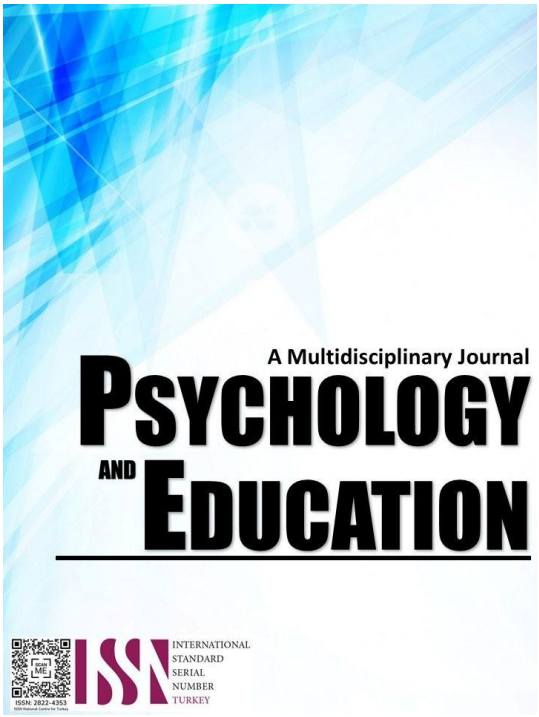
SELF-EFFICACY AND SELF-REGULATION IN THE COGNITIVE PROCESSING AND MASTERY OF MATHEMATICAL CONCEPTS AMONG STUDENTS IN SELECTED SECONDARY PUBLIC SCHOOLS OF TRECE MARTIRES CITY



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Research Article

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

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Abstract

This study examines the relationship between self-regulation and math self-efficacy among secondary public school students in Trece Martires City, Philippines, in the context of persistent challenges in mathematical proficiency. Despite the recognized importance of self-regulation—defined as the ability to monitor and control one's learning processes—and self-efficacy—the belief in one's capacity to succeed—Filipino students continue to underperform in mathematics, as evidenced by the country's low ranking in the Programme for International Student Assessment (PISA). Using a quantitative descriptive-correlational design, this research assessed 60 students through a validated questionnaire to measure their levels of self-efficacy and self-regulation in mathematical concept processing. Results indicated generally positive self-efficacy (mean = 3.22) and strong self-regulation (mean = 3.34), with a small but statistically significant positive correlation ($r = 0.22$, $p = 0.032$) between the two constructs. The findings suggest that enhancing both self-efficacy and self-regulation through targeted interventions—such as strategy training, teacher support, and reflective learning practices—could improve students' mathematical performance. This study contributes to the broader discourse on educational strategies in the Philippines, advocating for integrated approaches that address psychological and behavioral factors in learning.

Keywords: *self-regulation, self-efficacy, mathematics education, academic performance, secondary students, Philippines, PISA, learning strategies*

Introduction

In contemporary education, there is an increasing recognition of the importance of self-efficacy and self-regulation as essential components of student success, particularly in the mastery of complex subjects such as mathematics. Self-regulation, as described by Zimmerman (2018), is the ability to monitor, control, and direct one's own learning processes, including emotions, cognition, and behavior. This skill is crucial for students as it helps them manage academic challenges, stay focused on their goals, and adapt strategies to overcome difficulties. Similarly, self-efficacy, as defined by Bandura (2019), refers to an individual's belief in their capacity to perform specific tasks and achieve set goals. This belief significantly impacts students' motivation, perseverance, and overall academic performance, especially in subjects requiring cognitive engagement like mathematics.

Research indicates that self-regulation and self-efficacy are closely intertwined and play a substantial role in determining students' academic success (Schunk & DiBenedetto, 2020). Teachers play a critical role in fostering both constructs by creating supportive learning environments that enhance students' self-belief and their ability to regulate their learning behaviors. Effective teaching practices and meaningful teacher-student interactions are key to boosting students' confidence and guiding them in developing essential self-regulation strategies (Schunk & Ertmer, 2018).

Despite the growing recognition of these factors, Filipino students continue to face significant challenges in mathematics. According to the Programme for International Student Assessment (PISA) results from the Organization for Economic Cooperation and Development (OECD), Filipino students ranked among the lowest in mathematical literacy, placing 79th out of 79 countries assessed (OECD, 2019). This low performance is partly attributed to insufficient self-regulation and self-efficacy, which negatively affect students' ability to process and master mathematical concepts (Paris, 2019). These challenges emphasize the urgent need to explore and address these psychological factors in the development of Filipino students' mathematical skills.

This study seeks to examine the relationship between self-regulation and math self-efficacy among secondary public school students in Trece Martires City. By investigating how these psychological constructs influence students' cognitive processing and mastery of mathematical concepts, the study aims to shed light on their impact on academic achievement. The findings may provide valuable insights into the development of targeted teaching strategies and interventions that can enhance students' mathematical proficiency. Furthermore, this research will contribute to the broader discourse on improving student outcomes in the Philippines, particularly within the context of ongoing efforts to elevate educational standards. Ultimately, the study aims to lay the groundwork for future educational programs that foster self-regulation and self-efficacy.

Research Questions

This study aimed to identify the self-efficacy and self-regulation in learning among students in selected secondary public schools of Trece Martires City. However, specifically, it aimed to:

1. What is the profile of the respondents in terms of;
    1.1. sex; and

1.2. age?
2. What is the level of respondents perceived self-efficacy in relation with application and practicing mathematical concepts?
3. What is the level of respondent's perceived self-regulation in relation with application and practicing mathematical concepts?
4. Is there any significant relationship between self-efficacy and self-regulation of the students?

Literature Review

Defining Self-Regulation in Educational Contexts

Decades of research have confirmed the positive effects of self-regulated learning on students' wellbeing and their development as independent and collaborative learners. All students have the capacity to manage critical thinking, instilling proper behaviors and a mindset that enables them to gain the most from the discussion. The importance of providing students with opportunities to regulate their learning is crucial for teachers when designing and managing classrooms that empower students by incorporating effective teaching styles and maintaining a conducive learning environment. Giving rewards and punishments may influence the reinforcement of responsible behavior and guide students to manage their positive behavior for responsible learning (Jarvela et al., 2018).

Self-regulated learning refers to one's ability to understand and control one's learning environment. Self-regulation abilities include goal setting, self-monitoring, self-instruction, and self-reinforcement (Sahranavard et al., 2018). Self-regulated learning has also been highly praised as the key competence to initiate and maintain lifelong learning. Lifelong learning enables students to renew their self-motivation, recognize their personal interests and goals, enhance their professional skills, and boost their self-confidence. It can help the learners to achieve personal fulfillment and satisfaction. Self-regulated learning contributes to positive educational outcomes and supports sustainable development by promoting adaptive skills necessary for success in an ever-changing digital world (Šimić Šašić et al., 2023).

Effective learners are self-regulating, analyzing mathematical problems, and selecting, adapting, or inventing strategies to achieve their objectives. Learners also monitor their academic progress to adjust their learning and achieve success. Being mindful and focused helps students learn tasks quickly. Time management and good study habits increased the learning outcomes of the learners. Hence, self-regulation can lead to better educational performance by managing one's emotions. They also have a great motivation to study and can make targeted plans. As internal self-regulation increases, self-efficacy and planning also increase in a person (Lu et al., 2022; Truong, 2022; Greenquist-Marlett et al., 2024).

Defining Self-Efficacy in Educational Contexts

Self-efficacy plays a significant role in enhancing motivation, knowledge acquisition, and performance during examinations. Self-efficacy as the confidence in one's ability to exert control over motivation, behavior, and social environment. These cognitive self-evaluations influence various aspects of human experience, including goal-setting and attitudes toward academic tasks. Effective learners utilize metacognition and higher-order thinking skills, where metacognition involves monitoring and controlling thought processes, often linked to self-efficacy and task performance. Metacognition is crucial for managing declarative knowledge (facts) and procedural knowledge (Schunk & DiBenedetto, 2021).

Self-efficacy has been consistently demonstrated to predict academic performance and influence goal-setting, with higher levels of self-efficacy leading to more ambitious goals and stronger commitment to achieving them (Alhadabi & Karpinski, 2020; Thompson et al., 2022). This relationship is underscored by the role of self-efficacy in enhancing effort and persistence, which are critical mediators of performance goals (Thompson et al., 2022).

In various educational contexts, including online learning environments, self-efficacy remains a pivotal factor, significantly impacting learners' ability to manage their learning processes effectively (Korucu-Kış, 2021). Empirical studies have shown that students with high self-efficacy tend to exhibit higher levels of confidence and optimism, leading to enhanced participation in learning activities (Asakereh and Yousofi, 2018; Akturk and Ozturk, 2019). Moreover, self-efficacy's predictive power extends across different academic disciplines, including mathematics and sciences, where it positively correlates with overall academic achievement (Xu and Qi, 2019; Er et al., 2022).

Using effective learning strategies and having strong self-efficacy are significant characteristics of effective learners. Self-directive processes and self-beliefs enable learners to transform their mental abilities into academic performance skills. Recent studies have further emphasized the importance of self-regulated learning in enhancing academic performance. For instance, self-regulated learning strategies such as self-efficacy, task strategies, and self-evaluation have been identified as crucial for academic success, particularly in contexts where learners must adapt to new challenges. Moreover, research highlights the role of self-efficacy in distance education, where it influences learners' ability to manage their learning processes effectively, primarily through dimensions like academic, learning, and social self-efficacy (Ahmad et al., 2019; Korucu-Kış, 2021; Schunk & DiBenedetto, 2021).

Demographic Profile of Learners Affecting Level of Self-Regulation and Self-Efficacy

Demographic factors play a critical role in shaping students' self-efficacy and self-regulation in mathematics. Research indicates that

demographic variability, including gender and socioeconomic status (SES), can moderate the relationships between math achievement and self-efficacy development (ERIC, 2023). Studies have found that gender differences in math self-efficacy can influence academic performance, with males often showing higher self-efficacy. Furthermore, SES and race/ethnicity are also associated with differences in math achievement and self-efficacy growth. Understanding these complex relationships is essential for developing effective educational strategies. Moreover, demographic factors like parents' educational level and school type can significantly impact students' math performance (Hathella & Priyanath, 2021).

Moreover, demographic profiles, such as age and gender, can significantly influence the level of self-regulation and self-efficacy in mathematics. For instance, research has shown that male students often exhibit higher self-efficacy in math compared to female students, with gender differences observed in various studies. Understanding these dynamics is crucial for developing targeted interventions that support learners' self-regulation and math self-efficacy. Additionally, demographic factors such as residence, school type, and parents' educational level are significant predictors of math performance. By examining these factors, educators can tailor interventions to support students' unique needs better (Rodríguez et al., 2020; Zander et al., 2020).

Understanding the complex relationships between demographic factors, self-regulation, and math self-efficacy is crucial for developing effective educational strategies. Demographic factors, such as parents' educational level and school type, can significantly impact students' math performance, as they influence access to resources and quality of education. The students from higher socioeconomic backgrounds often have better access to educational resources, which can enhance their math self-efficacy and self-regulation skills. Additionally, the type of school attended can affect the quality of instruction and support available, further impacting students' math learning outcomes. By considering these demographic factors, educators can tailor interventions to address specific needs and improve math performance across diverse student populations (Hathella & Priyanath, 2021).

Self-Regulation in Mathematical Concept Processing

Self-regulation plays a pivotal role in mathematical concept processing, significantly influencing students' ability to manage their learning processes effectively. Recent studies have explored the relationship between self-regulation and mathematics performance across different contexts. For instance, a study examining German and Iranian college students found that self-regulation significantly predicted mathematics performance in students of Human Sciences but not in those studying math-related fields like Engineering/Informatics (Frontiers in Psychology, 2020). This suggests that self-regulation is particularly important for students who may not have a strong background in mathematics, as it helps them manage their learning more effectively.

Self-regulated learning (SRL) has been linked to reduced mathematics anxiety, with higher levels of SRL associated with lower anxiety levels (Pedagogical Research, 2024). This relationship highlights the importance of SRL in fostering a positive learning environment for mathematics. Additionally, research on pre-service mathematics teachers has identified distinct self-regulation profiles in mathematical problem-solving contexts, emphasizing the need for tailored instructional strategies to support diverse learning needs (MDPI, 2023). These profiles highlight the importance of understanding individual differences in self-regulatory strategies for effective teaching practices.

Recent studies have focused on enhancing self-regulation through specific instructional models. For example, the Problem-Based Learning (PBL) model has been shown to improve self-regulation and geometric problem-solving skills among junior high school students (EJMSE, 2024). This approach underscores the potential of structured learning environments in fostering self-regulatory skills, which are critical for success in mathematics. By recognizing these differences and implementing appropriate strategies, educators can create supportive learning environments that enhance students' ability to process mathematical concepts effectively.

The relationship between self-efficacy, self-regulated learning strategies, and performance in STEM disciplines highlights the importance of self-regulation in mathematical concept processing. Both self-efficacy and self-regulated learning (SRL) strategies are crucial predictors of academic success in STEM fields, as demonstrated by recent studies (Paz-Baruch, 2024). Understanding this relationship allows educators to develop targeted interventions aimed at enhancing students' self-regulatory skills. These interventions can lead to improved performance in mathematics by helping students manage their learning processes more effectively. By focusing on self-efficacy and SRL strategies, educators can create supportive learning environments that foster students' belief in their mathematical abilities, leading to better engagement and success in Mathematics.

Self-Efficacy in Mathematical Concept Processing Perceived Self-Regulation

The pattern of behavior exhibited by low self-efficacious students is likely to impact their success in college academics, as self-efficacy is one of the strongest predictors of academic achievement. Recent studies have shown that self-efficacy significantly influences academic performance across various subjects, including mathematics and reading literacy (Ugwuanyi, 2020; Kontaş & Özcan, 2022). The level of self-efficacy can also impact whether students like or dislike a subject, as it is influenced by factors such as teacher treatment and past experiences in that subject. Positive teacher feedback and supportive learning environments can enhance self-efficacy, leading to improved academic engagement and motivation (Korucu-Kış, 2021; Schunk & DiBenedetto, 2021). Additionally, research highlights the role of self-efficacy in mediating the relationship between learning engagement and academic achievement, underscoring its importance in educational settings (Zysberg & Schwabsky, 2021; Luo et al., 2023).

Methodology

Research Design

This study used a quantitative, descriptive-correlational research design to explore the relationship between students' perceived self-efficacy and self-regulation in processing mathematical concepts. The quantitative approach allows for numerical data collection and statistical analysis, while the descriptive aspect summarizes students' self-efficacy and self-regulation levels. The correlational design was used to determine if a statistically significant relationship exists between self-efficacy (independent variable) and self-regulation (dependent variable). This approach is suitable for understanding whether students' beliefs in their mathematical abilities are linked to how effectively they manage their learning processes.

Respondents

For this study, a stratified random sampling method was employed to ensure that different subgroups within the population of secondary public school students in Trece Martires City are well-represented. The strata could be based on factors such as grade level (e.g., Grade 9, Grade 10, Grade 11, Grade 12) or academic performance to capture a diverse range of experiences and perspectives. After identifying the strata, random sampling was used within each group to select participants, ensuring that every student within the stratum had an equal chance of being chosen.

A sample size of 60 students is considered reliable for a correlational study, as it provides a sufficient number of participants to detect statistically significant relationships between self-efficacy (independent variable) and self-regulation (dependent variable). This sample size offers a strong balance between practical feasibility and statistical power, allowing for meaningful analysis while ensuring the study remains manageable in terms of data collection and analysis. Additionally, with 60 samples, the study can achieve reliable results without introducing too much sampling error, making it appropriate for concluding the population from the sample.

Instrument

The research instrument used in this study is a researcher-made questionnaire constructed based on a comprehensive review of related literature (RRL) and associated studies (RRS). It is designed to gather data pertinent to the research questions, focusing on students' self-efficacy and self-regulation. The instrument is composed of closed-ended items, providing clear and structured responses for efficient data analysis. The questionnaire is divided into three sections, each targeting specific aspects of the study.

All questions are close-ended and rated on a 4-point Likert scale, allowing respondents to express varying degrees of agreement or effectiveness.

Additionally, the instrument underwent validation by research advisers and professionals from the education field to confirm its relevance and accuracy in measuring the intended variables.

Procedure

The data-gathering process for this study followed a systematic and organized approach to ensure the collection of reliable and valid data. The first step involved obtaining permission from the school authorities in the selected secondary public schools in Trece Martires City. The researchers formally communicated with the school administration to seek approval and discuss the scope of the study, emphasizing ethical considerations such as voluntary participation, the confidentiality of the respondents, and the anonymity of their responses.

Once permission was granted, the researchers proceeded with the planning and implementation of the sampling method, ensuring that equal representation was achieved from each of the selected schools. This ensured that the sample was representative of the student population in terms of grade level and other relevant demographic factors.

During the actual data collection, the questionnaires were distributed to the selected students. The researchers coordinated with school staff to facilitate the smooth administration of the questionnaires, ensuring that respondents had adequate time and clear instructions to complete the survey. The researchers were also available to answer any questions or clarify any uncertainties regarding the survey items. Once the questionnaires were completed, the researchers carefully retrieved the forms, ensuring that no data was lost. The data was then organized for analysis, making sure that all responses were appropriately recorded and coded for statistical analysis.

Throughout the data-gathering process, the researchers maintained open communication with school administrators, ensuring adherence to the agreed-upon schedule and ethical guidelines. The collected data were then prepared for statistical analysis, which formed the basis for answering the research questions and drawing meaningful conclusions to contribute to the study's objectives.

Data Analysis

The data collected from the respondents was analyzed using various statistical methods to address the research questions and hypotheses:

Frequency and Percentage: These were used to describe the demographic profile of the respondents.

Weighted Mean: This measured the central tendency of responses regarding the level of self-efficacy and self-regulation.

Pearson-r: This was employed to test the relationship between the level of self-efficacy and self-regulation.

Ethical Considerations

The study adhered to stringent ethical guidelines to protect the rights and confidentiality of the respondents. Participation in the study was entirely voluntary, with informed consent obtained from all participants. Respondents were assured that their identities would remain confidential and that the data collected would be used solely for the purposes of this research. In addition, any sensitive information regarding their demographic profile or academic performance was anonymized in the final report to maintain privacy.

Results and Discussion

Profile of the Respondents

Grade Level

Table 1. *Profile of the Respondents in terms of Grade Level*

Grade level	*Frequency*	*Percentage*
Grade 7	10	16.67 %
Grade 8	10	16.67 %
Grade 9	10	16.67 %
Grade 10	10	16.67 %
Grade 11	10	16.67 %
Grade 12	10	16.67 %
Total:	60	100 %

The profile of the respondents by grade level reveals an evenly distributed representation across all grade levels, with an equal proportion of 16.67% for Grades 7, 8, 9, 10, 11, and 12. Each of these grade levels contributed 10 respondents to the total sample of 60, indicating a well-balanced distribution across the entire spectrum of secondary education. This equal representation ensures that the findings of the study are reflective of a wide range of student perspectives, as no single grade level is overrepresented. Consequently, the data gathered is more likely to yield insights that are generalizable across different academic stages.

Sex

Table 2. *Profile of the Respondents in terms of Sex*

Sex	*Frequency*	*Percentage*
Male	23	38.33 %
Female	37	61.67%
Total:	60	100 %

The profile of the respondents by sex reveals an uneven distribution, with a higher proportion of female participants compared to male participants. Specifically, 61.67% of the respondents, or 37 out of 60, identified as female, while 38.33%, or 23 respondents, identified as male. This indicates a notable gender imbalance in the sample, with female perspectives being more prominently represented. While the study's findings still offer valuable insights, the higher representation of females may influence the overall results and should be considered when interpreting conclusions related to gender-specific experiences or perspectives.

Level of Perceived Self-Efficacy

In terms of Student Learning

Table 3. *Level of Perceived Self- Efficacy in terms of Student Learning*

Items	*WM*	*SD*	*VI*	*Rank*
I believe I can solve most Math problems with effort and practice.	3.65	0.70	Strongly Agree	4
I am confident in my ability to learn new Mathematical concepts.	3.98	0.60	Strongly Agree	1
I can perform well in Math even when I face challenging problems.	3.14	0.75	Agree	7
I believe that my success in Math depends on how much effort I put into studying.	3.55	0.68	Strongly Agree	5
I feel capable of improving my math skills with consistent practice.	3.60	0.66	Strongly Agree	3
I am confident that I can apply Mathematical concepts correctly in real-life situations.	3.20	0.72	Agree	6
I believe I can succeed in math even when I don't fully understand a topic initially.	2.43	0.78	Disagree	10
I can easily find ways to solve Math problems when faced with difficulty.	2.45	0.74	Disagree	8
I feel confident about my ability to pass math exams and assignments.	2.48	0.70	Disagree	9
I believe that I can achieve my desired math grades if I stay focused and work hard	3.70	0.65	Strongly Agree	2
Overall Mean:	3.22	-	Agree	

Legend: 1.00- 1.74 (Strongly Disagree) 1.75- 2.49 (Disagree) 2.50-3.24 (Agree) 3.25-4.00 (Strongly Agree)

Table 3 explores students' perceived self-efficacy in terms of their learning in mathematics. The item "I am confident in my ability to learn new mathematical concepts" ranks highest, with a Weighted Mean (WM) of 3.98 and Standard Deviation (SD) of 0.60, indicating that students strongly agree with this statement and feel highly capable of acquiring new math knowledge. This is followed by "I believe that I can achieve my desired math grades if I stay focused and work hard" (WM = 3.70, SD = 0.65), and "I feel capable of improving my Math skills with consistent practice" (WM = 3.60, SD = 0.66), both also falling under the "Strongly Agree" category.

These high ratings suggest that students perceive themselves as self-motivated and capable of academic success in mathematics when effort and consistency are applied. However, some items reflected lower self-efficacy, such as "I believe I can succeed in math even when I don't fully understand a topic initially" (WM = 2.43, SD = 0.78) and "I can easily find ways to solve math problems when faced with difficulty" (WM = 2.45, SD = 0.74), both of which fall under the "Disagree" category. These indicate areas where students feel less confident, especially when dealing with complex or unfamiliar problems. Overall, the mean score of 3.22 indicates that students generally agree with having a positive level of self-efficacy in learning mathematics. This supports the idea that while students recognize their potential for growth and achievement, targeted support in problem-solving and conceptual comprehension may further strengthen their confidence and performance in Math.

These findings support existing research highlighting the vital role of self-efficacy in students' mathematical success. Studies by Holenstein et al. (2021) and Zakariya (2022) emphasize that self-efficacy significantly influences concept processing and achievement, even more than grades or cognitive ability. Interventions like modeling competitions have been shown to boost students' confidence and engagement (Czocher et al., 2019). The present data, with an overall mean of 3.22, reflect a generally positive sense of self-efficacy among students, despite lower confidence in more challenging situations. Additionally, self-efficacy is seen as more predictive of immediate academic performance than self-concept (Marsh et al., 2019; Kriegbaum et al., 2015), and can be shaped by contextual factors like teacher feedback and classroom environment (Baiduri & Usmiyatun, 2023).

Level of Perceived Self-Regulation

In terms of Student Engagement

Table 4. *Level of Perceived Self- Regulation in terms of Student Engagement*

Items	*WM*	*SD*	*VI*	*Rank*
I set clear goals before I start studying mathematics	3.15	0.74	Agree	8
I monitor my progress while studying math to ensure I am understanding the material.	3.05	0.80	Agree	9
I manage my time effectively to complete Math assignments on time.	3.21	0.72	Agree	5
I actively seek help when I encounter difficulties with math concepts.	3.55	0.68	Strongly Agree	4
I review and adjust my study strategies if I find that I'm not understanding a math topic.	2.85	0.90	Agree	10
I regularly assess my understanding of mathematical concepts while studying.	3.20	0.75	Agree	6
I take breaks when needed to avoid feeling overwhelmed during math study sessions.	3.62	0.65	Strongly Agree	3
I make sure I practice math regularly to reinforce my learning.	3.78	0.60	Strongly Agree	2
I stay focused and avoid distractions when working on math assignments or problems	3.13	0.78	Agree	7
I use various strategies (e.g., summarizing, reviewing notes) to ensure I retain what I've learned in math.	3.90	0.55	Strongly Agree	1
Overall Mean:	3.34	-	Strongly Agree	

Legend: 1.00- 1.74 (Strongly Disagree) 1.75- 2.49 (Disagree) 2.50-3.24 (Agree) 3.25-4.00 (Strongly Agree)

Table 4 presents the level of perceived self-regulation in terms of student engagement in learning mathematics. The item "I use various strategies (e.g., summarizing, reviewing notes) to ensure I retain what I've learned in math" ranks highest, with a Weighted Mean (WM) of 3.90 and Standard Deviation (SD) of 0.55, indicating that students strongly agree with using strategic learning techniques to retain mathematical knowledge. This is followed by "I make sure I practice math regularly to reinforce my learning" (WM = 3.78, SD = 0.60) and "I take breaks when needed to avoid feeling overwhelmed during math study sessions" (WM = 3.62, SD = 0.65), both also falling under the "Strongly Agree" category.

In contrast, the lowest-rated item was "I review and adjust my study strategies if I find that I'm not understanding a math topic" with a WM of 2.85 (SD = 0.90), although still within the "Agree" range. This suggests that while students generally recognize the importance of adaptive strategies, fewer consistently apply them when faced with learning difficulties. Overall, the mean score of 3.34 falls under "Strongly Agree," indicating that students perceive themselves as actively engaged and self-regulated in their approach to learning mathematics. These results highlight a strong foundation of goal-setting, strategy use, and persistence among students, which are essential for academic success, especially in cognitively demanding subjects like math.

These findings support the growing body of research that underscores the critical role of self-regulation in mathematics learning. Studies show that self-regulation enhances students' ability to process mathematical concepts, particularly benefiting those without a strong math background (Frontiers in Psychology, 2020). It is also linked to reduced math anxiety, helping students manage stress and maintain focus (Pedagogical Research, 2024). Research further highlights the importance of recognizing individual differences in self-regulatory strategies (MDPI, 2023) and supports structured approaches like Problem-Based Learning (EJMSE, 2024) to improve time management and goal setting. Finally, the strong connection between self-regulation, self-efficacy, and academic performance in STEM fields (Paz-Baruch, 2024) reinforces the need to develop both skills to support student success in mathematics.

Significant Relationship of Self-Efficacy and Self-Regulation

Table 5. *Significant Relationship Between Self-Efficacy and Self-Regulation*

Variables	*Mean*	*R-value*	*P- value*	*Decision*
Self-Efficacy	3.22	0.22	0.032	Significant at $p < 0.05$
Self-Regulation	3.34			Reject Ho
				There is small positive relationship

Table 5 presents the significant relationship between self-efficacy and self-regulation among students. The results show a mean score of 3.22 for self-efficacy and 3.34 for self-regulation, indicating generally positive perceptions in both areas. The computed R-value of 0.22 suggests a small positive relationship, and the p-value of 0.032 confirms that this relationship is statistically significant at $p < 0.05$.

Based on this, the null hypothesis (Ho) is rejected, indicating that there is a meaningful association between students' self-efficacy and their self-regulation. This means that as students' belief in their mathematical abilities increases, so does their ability to manage and control their learning behaviors, even if the strength of the relationship is modest. These findings emphasize the importance of fostering both self-efficacy and self-regulatory strategies to enhance student engagement and academic performance in mathematics.

The findings of this study demonstrating a significant positive relationship between self-efficacy and self-regulation are consistent with Bandura's (1997) social cognitive theory, which posits that self-efficacy beliefs play a crucial role in motivating individuals to engage in self-regulatory behaviors such as goal-setting, self-monitoring, and persistence. Zimmerman and Schunk (2011) further emphasize that elevated levels of self-efficacy enhance students' capacity for effective self-regulated learning, facilitating better management of their cognitive and motivational processes. Empirical studies support this connection; Chemers, Hu, and Garcia (2001) identified a positive association between academic self-efficacy and self-regulation, which contributes to improved academic adjustment and performance. Similarly, Broadbent and Poon's (2015) meta-analysis confirmed a robust correlation between self-efficacy and self-regulated learning across diverse educational contexts, suggesting that interventions aimed at increasing self-efficacy may foster more effective self-regulation strategies, thereby enhancing students' overall academic achievement.

Conclusions

With the given objectives, this study concludes that:

The respondents were evenly distributed across Grades 7 to 12, each comprising 16.67% of the sample, ensuring a balanced representation across all secondary education levels. This broad distribution supports the generalizability of the findings across different academic stages.

The majority of respondents were female, accounting for 61.67% of the sample, while males comprised 38.33%. This gender imbalance should be considered when interpreting results, as female perspectives may be more prominently reflected.

Students reported generally positive self-efficacy in mathematics, with the highest confidence shown in their ability to learn new concepts (WM = 3.98). However, some challenges remain, particularly in persisting through complex problems, as indicated by lower ratings on related items. Overall, the mean self-efficacy score of 3.22 suggests a moderate to strong belief in their mathematical capabilities.

Perceived self-regulation was high, with students strongly endorsing the use of learning strategies such as summarizing and regular practice (highest WM = 3.90). While adaptive strategy use was slightly lower, the overall mean of 3.34 reflects active engagement and effective management of their learning processes.

A statistically significant positive relationship ($r = 0.22$, $p = 0.032$) was found between self-efficacy and self-regulation, indicating that higher confidence in mathematical abilities is associated with better self-management of learning behaviors, though the relationship strength is modest.

These findings underscore the importance of concurrently developing students' self-efficacy and self-regulatory skills to enhance motivation, engagement, and academic success in mathematics. Tailored interventions should address both beliefs and behaviors to support effective learning and performance.

Based on the conclusions, the following recommendations are proposed to strengthen students' mathematical learning through improved self-efficacy and self-regulation:

Implement targeted interventions to boost self-efficacy - Educators should design programs and activities that build students' confidence in their mathematical abilities, such as positive feedback, mastery experiences, and opportunities for success in progressively challenging tasks.

Incorporate self-regulation skill training - Schools should integrate lessons on effective study strategies, time management, goal-setting, and adaptive learning techniques to help students better manage their learning processes, especially when facing difficult mathematical concepts.

Provide continuous monitoring and personalized support - Teachers and counselors could offer regular check-ins and tailored guidance to help students identify and adjust ineffective learning strategies, fostering resilience and persistence in mathematics learning.

Encourage collaborative and reflective learning environments - Group work, peer tutoring, and reflection activities can promote both self-efficacy and self-regulation by allowing students to share strategies, receive social support, and internalize their learning progress.

Develop teacher training programs - Educators should be equipped with knowledge and tools to recognize and nurture students' self-efficacy and self-regulatory behaviors, enabling them to create supportive classroom environments that foster motivation and academic success.

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