MEDIATING Effect of Academic Self-Efficacy on the Relationship Between Math Study Skills and Math Vocabulary ACHIEVEMENT

Alvin G. Camacho[1], Lolly Jean C. Simbulas, PhD[2]

[1]Fulltime Instructor, Monkayo College of Arts, Sciences, and Technology
alvincamacho2398@gmail.com

[2]University of the Immaculate Conception, Davao City
lsimbulas@uic.edu.ph

ABSTRACT

Math study skills alone cannot guarantee an improved math vocabulary achievement, as students also need to develop confidence and belief in their ability, highlighting the significant role of academic self-efficacy. However, research on how academic self-efficacy mediates the relationship between math study skills and math vocabulary achievement remains limited. The main objective of the study was to assess the mediating effect of academic self-efficacy on the relationship between math study skills and math vocabulary achievement among Grade 10 students. This study utilized a quantitative descriptive-correlational design and mediation analysis. The results showed that Grade 10 students had a high level of math study skills and academic self-efficacy. However, Grade 10 students demonstrated a very low level of achievement in math vocabulary. The relationship between math study skills, academic self-efficacy, and math vocabulary achievement was positive and significant. Results also showed that academic self-efficacy fully mediated the relationship between math study skills and math vocabulary achievement. The findings suggest that teachers may develop interventions, such as goal-setting and peer-assisted learning, that directly target students' academic self-efficacy.

KEYWORDS: *Education, math study skills, academic self-efficacy, descriptive correlation, Philippines.*

INTRODUCTION

Math vocabulary achievement has served as a medium that could facilitate cognitive reasoning in mathematics learning. However, many students' poor achievement in math vocabulary (Riccomini et al., 2015) makes mastering mathematical concepts even more difficult. Singh (2016) conducted a study in India that found many Indian students had low achievement in mathematical vocabulary due to poor math study skills. In the USA, Powell et al. (2021) state that the average math vocabulary score of middle-grade students accounted for 67 percent or less.

In the Philippines, the mean score of students who took the math vocabulary test was 25.04, suggesting an average performance level, according to research done at Pilar, Capiz. Additionally, in a study conducted in Davao City, students are not proficient in understanding the meanings of words or evaluating mathematical terms in problem-solving (Timario, 2020). Further, an evaluation of children's conceptual understanding in the District of San Luis I, Division of Agusan del Sur, revealed challenges primarily related to mathematical vocabulary and the recognition of words and numbers (Guzman, 2023).

Accordingly, de Bree and Zee (2021) reported in their study that fostering self-efficacy would likely lead students to implement techniques and skills for studying that would support the enhancement of their math vocabulary achievement. Additionally, Hayat et al. (2020) mentioned that there has been extensive examination of the relationship between study skills and a range of factors in the paradigm for predicting vocabulary achievement using mediation techniques and modeling, with self-efficacy mediating this relationship.

Most studies have focused on either study skills or vocabulary in isolation, without considering how the two are interconnected and how self-efficacy mediates this relationship (Medallon, 2016). Additionally, there is limited research on the relationship between math study skills and achievement in mathematical vocabulary, with academic self-efficacy as a mediating variable (Tahir, 2022), particularly among Grade 10 students. In this regard, this study identifies a gap that needs to be addressed. Exploring how academic self-efficacy mediates the relationship between math study skills and math

vocabulary achievement is significant as it offers insights into educational practices and policy development.

Objectives of the Study. This study aimed to assess the level of Grade 10 students' math study skills, academic self-efficacy, and the extent of math vocabulary achievement. It also examined the significant relationships among math study skills and math vocabulary achievement, math study skills and academic self-efficacy, and math vocabulary achievement and academic self-efficacy. Moreover, this investigation examined the mediating effect of academic self-efficacy on the relationship between math study skills and math vocabulary achievement.

Theoretical Lens

Furthermore, the study draws on Albert Bandura's Social Cognitive Theory, developed in 1960, and the Causal Inference Theory (Rubin, 2015), which applies the concept of mediation analysis. Social cognitive theory (SCT) of Albert Bandura emphasizes the dynamic interaction between people (personal factors), their behavior, and their environments. This study emphasizes how self-efficacy can help Grade 10 students set goals, track their progress, and adjust their learning methods to improve retention. Moreover, the study applies Rubin's (2015) causal inference theory, which includes the concept of mediation analysis. This provides a statistical framework to understand causal relationships and is focused on estimating the effect of a treatment or intervention on an outcome by accounting for the potential outcomes under different conditions.

METHODOLOGY

Research Design. The study employed a quantitative research design using the descriptive-correlational technique to measure two or more closely related variables and to evaluate the relationships among them. The study also utilized mediation to assess if academic self-efficacy mediates the relationship between math study skills and math vocabulary achievement. The respondents in this study are Grade 10 students from the three public secondary schools in the municipality of Bunawan, province of Agusan del Sur. Grade 10 students are the ideal respondents for this study because they are transitioning from basic to more advanced math concepts, which is a pivotal phase in their academic development. The sampling technique used in selecting respondents for this study was stratified random sampling.

The study employed a simple mediation model, using the Sobel test for significance, as it provides a direct assessment of the indirect effect within the constraints of the study's quantitative design. While structural equation modeling (SEM) offers a more comprehensive analysis for complex path structures, the simple mediation approach was selected to maintain focus on the specific interplay between the three measured variables, ensuring clarity and interpretability in the context of the Grade 10 student population.

Research Instrument. Three sets of adapted survey questionnaires were used to collect data from respondents. The questionnaires were validated by a panel of experts and pilot-tested. The first adapted question scale for math study skills was developed by Kamel et al. (2020). The questionnaire had a Cronbach's alpha of 0.802, suggesting adequate internal consistency and reliability. The second questionnaire was about students' academic self-efficacy, adapted with slight modifications from Dullas (2018, April). The Cronbach's alpha value of the self-efficacy scale is 0.857. Thirdly, the researcher adapted Bowie's (2015) questionnaire to assess students' achievement in math vocabulary. The respondents have to choose one correct option. The computed Cronbach's alpha for this questionnaire is 0.726.

Data Gathering Procedure. The researcher requested an endorsement letter from the Dean of the Graduate School at the University of Immaculate Conception (UIC) to conduct this study and secure ethical clearance. A letter requesting permission to conduct a study involving the three identified schools was submitted to the principals and administrators of these schools.

Before the survey was implemented, informed parental consent was obtained from the students. The collected data was stored securely and used solely for research purposes, in accordance with the Data Privacy Act of 2012. *Mean and standard deviation.* It will be used to determine the level of academic self-efficacy, math study skills, and math vocabulary achievement.

Data Analysis. Statistical tools, including descriptive statistics, Pearson product-moment correlation, and Sobel z-value, were used to treat the data.

RESULTS AND DISCUSSION

Level of Math Study Skills of Grade 10 students

As shown in Table 1, the level of mathematics study skills among Grade 10 students has an overall mean of 2.93, indicating a high level. This implies that students often demonstrate strong study skills in math. It further implies that Grade 10 students can effectively manage their time, sustain concentration, and demonstrate active study strategies, note-taking, and test-taking strategies that enhance learning and performance in mathematics.

Table 1
Level of Math Study Skills of Grade 10 students

Indicators	Mean	SD	Description
Time Management	2.78	0.71	Moderate
Concentration	2.92	0.70	High
Study Aids	2.93	0.74	High
Test Strategies	2.93	0.71	High
Reading	2.98	0.69	High
Overall Mean	**2.93**	**0.70**	**High**

The finding is similar to the study of Feudel and Dietz (2019), which revealed that students exhibited a high level of math study skills. It emphasizes that students demonstrated exemplary math study skills, including managing their time, maintaining focus, developing strong reading skills, and practicing writing habits. Furthermore, the finding supports the study by Kamel et al. (2020), which indicated that students' math study skills are high. This means students' math study skills are improving through continuous refinement of their strategies, including organization, motivation, study aids, and time management.

Level of Academic Self-efficacy of Grade 10 students

Table 2 shows the level of academic self-efficacy among grade 10 students. Results revealed an overall mean of 2.91, indicating a high level. This implies that students' academic self-efficacy is often evident. It further implies that Grade 10 students perceive control over their academic success, are competent at completing tasks, navigate and overcome academic challenges, and

are able to plan, organize, monitor, and adjust their learning strategies to complete tasks and achieve specific objectives.

Table 2

Level of Academic Self-efficacy of Grade 10 students

	Mean	SD	Description
Perceived Control	2.95	0.70	High
Competence	2.75	0.69	Moderate
Persistence	3.0	0.71	High
Self-Regulated Learning	2.96	0.71	High
Overall Mean	**2.91**	**0.70**	**High**

The study's findings are similar to those of Zakariya (2022), who underscores that students have a high level of academic self-efficacy. This means that students demonstrate belief in their ability to accomplish academic tasks, confidence in overcoming challenges, and consistently monitor and improve their learning progress.

Level of Students' Math Vocabulary Achievement

Table 3 shows the level of math vocabulary achievement among the students, measured as the percentage of correct answers. Results revealed a mean of 33.84, indicating that students did not meet the expectation. This implies that the students have very low levels of math vocabulary achievement, which means they struggle to grasp mathematical terms, symbols, and language across various domains, such as algebra, geometry, data and probability, and numbers and operations.

Table 3

Level of Students' Math Vocabulary Achievement

Math Vocabulary Achievement	Mean	SD	Description
Numbers and Operations	39.83	24.77	Very Low
Algebra	33.67	13.96	Very Low
Geometry	32.81	15.00	Very Low
Data and Probability	29.04	18.22	Very Low
Overall	**33.84**	**18.0**	**Very Low**

The findings of the study support the study of Bowie (2015), which highlighted that students have very low vocabulary achievement. This means that students have difficulty grasping basic mathematical concepts and processes in numbers, algebra, geometry, and data and probability. In a similar vein, Slusser et al. (2019) report low levels of achievement in math vocabulary among students. With this, it poses a significant concern, specifically for the grade 10 students, as they will be exposed to more advanced math terms in senior high school and college-level.

Significance of the Relationship between Math Study Skills, Academic Self-efficacy, and Math Vocabulary Achievement

Table 4 shows the relationships between math study skills, academic self-efficacy, and math vocabulary achievement. As for the relationship between math study skills and math vocabulary achievement, the results indicate that students' math study skills are significantly positively related to their math vocabulary achievement ($p = 0.031$), which is less than the 0.05 level of significance (two-tailed). The table further revealed that, although math study skills are significantly related to math vocabulary achievement, the relationship is not very strong, with a correlation coefficient of 0.131. Likewise, the table shows that the relationship between academic self-efficacy and math vocabulary achievement is significant and positive, with a p-value of 0.004, which is less than the alpha level of 0.05.

Table 4

Significance of the Relationship between Math Study Skills, Academic Self-efficacy, and Math Vocabulary Achievement

	r	p-value	Remarks
Math Study Skills and Math Vocabulary Achievement	0.131	0.031	Significant
Academic Self-efficacy and Math Vocabulary Achievement	0.173	0.004	Significant
Math Study Skills and Academic Self-efficacy	0.781	0.000	Significant

The relationship between the two variables in this study is weak, with a correlation coefficient of 0.173. Further, the results show a significant, positive

relationship between math study skills and academic self-efficacy, with a p-value of 0.00, which is lower than the alpha set at 0.05. This means that as students' math study skills improve, their academic self-efficacy also increases significantly. The table also revealed that the relationship between the two variables in this study is strong, with a correlation coefficient of 0.781.

The result supports the paper by Suárez‑Pellicioni et al. (2021), which shows that, regardless of the breadth and depth of students' achievement in math vocabulary, they can still employ strategies and skills that create variability in their performance. Also, Powell et al. (2021) emphasize that there is a minimal link between mathematical vocabulary achievement and math study skills. Furthermore, Borgonovi and Pokropek (2019) highlighted that the relationship between academic self-efficacy and math vocabulary achievement is multifaceted and influenced by numerous interconnected factors, underscoring disparities in self-efficacy across students from varying socioeconomic backgrounds. For instance, students with high levels of self-efficacy, consequently, correlate with greater mathematical achievement and proficiency in vocabulary (Khasawneh et al., 2021).

Also, in the present study by Dadandı (2023), academic self-efficacy beliefs can activate self-regulation, helping students evaluate the effectiveness of their study skills. Notably, students who perceive themselves as competent in mathematics tend to engage with tasks more persistently, employ effective math study skills, and thereby increase their self-efficacy, enabling them to navigate challenges that may arise in their studies (Thompson et al., 2022).

Mediation Analysis of Academic Self-efficacy on the Relationship between Math Study Skills and Math Vocabulary Achievement

Table 5 presents the direct, indirect, and total effects, along with the path coefficients. The direct effect of math study skills on math vocabulary achievement is -0.3138 ($p > 0.05$), which is not significant when academic self-efficacy is not considered as a mediator. This means that math study skills have no significant direct influence on math vocabulary achievement, but one still needs to consider the mediating process to determine whether the relationship is explained by academic self-efficacy.

Table 5

Mediation Analysis of Academic Self-efficacy on the Relationship between Math Study Skills and Math Vocabulary Achievement

Independent Variable (IV)	**Math Study Skills**		
Dependent Variable (DV)	**Math Vocabulary Achievement**		
Mediating Variable (MV)	**Academic Self-efficacy**		
	Standardized Beta (β)	Standard Error	p-value
Direct Effects (IV → DV)			
Math Study Skills on Math Vocabulary Achievement	-.3138	2.9831	0.916
Indirect Effects (IV→ MV → DV)			
Math Study Skills→ Academic Self-efficacy→ Math Vocabulary Achievement	4.3772	0.191	0.038
Math Study Skills → Academic Self-efficacy	4.0633	1.8722	0.031
Path Coefficients			
Academic Self-efficacy → Math Vocabulary Achievement	0.173	2.080	0.004
Math Study Skills → Math Vocabulary Achievement	0.131	1.872	0.031
Math Study Skills → Academic Self-efficacy	0.782	0.034	0.001
R-Squared			
Math Vocabulary Achievement	0.030		
Academic Self-efficacy	0.610		

On the other hand, math study skills indirectly affect math vocabulary achievement through academic self-efficacy, with a value of 4.3772 ($p<.05$). As such, math study skills affect the mediator variable, academic self-efficacy, which then affects the dependent variable, math vocabulary achievement. It means that part of the effect of math study skills on math vocabulary achievement happens through academic self-efficacy. This suggests that

academic self-efficacy plays a significant role in explaining how math study skills impact math vocabulary achievement.

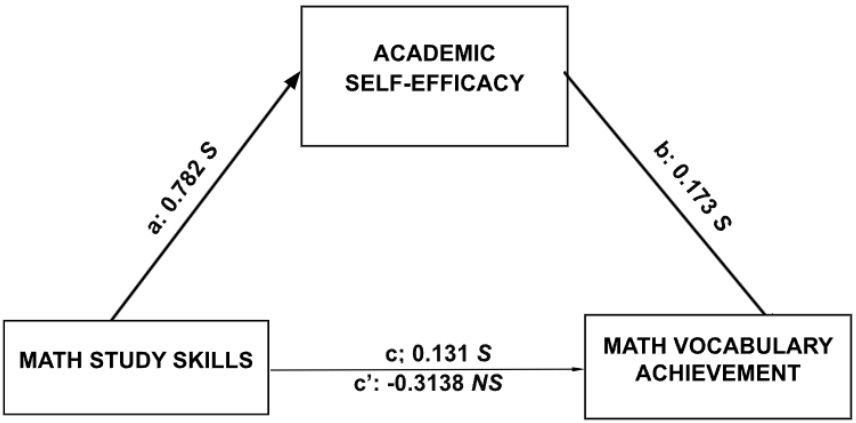
Meanwhile, the total effect represents the combined effect of math study skills on math vocabulary achievement, including both direct and indirect pathways through academic self-efficacy mediation. This means that the total effect of math study skills on math vocabulary achievement is 4.0633 units ($p < .05$), considering both direct and indirect pathways. Correspondingly, it represents the overall influence of the independent variable, math study skills, on the dependent variable, math vocabulary achievement, which is significant and larger than the direct effect because it includes the mediation pathway.

Based on the mediation analysis results, full mediation occurs when the direct effect of the independent variable (IV) on the dependent variable (DV) becomes non-significant after accounting for the mediator. In this case, since the direct effect of math study skills → math vocabulary achievement is not significant ($p = 0.916$) and there is a significant indirect effect ($p = 0.038$), the evidence suggests that academic self-efficacy fully mediates the relationship between math study skills and math vocabulary achievement. To add, the significant indirect effect suggests that math study skills influence math vocabulary achievement entirely through academic self-efficacy. The non-significant direct effect remarks indicate that academic self-efficacy fully accounts for the relationship between math study skills and math vocabulary achievement.

Visually, Figure 3 shows that the path from math study skills to academic self-efficacy has a standardized coefficient of 0.782 ($p > .05$). In addition, the path from academic self-efficacy to math vocabulary achievement has a standardized coefficient of 0.173. Meanwhile, the direct path from math study skills to math vocabulary achievement has a standardized coefficient of 0.131, which is significant ($p < .05$) at a 95 percent confidence level, with a standard error of 1.872. As such, this path is statistically significant, suggesting that math study skills have a meaningful direct impact on math vocabulary achievement.

Figure 1

The Path Plot of Academic Self-efficacy as a Mediating Variable on the Relationship between Math Study Skills and Math Vocabulary Achievement



The findings support the study by de Bree & Zee (2021), who state that the stronger students' self-efficacy beliefs, the more likely they are to implement techniques and strategies for studying in this context, and that such beliefs would support students in enhancing their vocabulary achievement. According to Tahir (2022), the use of analytical approaches in subsequent tasks after performing a previous task is mediated by self-efficacy; with increased self-efficacy, individuals make greater use of tactics. Extensive research has explored the relationship between study skills and various factors within the framework for predicting vocabulary achievement in educational settings. Using comprehensive statistical modeling and mediation techniques, studies such as Hayat et al. (2020) have highlighted the significance of these factors, with self-efficacy identified as a key contributor (Shehzad et al., 2010).

In summary, Grade 10 students have strong math study skills and high academic self-efficacy. However, Grade 10 students achieve a very low level of math vocabulary. Additionally, there is a significant relationship between academic self-efficacy, math study skills, and math vocabulary achievement. Lastly, academic self-efficacy fully mediated the relationship between math study skills and math vocabulary achievement. This implies that to increase math vocabulary achievement, teachers should focus on manipulating academic

self-efficacy rather than directly targeting math study skills.

As recommendations, teachers may provide instructional support, such as designing and implementing math vocabulary mini-enhancement materials that promote gradual independence and provide scaffolding for students. This may help build students' confidence in their academic abilities and competence. Administrators may also create sustainable programs, such as a project-based math vocabulary program and a peer/mentoring program, that will help students develop their math study skills. Parents may always provide positive emotional support to students, such as encouraging them even in the midst of uncertainty. Lastly, future researchers may explore other contributing factors that could influence math vocabulary achievement.

Despite the insights gained, this study has several limitations that we should acknowledge. First, the cross-sectional nature of the data limits the ability to establish definitive causal claims regarding the relationships between math study skills, academic self-efficacy, and math vocabulary achievement. Additionally, the sample size and its specific focus on Grade 10 students in a single municipality may affect the generalizability of the results to other populations. Future researchers should consider longitudinal designs to better capture developmental trends over time and utilize larger, more diverse samples to further build on and validate these findings.

REFERENCES

Borgonovi, F., & Pokropek, A. (2019). Seeing is believing: Task-exposure specificity and the development of mathematics self-efficacy evaluations. Journal of Educational Psychology, 111(2), 268–283. Retrieved in April 2025. https://doi.org/10.1037/edu0000283

Bowie, A. L. (2015). The relationship between middle school students' mathematical vocabulary and their achievements in mathematics: A mixed method study (Doctoral dissertation). Kennesaw State University. Retrieved in November 2024. https://digitalcommons.kennesaw.edu/etd/664/

Dadandı, İ. (2023). Academic self-efficacy, study skills and academic achievement: A serial mediation model. Research on Education and Psychology, 7(2), 291–306. Retrieved in November 2024. https://doi.org/10.54535/rep.1342022

de Bree, E., & Zee, M. (2021). The unique role of verbal memory, vocabulary, concentration and self-efficacy in children's listening comprehension in upper elementary grades. First Language, 41(2), 129–153. Retrieved in November 2024. https://doi.org/10.1177/0142723720941680

Dullas, A. R. (2018). The development of an academic self-efficacy scale for Filipino junior high school students. Frontiers in Education, 3, 19. Retrieved in November 2024. https://doi.org/10.3389/feduc.2018.00019

Feudel, F., & Dietz, H. M. (2019). Supporting the use of study skills in large mathematics service courses to enhance students' success–one example. In Eleventh Congress of the European Society for Research in Mathematics Education (No. 14). Retrieved in March 2025. https://www.researchgate.net/publication/361389161

Guzman, J., & Li, A. (2023). Measuring founding strategy. Management Science, 69(1), 101–118. Retrieved in December 2024. https://doi.org/10.1287/mnsc.2021.4120

Hayat, A. A., Shateri, K., Amini, M., & Shokrpour, N. (2020). Relationships between academic self-efficacy, learning-related emotions, and metacognitive learning strategies with academic performance in medical students: A structural equation model. *BMC Medical Education, 20*(1), 1–11. Retrieved in December 2024. https://doi.org/10.1186/s12909-020-02006-1

Imbens, G. W., & Rubin, D. B. (2015). Causal inference in statistics, social, and biomedical sciences. Cambridge University Press. Retrieved in December Retrieved in December 2024. https://doi.org/10.1017/CBO9781139025750

Kamel, A. M., Behery, F. A., Kenawy, G. M., El Ghamrawy, T. A., Ali, M. S., Nasr, M. M., ... & Baag, M. M. (2020). Exploring study skills among university students in Riyadh, Saudi Arabia. *Saudi Journal of Oral Sciences, 7*(2), 90–98. Retrieved in November 2024. https://doi.org/10.4103/sjos.sjoralsci_87_19.

Khasawneh, E., Gosling, C., & Williams, B. (2021). What impact does math anxiety have on university students? *BMC Psychology, 9*, 1–9. Retrieved in December 2024. https://doi.org/10.1186/s40359-021-00541-7

Medallon, M. [Ed.D]. (2016). Math study skills and attitude towards mathematics and statistics as antecedents of statistics learning. *Laguna Journal of Multidisciplinary Research*, 4. Retrieved in November 2024. https://lpulaguna.edu.ph/wp-content/uploads/2017/03/Math-Study-Skills

-and-Attitude-Towards-Mathematics-and-Statistics-as-Antecedents-of-Statistics-Learning.pdf

Powell, S. R., Bos, S. E., & Lin, X. (2021). The assessment of mathematics vocabulary in the elementary and middle school grades. *Diversity Dimensions in Mathematics and Language Learning*, 24, 313–330. Retrieved in November 2024. https://doi.org/10.1515/9783110661941-016

Riccomini, P. J., Smith, G. W., Hughes, E. M., & Fries, K. M. (2015). The language of mathematics: The importance of teaching and learning mathematical vocabulary. *Reading & Writing Quarterly*, 31(3), 235–252. Retrieved in November 2024. https://doi.org/10.1080/10573569.2015.1030995

Shehzad, M. W., Alghorbany, A., Lashari, S. A., & Lashari, T. A. (2019). Self-efficacy sources and reading comprehension: The mediating role of reading self-efficacy beliefs. *3L: Language, Linguistics, Literature*, 25(3). Retrieved in December 2024. https://doi.org/10.17576/3L-2019-2503-07

Singh, K. (2016). Study skills and academic achievement of college students. *International Journal of Research in Social Sciences and Humanities*, 6(12), 32–37. Retrieved in December 2024. https://doi.org/10.17576/3L-2019-2503-07

Slusser, E., Ribner, A., & Shusterman, A. (2019). Language counts: Early language mediates the relationship between parent education and children's math ability. *Developmental Science*, 22(3), e12773. Retrieved in December 2024. https://doi.org/10.1111/desc.12773

Suárez-Pellicioni, M., Demir-Lira, Ö. E., & Booth, J. R. (2021). Neurocognitive mechanisms explaining the role of math attitudes in predicting children's improvement in multiplication skill. *Cognitive, Affective, & Behavioral Neuroscience*, 21, 917–935. Retrieved in December 2024. https://doi.org/10.3758/s13415-021-00878-2

Tahir, K. W. (2022). The relationship between vocabulary learning strategies and academic achievement: A mediation role of academic self-efficacy. *Journal of The Iraqi University*, 56(3). Retrieved in April 2025. https://www.iraqoaj.net/iasj/pdf/e4a10792c8521bfb

Thompson, G., Aizawa, I., Curle, S., & Rose, H. (2022). Exploring the role of self-efficacy beliefs and learner success in English medium instruction. *International Journal of Bilingual Education and Bilingualism*, 25(1), 196–209. Retrieved in April 2025.

https://doi.org/10.1080/13670050.2019.1689914

Timario, R. R. (2020). Reading comprehension and problem-solving skills of grade seven students: A mixed sequential explanatory approach. *American Journal of Humanities and Social Sciences Research (AJHSSR)*, 4(6), 83–91. Retrieved in April 2025. https://www.ajhssr.com/reading-comprehension-and-problem-solving-skills-of-grade-sevenstudents-a-mixed-sequential-explanatory-approach/

Zakariya, Y. F. (2022). Improving students' mathematics self-efficacy: A systematic review of intervention studies. *Frontiers in Psychology*, 13, 986622. Retrieved in April 2025. https://doi.org/10.3389/fpsyg.2022.986622