in Artificial Intelligence, 5, 755361. https://doi.org/10.3389/frai.2022.755361
114. Langoban, M. A., Tan, R. G., & Lomibao, L. S. (2023). Why is there a Need to Foster Positive Attitude Among Learners in Learning Mathematics. Journal of Innovations in Teaching and Learning, 3(1), 35-38. https://l1nq.com/c3pjkue
115. Li, S., & Lajoie, S. P. (2022). Cognitive engagement in self-regulated learning. European Journal of Psychology of Education, 37(3), 833-852. https://www.jstor.org/stable/48707442
116. Li, S., Xu, J., Jia, X., Zhao, Y., Liu, X., & Wang, Y. (2024). Translation and psychometric validation of the Chinese version of the metacognitive awareness scale among nursing students. Frontiers in Psychology, 15, 1354810. https://doi.org/10.3389/fpsyg.2024.1354810
117. Lin, P., Hou, H., & Chang, K. (2020). The development of a collaborative problem solving environment that integrates a scaffolding mind tool and simulation-based learning: an analysis of learners' performance and their cognitive process in discussion. Interactive Learning Environments, 30(7), 1273–1290. https://doi.org/10.1080/10494820.2020.1719163
118. Loaiza, Y., Patiño, M., Umaña, O., & Duque, P. (2023). What is New in Metacognition Research? Answers from Current Literature. Educación Y Educadores, 25(3), 1–24. https://doi.org/10.5294/edu.2022.25.3.5
119. Longobardi, C., Settanni, M., Lin, S., & Fabris, M. A. (2020). Student–teacher relationship quality and prosocial behaviour: The mediating role of academic achievement and a positive attitude towards school. British Journal of Educational Psychology, 91(2), 547–562. https://doi.org/10.1111/bjep.12378
120. Lugosi, E., & Uribe, G. (2020). Active learning strategies with positive effects on students' achievements in undergraduate mathematics education. International Journal of Mathematical Education in Science and Technology, 53(2), 403–424. https://doi.org/10.1080/0020739x.2020.1773555
121. Macabecha, E. A., Tangcogo, K. T., Sawit, M. R. E., & Ucang, J. T. (2024). Metacognitive Strategy on students' Mathematics Self-Efficacy and Critical Thinking skills. International Journal of Applied Science and Research, 07(01), 25–33. https://doi.org/10.56293/ijasr.2024.5704
122. Madrilejos, K. (2025). Structural Equation Model of students' interest, motivation, Self-Efficacy, persistence, and Perceived teaching quality in Mathematics. jippublication.com. https://doi.org/10.69569/jip.2024.698
123. Madrilejos, K. (2025). Structural Equation Model of students' interest, motivation, Self-Efficacy, persistence, and Perceived teaching quality in Mathematics. jippublication.com. https://doi.org/10.69569/jip.2024.698
124. Mahasneh, A. M., Gazo, A. M., & Al-Adamat, O. (2025). The relationship between mathematics anxiety, motivation to learn and attitudes towards mathematics among school students. South African Journal of Education, 45(Supplement 2), S1. https://doi.org/10.15700/saje.v45ns2a2403
125. Malimban, D. O. (2025). Metacognition and Problem-Solving skills of Grade 9 students. Psychology and Education a Multidisciplinary Journal, 46(2), 130–142. https://doi.org/10.70838/pemj.460201
126. Marantika, J. E. R. (2021). Metacognitive ability and autonomous learning strategy in improving learning outcomes. Journal of Education and Learning (EduLearn), 15(1), 88–96. https://doi.org/10.11591/edulearn.v15i1.17392
127. McGuire, S., McGuire, S. Y., & Angelo, T. (2023). Teach students how to learn. https://doi.org/10.4324/9781003447313
128. Misajon, C. C. (2025). Learners' Self-Efficacy and Attitude towards Mathematics. Cognizance Journal of Multidisciplinary Studies, 5(5), 547–550. https://doi.org/10.47760/cognizance.2025.v05i05.033
129. Morales-Navarro, L., Fields, D. A., & Kafai, Y. B. (2024). Understanding growth mindset practices in an introductory physical computing classroom: high school students' engagement with debugging by design activities. Computer Science Education, 35(4), 695–725. https://doi.org/10.1080/08993408.2024.2317080
130. Morosanova, V. I., Bondarenko, I. N., & Fomina, T. G. (2022). Conscious self-regulation, motivational factors, and personality traits as predictors of students' academic performance: a linear empirical model. Psychology in Russia State of Art, 15(4), 170–187. https://doi.org/10.11621/pir.2022.0411
131. Mulaudzi, I. C. (2023). Factors Affecting Students' academic performance: A case study of the university context. Journal of Social Science for Policy Implications. https://doi.org/10.15640/jsspi.v11n1a3

132. Mulaudzi, I. C. (2023). Factors affecting students' academic performance: a case study of the university context. Journal of Social Science for Policy Implications, 11(1), 18-26. https://l1nq.com/vhykb0a
133. Muncer, G., Higham, P. A., Gosling, C. J., Cortese, S., Wood-Downie, H., & Hadwin, J. A. (2021). A Meta-Analysis investigating the association between metacognition and math performance in adolescence. Educational Psychology Review, 34(1), 301–334. https://doi.org/10.1007/s10648-021-09620-x
134. Nasrullah, R. (2025). EFL Students' Metacognitive Strategies in Learning Speaking. IDEAS: Journal on English Language Teaching and Learning, Linguistics and Literature, 13(2), 4716-4729. https://ejournal.iainpalopo.ac.id/index.php/ideas/article/view/5898
135. Naungayan, R. R. (2022). Attitude towards mathematics and mathematics achievement of secondary school learners in Banayoyo-Lidlidda District. Puissant, 3, 395-407. https://www.ssoar.info/ssoar/handle/document/77748
136. Naz, B., & Qayyum, A. (2025b). Effectiveness of Problem-Solving as a teaching strategy in enhancing students' conceptual understanding and critical thinking in mathematics education. Research Journal for Social Affairs, 3(6), 693–702. https://doi.org/10.71317/rjsa.003.06.0500
137. Ncube, M., & Luneta, K. (2025). Concept-based instruction: Improving learner performance in mathematics through conceptual understanding. Pythagoras, 46(1). https://doi.org/10.4102/pythagoras.v46i1.815
138. nGjicali, K., & Lipnevich, A. A. (2021). Got math attitude? (In)direct effects of student mathematics attitudes on intentions, behavioral engagement, and mathematics performance in the U.S. PISA. Contemporary Educational Psychology, 67, 102019. https://doi.org/10.1016/j.cedpsych.2021.102019
139. Núñez, R. P., Procopio, M. V. R., Fernández-Cézar, R., & Solano-Pinto, N. (2024). Affective domain and mathematics achievement of Colombian students under multiple correspondence analysis. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1261829
140. Nurbavliyev, O., Gur, T., Almas, A., & Abdulbaki, M. (2023). The effect of active learning on students' success and information retention in advanced mathematics. bulletin-phmath.kaznpu.kz. https://doi.org/10.51889/2959-5894.2023.82.2.015
141. OECD. (2023). PISA 2022 results: Factsheets - Philippines. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/11/pisa-2022-results-volume-i-and-ii-country-notes_2fca04b9/philippines_dbf92b65/a0882a2d-en.pdf
142. Ojastro, N. C., Banot, V. L., Ragay, N. L., & Batucan, N. A. (2025). Academic performance and National Achievement Test (NAT) performance in science and mathematics. Science International (Lahore), 37(1), 109-117. https://surli.cc/zbevza
143. Oudman, S., Van De Pol, J., & Van Gog, T. (2021). Effects of self-scoring their math problem solutions on primary school students' monitoring and regulation. Metacognition and Learning, 17(1), 213–239. https://doi.org/10.1007/s11409-021-09281-9
144. Özçakmak, H. (2021). The effect of metacognitive awareness on academic success. African Educational Research Journal, 9(2), 434–448. https://doi.org/10.30918/aerj.92.21.020
145. Özçakmak, H. (2021c). The effect of metacognitive awareness on academic success. African Educational Research Journal, 9(2), 434–448. https://doi.org/10.30918/aerj.92.21.020
146. Ozturk, N. (2024). Revisiting Flavell's theory of metacognition for metacognitive responsiveness. Kuramsal Eğitimbilim, 17(2), 257–271. https://doi.org/10.30831/akukeg.1232284
147. Park, E., & Cheon, J. (2024). Exploring Debugging Challenges and Strategies using Structural Topic Model: A Comparative Analysis of High and Low-Performing Students. Journal of Educational Computing Research, 62(8), 1884–1906. https://doi.org/10.1177/07356331241291174
148. Park, E., & Cheon, J. (2024). Exploring Debugging Challenges and Strategies using Structural Topic Model: A Comparative Analysis of High and Low-Performing Students. Journal of Educational Computing Research, 62(8), 1884–1906. https://doi.org/10.1177/07356331241291174
149. Peer, M., Brunec, I. K., Newcombe, N. S., & Epstein, R. A. (2021). Structuring knowledge with cognitive maps and cognitive graphs. Trends in cognitive sciences, 25(1), 37-54. https://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613(20)30250-3
150. Peng, P., Liu, Y., Li, S., Namkung, J., Chow, J., & Lin, L. (2025). Exploring the Effectiveness of Word-Problem strategy and strategy combinations: A Systematic Review and Network Meta-Analysis. Educational Psychology Review, 37(3). https://doi.org/10.1007/s10648-025-10057-9

151. Perera-Rodríguez, V. H. (2026). More than ability: Teachers' perspectives on how student attitudes shape mathematics achievement. Eurasia Journal of Mathematics Science and Technology Education, 22(5), em2825. https://doi.org/10.29333/ejmste/18501
152. Pokhrel, M., Sharma, L., Sharma, T., Poudel, M. P., & Laxmi, G. C. (2024). Enhancing Mathematics Learning through Self-Directed Pedagogy: Strategies and Evaluation Techniques for Effective Student Engagement. Journal of Computational Analysis & Applications, 33(8). https://tinywebs.site/ItlKw3
153. Qorib, M. (2024). Analysis of differentiated instruction as a learning solution in student diversity in inclusive and moderate education. International Journal Reglement & Society (IJRS), 5(1), 43-55. https://jurnal.bundamediagrup.co.id/index.php/ijrs/article/view/452
154. Raković, M., Bernacki, M. L., Greene, J. A., Plumley, R. D., Hogan, K. A., Gates, K. M., & Panter, A. T. (2021). Examining the critical role of evaluation and adaptation in self-regulated learning. Contemporary Educational Psychology, 68, 102027. https://doi.org/10.1016/j.cedpsych.2021.102027
155. Rehman, N., Huang, X., & Mahmood, A. (2025). Altering students' attitude towards learning mathematics through project-based learning: A mathematics project. South African Journal of Education, 45(1), 1–14. https://doi.org/10.15700/saje.v45n1a2491
156. Rivas, S. F., Saiz, C., & Ossa, C. (2022). Metacognitive strategies and development of critical thinking in higher education. Frontiers in Psychology, 13, 913219. https://doi.org/10.3389/fpsyg.2022.913219
157. Rivera, M., & Canoy, O. (2025). Self-Efficacy and Self-Regulation in the Cognitive Processing and Mastery of Mathematical Concepts among Students in Selected Secondary Public Schools of Trece Martires City. Psychology and Education a Multidisciplinary Journal, 45(9), 1161–1169. https://doi.org/10.70838/pemj.450908
158. Rivers, M. L. (2020). Metacognition About Practice Testing: a Review of Learners' Beliefs, Monitoring, and Control of Test-Enhanced Learning. Educational Psychology Review, 33(3), 823–862. https://doi.org/10.1007/s10648-020-09578-2
159. Roslan, T. R. N., & Ch'ng, C. K. (2021). Understanding Students' Intention to Engage in Deep Learning: Application of the Theory of Planned Behaviour. Ilkogretim Online, 20(4). doi: 10.17051/ilkonline.2021.04.54
160. Russell, J. M., Baik, C., Ryan, A. T., & Molloy, E. (2020). Fostering self-regulated learning in higher education: Making self-regulation visible. Active Learning in Higher Education, 23(2), 97–113. https://doi.org/10.1177/1469787420982378
161. Russo, J., Kalogeropoulos, P., & Roche, A. (2023). Exploring underachieving students' views of, and attitudes towards, mathematics across stage of schooling. Asian Journal for Mathematics Education, 2(2), 240–257. https://doi.org/10.1177/27527263231177435
162. Saks, K., Ilves, H., & Noppel, A. (2021). The impact of procedural knowledge on the formation of declarative Knowledge: How accomplishing activities designed for developing learning skills impacts teachers' knowledge of learning skills. Education Sciences, 11(10), 598. https://doi.org/10.3390/educsci11100598
163. Salani, E. & Shimmy Sethukge. (2024). Exploring Teachers' Perspectives and Influential Factors in Math instruction for Goodhope. In International Journal of Teaching and Learning Sciences (Vol. 2024, pp. 1–16) [Journal-article]. https://doi.org/10.47991/2024/IJTLS-104
164. Säljö, R. (2023). Learning in educational settings. Confero Essays on Education Philosophy and Politics, 9(2), 18–41. https://doi.org/10.3384/confero.2001-4562.231217
165. Saqr, M., Matcha, W., Uzir, N. A., Jovanovic, J., Gašević, D., & López-Pernas, S. (2023). Transferring effective learning strategies across learning contexts matters: A study in problem-based learning. Australasian Journal of Educational Technology, 35–57. https://doi.org/10.14742/ajet.8303
166. Sari, Y. I. H., Chen, M., & Gunawan, I. (2024). Comprehension Monitoring in Reading Comprehension: A Bibliometric Study. Chung Cheng Educational Studies, 23(2), 1-53. https://doi.org/10.53106/168395522024122302001
167. Scheibe, D. A., Was, C. A., Dunlosky, J., & Thompson, C. A. (2023). Metacognitive cues, working memory, and math anxiety: The regulated attention in mathematical problem solving (RAMPS) framework. Journal of Intelligence, 11(6), 117. https://www.mdpi.com/2079-3200/11/6/117
168. Seepiwsiw, K., & Seehamongkon, Y. (2023). The development of Mathematical Problem-Solving and Reasoning abilities of sixth graders by organizing learning activities using open approach. Journal of Education and Learning, 12(4), 42. https://doi.org/10.5539/jel.v12n4p42

169. Segarra, J., & Julià, C. (2021). Mathematics Teaching efficacy belief and attitude of pre-service teachers and academic achievement. European Journal of Science and Mathematics Education, 10(1), 1–14. https://doi.org/10.30935/scimath/11381
170. 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. https://doi.org/10.29333/iji.2023.16432a
171. Shah, N. H., Nazir, N., Arshad, M., Akhter, K., Shaheen, A. K., Younas, S., & Ghazanfar, F. (2023). Effect of Students Attitude Towards Mathematics on their Mathematical Achievement at Secondary School Level. International Journal of Emerging Technologies in Learning (iJET), 18(12), 178–192. https://doi.org/10.3991/ijet.v18i12.38765
172. Shekh-Abed, A. (2024). Metacognitive self-knowledge and cognitive skills in project-based learning of high school electronics students. European Journal of Engineering Education, 1–16. https://doi.org/10.1080/03043797.2024.2374479
173. Shi, Y., & Qu, S. (2022). The effect of cognitive ability on academic achievement: The mediating role of self-discipline and the moderating role of planning. Frontiers in Psychology, 13, 1014655. https://doi.org/10.3389/fpsyg.2022.1014655
174. Sholeh, M. I. (2023). Evaluation and monitoring of Islamic Education learning management in efforts to improve education quality. Communautaire Journal of Community Service, 2(2), 108–117. https://doi.org/10.61987/communautaire.v2i2.159
175. Shone, E. T., Weldemeskel, F. M., & Worku, B. N. (2023). The role of students' mathematics perception and self-efficacy toward their mathematics achievement. Psychology in the Schools, 61(1), 103–122. https://doi.org/10.1002/pits.23033
176. Siller, H., & Ahmad, S. (2024). Analyzing the impact of collaborative learning approach on grade six students' mathematics achievement and attitude towards mathematics. Eurasia Journal of Mathematics Science and Technology Education, 20(2), em2395. https://doi.org/10.29333/ejmste/14153
177. Silver, N., Kaplan, M., LaVaque-Manty, D., & Meizlish, D. (Eds.). (2023). Using reflection and metacognition to improve student learning: Across the disciplines, across the academy. Taylor & Francis.y https://tinywebs.site/1Hs1O1
178. Singh, H., Kaur, B., Sharma, A., & Singh, A. (2023). Framework for suggesting corrective actions to help students intended at risk of low performance based on experimental study of college students using explainable machine learning model. Education and Information Technologies, 29(7), 7997–8034. https://doi.org/10.1007/s10639-023-12072-1
179. Sucahyo, E., Kartono, K., & Mulyono, M. (2021). Mathematical understanding and self-confidence of elementary school with realistic mathematics education model. Journal of Primary Education, 10(3), 308-322. https://journal.unnes.ac.id/sju/jpe/article/view/49059/19946
180. Syaiful, Huda, N., Mukminin, A., & Kamid. (2022). Using a metacognitive learning approach to enhance students' critical thinking skills through mathematics education. SN Social Sciences, 2(4). https://doi.org/10.1007/s43545-022-00325-8
181. Tasarib, A., Rosli, R., & Rambely, A. S. (2025). Impacts and challenges of mathematical modelling activities on students' learning development: A systematic literature review. Eurasia Journal of Mathematics Science and Technology Education, 21(5), em2641. https://doi.org/10.29333/ejmste/16398
182. Tay, L. Y., Chan, M., Chong, S. K., Tan, J. Y., & Aiyoob, T. B. (2023). Learning of Mathematics: A Metacognitive Experiences perspective. International Journal of Science and Mathematics Education, 22(3), 561–583. https://doi.org/10.1007/s10763-023-10385-8
183. Tay, L.Y., Chan, M., Chong, S.K. et al. (2024) Learning of Mathematics: A Metacognitive Experiences Perspective. Int J of Sci and Math Educ 22, 561–583 https://doi.org/10.1007/s10763-023-10385-8
184. Tee, K. N., Leong, K. E., & Rahim, S. S. A. (2020). A Self-Regulation Model of Mathematics Achievement for Eleventh-Grade Students. International Journal of Science and Mathematics Education, 19(3), 619–637. https://doi.org/10.1007/s10763-020-10076-8
185. Teng, M. F., Qin, C., & Wang, C. (2021). Validation of metacognitive academic writing strategies and the predictive effects on academic writing performance in a foreign language context. Metacognition and Learning, 17(1), 167–190. https://doi.org/10.1007/s11409-021-09278-4
186. Thi-Nga, H., Thi-Binh, V., & Nguyen, T. (2024). Metacognition in mathematics education: From academic chronicle to future research scenario–A bibliometric analysis with the Scopus database. Eurasia

Journal of Mathematics Science and Technology Education, 20(4), em2427. https://doi.org/10.29333/ejmste/14381

187. Tibken, C., Richter, T., & Wannagat, W. (2023). Metacognitive comprehension monitoring: Cognitive abilities explain performance differences between younger and older adults. Scientific Studies of Reading, 28(3), 284–302. https://doi.org/10.1080/10888438.2023.2261572
188. Travero, A. S., & Japos, G. V. (2024b). Affective Determinants of Mathematics Learning: A Literature review. Basic and Applied Education Research Journal, 5(2), 68–77. https://doi.org/10.11594/baerj.05.02.02
189. 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/v51i62009
190. Tuononen, T., Hyytinen, H., Räisänen, M., Hailikari, T., & Parpala, A. (2022). Metacognitive awareness in relation to university students’ learning profiles. Metacognition and Learning, 18(1), 37–54. https://doi.org/10.1007/s11409-022-09314-x
191. Tuononen, T., Hyytinen, H., Räisänen, M., Hailikari, T., & Parpala, A. (2022). Metacognitive awareness in relation to university students’ learning profiles. Metacognition and Learning, 18(1), 37–54. https://doi.org/10.1007/s11409-022-09314-x
192. Ukobizaba, F., Nizeyimana, G., & Mukuka, A. (2021). Assessment Strategies for Enhancing Students’ mathematical problem-solving skills: A Review of literature. Eurasia Journal of Mathematics Science and Technology Education, 17(3), em1945. https://doi.org/10.29333/ejmste/9728
193. Urban, K., & Urban, M. (2023). How can we measure metacognition in creative problem-solving? Standardization of the MCPS scale. Thinking Skills and Creativity, 49, 101345. https://doi.org/10.1016/j.tsc.2023.101345
194. Vale, I., & Barbosa, A. (2023). Active learning strategies for an effective mathematics teaching and learning. European Journal of Science and Mathematics Education, 11(3), 573–588. https://doi.org/10.30935/scimath/13135
195. Varveris, D., Saltas, V., & Tsiantos, V. (2023). Exploring the role of metacognition in measuring students’ critical thinking and knowledge in mathematics: A comparative study of regression and neural networks. Knowledge, 3(3), 333–348. https://doi.org/10.3390/knowledge3030023
196. Wakhata, R., Mutarutinya, V., & Balimuttajjo, S. (2022). Secondary school students’ attitude towards mathematics word problems. Humanities and Social Sciences Communications, 9(1). https://doi.org/10.1057/s41599-022-01449-1
197. Wakhata, R., Mutarutinya, V., & Balimuttajjo, S. (2023). Dataset on the relationship between students’ attitude towards, and performance in mathematics word problems, mediated by active learning heuristic problem-solving approach. Data in Brief, 48, 109055. https://doi.org/10.1016/j.dib.2023.109055
198. Wang, C., Wang, H., Li, Y., Dai, J., Gu, X., & Yu, T. (2024). Factors influencing university students’ behavioral intention to use generative artificial intelligence: integrating the theory of planned behavior and AI literacy. International Journal of Human-Computer Interaction, 41(11), 6649–6671. https://doi.org/10.1080/10447318.2024.2383033
199. Wang, F., Liu, D., & Zhang, M. (2024). Metacognitive processes, situational factors, and clinical decision-making in nursing education: a quantitative longitudinal study. BMC Medical Education, 24(1), 1530. https://doi.org/10.1186/s12909-024-06467-y
200. Wang, G., Kang, Y., Jiao, Z., Chen, X., Zhen, Y., Zhang, D., & Su, M. (2022). Development and Application of Intelligent Assessment System for Metacognition in Learning Mathematics among Junior High School Students. Sustainability, 14(10), 6278. https://doi.org/10.3390/su14106278
201. Wang, L., Peng, F., & Song, N. (2022). The impact of students’ mathematical attitudes on intentions, behavioral engagement, and mathematical performance in the China’s context. Frontiers in Psychology, 13, 1037853. https://doi.org/10.3389/fpsyg.2022.1037853
202. Wang, W., & Derakhshan, A. (2025). Exploring the role of EFL students’ openness to diversity and self-regulation in their attitudes towards and engagement with data-driven Second Language (L2) Learning. Learning and Individual Differences, 121, 102725. https://doi.org/10.1016/j.lindif.2025.102725
203. Weinert, F. E., & Kluwe, R. H. (2026c). Metacognition, motivation, and understanding. https://doi.org/10.4324/9781003758167

204. Wen, R., & Dubé, A. K. (2022). A systematic review of secondary students' attitudes towards mathematics and its relations with mathematics achievement. Journal of Numerical Cognition, 8(2), 295–325. https://doi.org/10.5964/jnc.7937
205. Whalen, K., & Paez, A. (2020). Student perceptions of reflection and the acquisition of higher-order thinking skills in a university sustainability course. Journal of Geography in Higher Education, 45(1), 108–127. https://doi.org/10.1080/03098265.2020.1804843
206. Wilkin, G. A. (2025, February). " Debugging: From Art to Science" A Case Study on a Debugging Course and Its Impact on Student Performance and Confidence. In Proceedings of the 56th ACM Technical Symposium on Computer Science Education V. 1 (pp. 1225-1231). https://dl.acm.org/doi/abs/10.1145/3641554.3701893
207. Wolters, C. A., & Brady, A. C. (2020). College Students' Time Management: a Self-Regulated Learning Perspective. Educational Psychology Review, 33(4), 1319–1351. https://doi.org/10.1007/s10648-020-09519-z
208. Wong, I. H., & Wong, T. T. (2021). Exploring the relationship between intellectual humility and academic performance among post-secondary students: The mediating roles of learning motivation and receptivity to feedback. Learning and Individual Differences, 88, 102012. https://doi.org/10.1016/j.lindif.2021.102012
209. Wong, J., Baars, M., He, M., De Koning, B. B., & Paas, F. (2021). Facilitating goal setting and planning to enhance online self-regulation of learning. Computers in Human Behavior, 124, 106913. https://doi.org/10.1016/j.chb.2021.106913
210. Xiao, F., & Sun, L. (2021). Students' motivation and affection profiles and their relation to mathematics achievement, persistence, and behaviors. Frontiers in Psychology, 11, 533593. https://doi.org/10.3389/fpsyg.2020.533593
211. Yang, S., Baird, M., O'Rourke, E., Brennan, K., & Schneider, B. (2024). Decoding Debugging Instruction: A Systematic Literature Review of Debugging Interventions. ACM Transactions on Computing Education, 24(4), 1–44. https://doi.org/10.1145/3690652
212. Yang, X., & Kaiser, G. (2022). The impact of mathematics teachers' professional competence on instructional quality and students' mathematics learning outcomes. Current Opinion in Behavioral Sciences, 48, 101225. https://doi.org/10.1016/j.cobeha.2022.101225
213. Yap, J. B. K., & Wong, S. S. H. (2024). Deliberately making and correcting errors in mathematical problem-solving practice improves procedural transfer to more complex problems. Journal of Educational Psychology, 116(7), 1112–1128. https://doi.org/10.1037/edu0000850
214. Yarcia, L., & Nangpuhan, D. G. (2026). Metacognition, attitude towards mathematics and academic performance of grade - 9 students in a district of Nueva Vizcaya. International Journal of Sustainability and Advanced Integrated Research, 2(2), 27–34. https://doi.org/10.65339/ijsair.v2.i2.157
215. Yeboah, E. (2023, October 1). The impact of metacognitive awareness on the academic performance in mathematics of senior high school students from Korle Klottey Municipal. https://ir.uew.edu.gh/handle/123456789/4965
216. Yilmaz, F. G. K. (2022). The effect of learning analytics assisted recommendations and guidance feedback on students' metacognitive awareness and academic achievements. Journal of Computing in Higher Education, 34(2), 396–415. https://doi.org/10.1007/s12528-021-09304-z
217. Yunus, M., Setyosari, P., Utaya, S., Kuswandi, D., Amirullah, A., & Rusdi, M. (2021). The relationship between achievement motivation, metacognitive awareness, attitudes and problem-solving abilities in students. Cypriot Journal of Educational Sciences, 16(1), 32–45. https://doi.org/10.18844/cjes.v16i1.5506
218. Ÿz, H. (2022). Metacognitive Awareness and Academic Motivation: A Cross-Sectional Study in Teacher Education context of Turkey. Procedia - Social and Behavioral Sciences, 232, 109–121. https://doi.org/10.1016/j.sbspro.2016.10.035
219. Zarepour, B., Soleimani, H., & Sanjari, M. (2024). Exploring assessment strategies used to promote metacognitive development in science education. Assessment and Practice in Educational Sciences, 2(2), 1-9. https://acesse.one/c6vktb3t
220. Zepeda, C. D., & Nokes-Malach, T. J. (2023). Assessing Metacognitive Regulation during Problem Solving: A Comparison of Three Measures. Journal of Intelligence, 11(1), 16. https://doi.org/10.3390/jintelligence11010016

221. 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
222. Zhang, Q., Wu, J., & Yang, Y. (2026). Association of Mathematical Metacognition with High School Students' Academic Achievement: A Chain-mediated Analysis of Learning Strategies and Engagement. International Journal of Science and Mathematics Education, 24(1). https://doi.org/10.1007/s10763-025-10635-x
223. Zheng, Z. (2025). Theoretical insights and empirical findings on metacognition in translation: a review and conceptual framework. Discover Psychology, 5(1). https://doi.org/10.1007/s44202-025-00522-5
224. Ziernwald, L., Hillmayr, D., & Holzberger, D. (2022). Promoting High-Achieving Students through Differentiated instruction in Mixed-Ability Classrooms—A Systematic Review. Journal of Advanced Academics, 33(4), 540–573. https://doi.org/10.1177/1932202x221112931
225. Zohar, A., & Ben-Ari, G. (2022). Teachers' knowledge and professional development for metacognitive instruction in the context of higher order thinking. Metacognition and Learning, 17(3), 855–895. https://doi.org/10.1007/s11409-022-09310-1
226. Zou, L., Zhang, Z., Mavilidi, M., Chen, Y., Herold, F., Ouwehand, K., & Paas, F. (2025). The synergy of embodied cognition and cognitive load theory for optimized learning. Nature Human Behaviour, 9(5), 877–885. https://doi.org/10.1038/s41562-025-02152-2
227. Zuo, S., Huang, Q., & Qi, C. (2024). The relationship between cognitive activation and mathematics achievement: mediating roles of self-efficacy and mathematics anxiety. Current Psychology, 43(39), 30794–30805. https://doi.org/10.1007/s12144-024-06700-3

C. Websites, Online Sources, and Repositories

1. Abdelshiheed, M., Hostetter, J. W., Barnes, T., & Chi, M. (2023). Bridging declarative, procedural, and conditional metacognitive knowledge gap using deep reinforcement learning. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2304.11739
2. Ajayi, J. (2024). METACOGNITIVE STRATEGIES IN THE CLASSROOM. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=BkZGnTYAAAAJ&citation_for_view=BkZGnTYAAAAJ:u-x6o8ySG0sC
3. Akaeze, J. U., & Okigbo, E. C. (2021, March 5). Effect of metacognitive reading strategy and graphic organizer on students' retention of mathematics concepts in junior secondary schools of onitsha education zone. https://www.sejrsd.org.ng/index.php/SEJRSD/article/view/139
4. Alivio, C. J. P., & Tan, D. A. (2025, April 29). The effect of student metacognitive awareness on academic performance in mathematics of grade ten learners. https://sarcouncil.com/2025/04/the-effect-of-student-metacognitive-awareness-on-academic-performance-in-mathematics-of-grade-ten-learners
5. Alivio, C. J. P., & Tan, D. A. (2025b, April 29). The effect of student metacognitive awareness on academic performance in mathematics of grade ten learners. https://sarcouncil.com/2025/04/the-effect-of-student-metacognitive-awareness-on-academic-performance-in-mathematics-of-grade-ten-learners
6. Ampadu, E., & Anokye-Poku, D. (2022). Influence of Personal, Motivational and Learning Environment Factors on Students' Attitudes toward Mathematics. https://eric.ed.gov/?id=EJ1347469
7. Arianto, F., & Hanif, M. (2024). Evaluating metacognitive Strategies and Self-Regulated learning to predict primary school students' Self-Efficacy and Problem-Solving skills in science learning. https://eric.ed.gov/?id=EJ1441218
8. Arthur, Y. D., Appiah, S. K., Amo-Asante, K., & Asare, B. (2022). Modeling student's interest in mathematics: role of history of mathematics, Peer-Assisted learning, and student's perception. https://eric.ed.gov/?id=EJ1359356
9. Asvio, N. (2022). The influence of learning motivation and learning environment on undergraduate students' learning achievement of management of Islamic education, study program of IAIN Batusangkar In 2016. https://tinywebs.site/IU79iK
10. Baguin, R., & Janiola, F. (2024). Students' Level of Metacognitive Awareness as correlates of their Mathematics Achievement. Zenodo (CERN European Organization for Nuclear Research). https://doi.org/10.5281/zenodo.10523794

11. Bukhari, S. U. P., Rafique, M., Khaliq, N., Hatesh, H., Umer, N., Ahmed, S., ... & Nadeem, S. V. (2024). Academic performance indicators to improve learning outcomes of students in educational institutes: beyond standardized tests. Migration Letters, 21(S11), 1428-140. https://tinywebs.site/5Szwu3
12. Cashata, Z. A., Seyoum, D. G., & Gashaw, F. E. (2023). Enhancing college students' procedural knowledge of physics using blended Jigsaw-IV Problem-Solving instruction. https://eric.ed.gov/?id=EJ1379326
13. Fitz, J., & Contributor, H. P. (2025, June 16). Positive Conditions for Mathematics Learning: An overview of the research. https://eric.ed.gov/?id=ED674783
14. Ginat, D. (2021). Abstraction, declarative observations and algorithmic problem solving. Questa Soft. https://www.ceeol.com/search/article-detail?id=1002209
15. Hamzah, H., Hamzah, M. I., & Zulkifli, H. (2023). Self-regulated Learning Theory in Metacognitive-Based Teaching and Learning of High-Order Thinking Skills (HOTS). Tem Journal, 12(4). https://www.ceeol.com/search/article-detail?id=1199658
16. Harun, Kartowagiran, B., & Manaf, A. (2021). Student Attitude and Mathematics Learning Success: A Meta-Analysis. https://eric.ed.gov/?id=EJ1319617
17. Hassan, S., Venkateswaran, S. P., Agarwal, P., Sulaiman, A. R. B., & Burud, I. a. S. (2022). Metacognitive awareness and its relation to students' academic achievement: Time to ponder its implication in delivery of the curriculum. Research Square. https://doi.org/10.21203/rs.3.rs-1266966/v1
18. Hwang, S., & Son, T. (2021). Students' Attitude toward Mathematics and Its Relationship with Mathematics Achievement. https://eric.ed.gov/?id=EJ1313916
19. Julaiha, M. M., & Thaiba, M. B. (2025). Fostering Student Involvement In Mathematics: A Review Of Strategies For Motivation And Engagement. Contemporary Techniques In Math Education. https://tinywebs.site/VSCIrF
20. Kadir, K. & Universitas Islam Negeri Syarif Hidayatullah. (2023). Students' Mathematics Achievement Based On Performance Assessment Through Problem Solving-Posing And Metacognition Level. In Mathematics Teaching Research Journal (Vol. 15, Issue 3). https://files.eric.ed.gov/fulltext/EJ1408243.pdf
21. Kahveci, H. (2023). The positive and negative effects of teacher attitudes and behaviors on student progress. https://eric.ed.gov/?id=EJ1380987
22. Koyuncuoglu, D. (2023). The Mediating Role of General Self-Efficacy in the Relationship between Metacognition and Academic Success of University Students. https://eric.ed.gov/?id=EJ1395892
23. Kurdal, C., & Kaplan, A. (2023, May 15). The relationship between middle school students' metacognitive awareness and their attitudes to mathematics. https://tujme.org/index.php/tujme/article/view/77
24. Lapinid, M. R. C., Cordell II, M. O., Teves, J. M., Yap, S. A., & Bernardo, A. B. (2022). Addressing the poor mathematics performance of Filipino learners: Beyond curricular and instructional interventions. https://animorepository.dlsu.edu.ph/cgi/viewcontent.cgi?article=1091&context=res_aki
25. Maksum, A., Widiana, I. W., & Marini, A. (2021.). Path analysis of Self-Regulation, social Skills, Critical Thinking and Problem-Solving Ability on social studies learning outcomes. https://eric.ed.gov/?id=EJ1304557

26. Mbarawii, W., & Amabibi, F. I. (2024). Managing student enrollment for goal attainment in public senior secondary schools: The role of monitoring and evaluation, and resource allocation planning. In International Journal of Economics, Environmental Development and Society (Vols. 3–3, pp. 326–346). https://www.ijeeds.com.ng/assets/vol.%2C-5(3)-mbarawii%2C-w.%2C---amabibi%2C-f.-i..pdf
27. Mertasari, N. M. S., Sastri, N. L. P. P., & Pascima, I. B. N. (2023). Performance Assessment: Improving metacognitive ability in mathematics learning. https://eric.ed.gov/?id=EJ1415281
28. Methkal, A. a. Y. (2024). Solving mathematics anxiety, lack of confidence and negative attitude with artificial intelligence models: insights from stakeholders. Zenodo (CERN European Organization for Nuclear Research). https://doi.org/10.5281/zenodo.14599899
29. Mughal A. (2025) 'Thinking about thinking': What is metacognition | Hachette Learning. https://www.hachettelearning.com/blog/thinking-about-thinking-what-is-metacognition
30. Nwanakezie, I. S., & Ogona, I. K. (2021). Task development procedures for effective educational management. In International Journal of Institutional Leadership, Policy and Management, International

Journal of Institutional Leadership, Policy and Management (Vol. 3, Issue 1, pp. 106–133) [Journal-article]. https://www.ijilpm.com.ng/assets/vol.%2C-3(1)-nwanakezie---ogona.pdf

31. Oladimeji, D. O. (2023, February 1). Effects of declarative and enhanced-declarative knowledge approaches on students’ learning outcomes in quantitative economics contents in senior secondary schools in oyo town. http://140.105.46.132:8080/xmlui/handle/123456789/2091
32. Ozcan, M. (2021). Factors Affecting Students’ Academic Achievement according to the Teachers’ Opinion. Questa Soft. https://www.ceeol.com/search/article-detail?id=1010667
33. Poudel, K. C. (2023). Impact of classroom environment on high school students' mathematics anxiety. Academic journal of mathematics education. https://l1nq.com/wp8o8aj
34. Reyes, J. D., & Reyes, Z. Q. (2024). A model of teaching metacognition in solving mathematical word problems. International Journal of Contemporary Sciences, 1(11), 728-747. https://pdfs.semanticscholar.org/598a/f5f73cf8df1a9a274fa47f5b3223d57967a7.pdf
35. Santangelo, J., Cadieux, M., & Zapata, S. (2021). Developing student metacognitive skills using active learning with embedded metacognition instruction. Journal of STEM Education: Innovations and Research, 22(2). Retrieved from https://www.jstem.org/jstem/index.php/JSTEM/article/view/2475
36. Scorțan, D. (2023). Metacognitive strategies and academic success. Questa Soft. https://www.ceeol.com/search/article-detail?id=1342234
37. Soroosh, Z., & Pourhosein, M. (2024). Leveraging Metacognitive Approaches to Improve Educational Performance. Iranian Journal of Learning and Memory, 7(28), 5-24. https://journal.iepa.ir/article_229077_ae5b26df9afd9b4a7df5ea0e4bcc8254.pdf
38. Srivastava, A. (2024). Theories and concepts on metacognition in literature with educational implications. Indian Journal of Psychology, 116-123. https://surl.lt/wibuvl
39. Srivastava, A. (2024). Theories and concepts on metacognition in literature with educational implications. Indian Journal of Psychology, 116-123. https://sl1nk.com/qvbw8dt
40. Sujatha, S., & Vinayakan, K. (2023). Assessing The Impact Of Math Competitions And Challenges On Student Learning: A Review. In International Journal of Advanced Trends in Engineering and Technology (Vol. 8, Issue 2, pp. 62–67). https://ijatet.dvpublication.com/uploads/676bcac6378c6_251.pdf
41. Suthish, M. M., & Venkatesan, M. K. (2025). Mathematics Curriculum Development: An Analysis Of Successful Frameworks And Approaches. Contemporary Techniques In Math Education. https://tinywebs.site/tcvbhg
42. Swanson, H. J., Ojutiku, A., & Dewsbury, B. (2024). The impacts of an academic intervention based in metacognition on academic performance. https://eric.ed.gov/?id=EJ1429038
43. Tamaulina, T. (2025). Developing critical and logical thinking skills through the use of Non-Routine problems in mathematics education. thejoas.com. https://doi.org/10.59613/hhvase06
44. Wafa, B. G. B. (2025, June 1). Students’ Attitudes Towards The Effect Of Fear And Anxiety On Their Academic Achievement. https://dspace.univ-guelma.dz/jspui/handle/123456789/17961
45. Wakhata, R., Mutarutinya, V., & Balimuttajjo, S. (2023). Dataset on the relationship between students’ attitude towards, and performance in mathematics word problems, mediated by active learning heuristic problem-solving approach. Data in Brief, 48, 109055. https://doi.org/10.1016/j.dib.2023.109055