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PREDICTIVE FACTORS OF MATHEMATICS ACHIEVEMENT: A STUDY ON MATHEMATICS ANXIETY, GRIT, AND MOTIVATION

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ABSTRACT

Mathematics achievement is shaped by various non-cognitive factors that influence students' engagement, persistence, and performance. This study examined the predictive roles of mathematics anxiety, grit, and motivation on the mathematics achievement of Grade 11 students at San Agustin Institute of Technology during the school year 2025–2026. Guided by a quantitative descriptive-correlational design, data were collected from 166 respondents using validated instruments and analyzed through descriptive statistics, Pearson correlation, and multiple regression. Results revealed that students exhibited moderate levels of mathematics anxiety, grit, and motivation, and demonstrated satisfactory mathematics achievement. Mathematics anxiety was significantly and negatively correlated with achievement, while grit and motivation were positively correlated. Multiple regression analysis showed that grit was the strongest positive predictor, followed by mathematics anxiety as a significant negative predictor, whereas motivation was not significant. The findings underscore the importance of fostering perseverance and addressing anxiety to improve students' mathematics achievement.

Keyword: achievement, anxiety, grit, motivation, regression

1. INTRODUCTION

Mathematics is a fundamental subject that helps students develop good thinking and problem-solving skills, which are important for success in school and future jobs. However, the Philippines continues to face challenges in mathematics achievement. Recent international assessments, like the 2022 Programme for International Student Assessment (PISA), show that Filipino students scored an average of 355 in mathematics, which is much lower than the Organisation for Economic Co-operation and Development (OECD) average of 472. This places the country among the lowest in the world in math ability (OECD, 2022).

A key reason for this persistent problem is the influence of non-cognitive factors on student learning and achievement. Studies consistently show that a learner's emotional state and personal beliefs play a significant role in their academic outcomes. Mathematics anxiety, for example, is characterized by feelings of fear, stress, or worry when working with numbers or solving problems. A study by Colinares and Ucang (2025) among Grade 10 learners revealed a moderate but significant negative correlation between mathematics anxiety and academic performance, indicating that as anxiety levels rise, performance tends to decline.

Beyond anxiety, two other psychological factors such as motivation and grit have a strong impact on student success. Motivation is the internal drive that initiates and sustains goal directed behavior, encouraging students to engage with challenging tasks and persist until they succeed. Campanilla (2024) reported that motivation significantly predicts mathematics achievement and, together with parental education background, explains a meaningful portion of the variance in Grade 9 students' performance. Meanwhile, grit, defined as perseverance and passion for long term goals, further strengthens student achievement. Segal & Kalfon-Hakhmigari (2025) found that grit enables STEM high school students to maintain higher mathematics grades even when cognitive ability is comparatively lower, highlighting grit as a compensatory factor

that supports continued effort and resilience in learning mathematics.

Although many studies have examined these factors separately, only a few have looked at how they work together to predict mathematics achievement, especially in the Philippines. Previous research shows that mathematics anxiety alone explains only a small part of student achievement (Barroso et al., 2021), which means other factors like grit and motivation must also be considered. This study addresses that gap by examining the combined influence of mathematics anxiety, motivation, and grit on the achievement of students in San San Agustin Institute of Technology (SAIT).

Hence, this study was conducted to determine the levels of mathematics anxiety, grit, motivation, and mathematics achievement of Grade 11 students in San San Agustin Institute of Technology for the S.Y 2025-2026. It also examined the significant relationship among these variables and identified which among them was the strongest predictor of mathematics achievement. Guided by a quantitative, descriptive-correlational research design and using multiple regression analysis, the study aimed to generate data that would inform teachers, parents, and administrators on which non-cognitive factors most strongly influenced students' mathematics performance. The results were expected to provide evidence-based recommendations for designing interventions that addressed these psychological variables to improve learning outcomes.

2. LITERATURE REVIEW

This study was built on the premise that mathematics achievement was a multi-faceted outcome influenced by a combination of a student's psychological traits. To explain the relationships among the variables, the research drew upon established theoretical frameworks.

2.1 Attentional Control Theory (ACT)

The relationship between Mathematics Anxiety and achievement was primarily guided by Attentional Control Theory (ACT) (Eysenck et al., 2007). ACT proposed that anxiety impaired the brain's ability to control attention, which was crucial for effective cognitive performance. When a student experienced mathematics anxiety, worry-related thoughts invaded and occupied their limited working memory, leaving fewer cognitive resources available for task-relevant processing, such as solving a math problem. This cognitive interference directly led to reduced performance and errors, creating a negative feedback loop where poor performance reinforced the initial anxiety.

Previous research strongly supported this model: Ashcraft and Moore (2019) demonstrated that mathematics anxiety disrupted working memory and cognitive processing, directly reducing a student's capacity to focus and solve problems. Colinares and Ucang (2025) found a significant negative correlation between mathematics anxiety and academic performance among Grade 10 learners, emphasizing that even moderate anxiety hindered achievement. Carey et al. (2016) also supported this cognitive interference model, showing how intrusive thoughts consumed mental resources. Furthermore, a meta-analysis by Barroso et al. (2021) confirmed the negative relationship between math anxiety and math achievement across various studies and populations. Based on this, the following null hypothesis was tested: H1: There is no significant relationship between mathematics anxiety and mathematics achievement.

2.2 Self-Regulation Theory (SRT)

The influence of Grit on Mathematics Achievement was explained through the lens of Self-Regulation Theory (SRT) (Zimmerman & Schunk, 2016). SRT suggested that successful learning resulted from a student's ability to control their thoughts, behaviors, and emotions to achieve their goals. Grit, defined as perseverance and passion for long-term goals (Duckworth et al., 2007), was a key component of self-regulation. Students high in grit were more likely to persevere through difficult tasks, remain focused on long-term academic objectives, and exhibited resilience in the face of setbacks, directly translating to improved performance in challenging subjects like mathematics.

This conceptual link was highly supported by evidence. A meta-analysis by Credé et al. (2017) consistently reported that grit predicted academic performance beyond cognitive ability, with the perseverance component being the key driver. Segal and Kalfon-Hakhmigari (2025) found that grit enabled students to maintain strong

mathematics performance even with lower cognitive ability, highlighting its compensatory effect. Additionally, Yu et al. (2021) established that grit was positively associated with achievement and inversely related to mathematics anxiety, suggesting it mitigated the detrimental effects of anxiety. Postigo et al. (2021) also noted that higher grit levels led to better academic achievement in adolescents over time. Based on this, the following null hypothesis was tested: H2: There is no significant relationship between grit and mathematics achievement.

2.3 Expectancy-Value Theory (EVT)

The role of Motivation was primarily understood through the Expectancy-Value Theory (EVT) (Pintrich & De Groot, 1990). EVT proposed that a student's motivation and subsequent effort depended on two main factors: their expectation for success (self-efficacy) and the value they placed on the task. Students were more likely to invest effort in learning when they believed they could succeed and when they saw the utility or importance of the subject for their future. This framework directly linked a student's internal beliefs and values to their engagement, persistence, and, consequently, their achievement.

Supporting evidence from Wang et al. (2015) demonstrated that motivation could act as a protective buffer against the negative effects of mathematics anxiety, allowing students to perform well despite their fears. Rosete and Olua (2024) and Campanilla (2024) also reported that higher motivation was associated with stronger academic outcomes and significantly predicted mathematics achievement. However, some research offered a more nuanced view: Tabigne (2025) reported that high motivation in certain student populations did not always translate into high performance, suggesting its effect was often mediated by other factors like perseverance or emotional control. Based on this, the following null hypothesis was tested: H3: There is no significant relationship between motivation and mathematics achievement.

This study integrated the three primary theories (ACT, SRT, and EVT) to address the literature gap concerning the simultaneous and relative predictive power of these non-cognitive factors. The Combined Predictors Hypothesis posited that when Math Anxiety (X_1), sustained Grit (X_2), and motivation (X_3) were accounted for together, they would collectively explain a significant portion of the variance in mathematics achievement ($\hat{Y}$). The multiple regression approach aimed to determine the unique contribution of each variable when controlling for the others. The general body of literature (Lee & Stankov, 2018) consistently found that a combination of non-cognitive factors, including self-beliefs and effort, were powerful influencers of achievement, often exceeding the predictive power of general intelligence alone. Furthermore, research focusing on the combined effects of these domains (Wang et al., 2018; Yu et al., 2021) suggested complex interplay, reinforcing the need for a multi-variable model to capture the true predictive landscape of mathematics success. Based on this, the final null hypothesis was tested: H4: Mathematics anxiety, grit, and motivation do not significantly predict mathematics achievement.

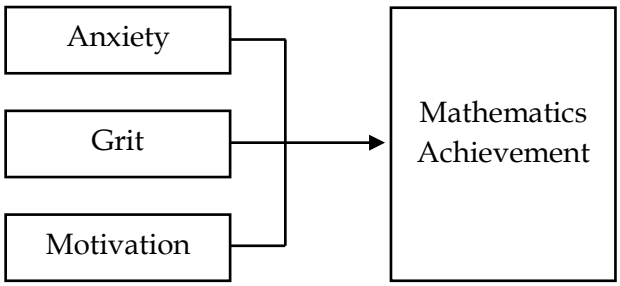

Figure 1. Conceptual Framework

The conceptual framework shown in Figure 1, illustrated that the study focused on determining the collective and individual predictive roles of Anxiety, Grit, and Motivation, on a single outcome, Mathematics Achievement. The model posited a direct link where Anxiety, Grit, and Motivation were hypothesized to influence or predict the level Mathematics Achievement. The analysis of the research sought to quantify the strength and direction of these relationships, specifically identifying which factor had the greatest statistical influence on student performance in mathematics.

3. METHODOLOGY

3.1 Research Design

This study employed a descriptive-correlational research design to examine the relationships among mathematics anxiety, grit, motivation, and mathematics achievement, and to identify their predictive power. This design was appropriate

because it allowed the investigation of how multiple psychological variables relate to students' mathematics performance without manipulating any variables. Multiple linear regression analysis was used to determine the unique contribution of each predictor variable beyond simple associations.

3.2 Research Locale

The study was conducted at San Agustin Institute of Technology (SAIT) in Valencia City, Bukidnon, Philippines. SAIT is a private educational institution offering Senior High School programs across four strands: STEM, ABM, HUMSS, and TVL. Its diverse student population provided an ideal setting for exploring how non-cognitive factors influence mathematics achievement among learners from various academic tracks and socio-economic backgrounds.

3.3 Population and Sample

The participants were Grade 11 students enrolled in mathematics courses at SAIT during the school year 2025–2026. A stratified random sampling technique was used to ensure proportional representation across the four academic strands. Using G*Power 3.1 software, the minimum sample size was computed based on a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$, and a statistical power ($1-\beta$) of 0.95, resulting in 115 participants. A 20% buffer was added to account for potential non-responses, yielding a final sample target of 138 students. A total of 166 Grade 11 students ultimately participated in this study, exceeding the minimum required sample size and ensuring sufficient power for the analyses.

3.4 Research Instruments

Data were gathered using three standardized self-report instruments and official academic records. Mathematics anxiety was measured with the 9-item Modified Abbreviated Math Anxiety Scale (mAMAS) (Carey et al., 2017), which demonstrated good reliability ($\alpha = 0.813$). Grit was assessed using the 12-item Grit Scale (Duckworth et al., 2007), with acceptable reliability ($\alpha = 0.711$); negatively worded items (2, 3, 5, 7, 8, and 11) were reverse-scored before analysis. Motivation was measured using the 15-item Mathematics Motivation Questionnaire (MMQ) (Fiorella et al., 2021) with a reliability coefficient of $\alpha = 0.803$. Mathematics achievement was operationalized as the students' official first-quarter mathematics grades, retrieved from the school registrar.

3.5 Data Gathering Procedure

Ethical clearance was obtained prior to data collection, and permission to conduct the study was granted by the school administration. The survey was administered primarily through Google Forms, ensuring efficient distribution and data compilation. Students without internet access were provided with connectivity support, while printed questionnaires were distributed to those without devices, and their responses were manually encoded. The researcher was physically present during administration to explain the purpose of the study, guide participants, and ensure proper completion of the questionnaires. Mathematics achievement data were collected from official records following data privacy protocols.

3.6 Data Analysis

Data were processed using the Statistical Package for the Social Sciences (SPSS). Assumptions of parametric tests were verified through the Shapiro–Wilk test and histogram inspection to confirm data normality. Descriptive statistics such as mean and standard deviation were used to describe the levels of mathematics anxiety, grit, motivation, and mathematics achievement. Pearson correlation analysis determined the strength and direction of relationships among the variables, while multiple linear regression identified significant predictors of mathematics achievement and their relative contributions to the overall model.

3.7 Ethical Considerations

The study strictly adhered to ethical research standards. Informed consent was obtained from all participants, outlining the study's objectives, procedures, voluntary nature, and the right to withdraw without consequences. Confidentiality was ensured by anonymizing responses and securely storing all data. Ethical clearance was obtained from the institutional research ethics committee, and the study complied with national and institutional ethical guidelines.

4. RESULT AND DISCUSSION

4.1 Level of Mathematics Anxiety

Table 1 shows the level of mathematics anxiety with an overall mean score of 3.19 with of standard deviation of 0.61, which falls under the "Moderate Anxiety" category. Among the indicators, the highest levels of anxiety were reported when facing surprise quizzes (M = 4.07), taking a math test (M = 3.86), and thinking about a math test the day before (M = 3.63) all described as "Quite a bit of Anxiety." In contrast, lower anxiety levels were reported when listening to another student explain a problem (M = 2.62) and starting a new topic (M = 2.70), both rated as "Moderate Anxiety."

Table 1. Level of Mathematics Anxiety

Indicator	Mean	SD	Description
1. Finding out you are going to have a surprise math quiz when you start your math lesson.	4.07	1.01	Quite a bit of Anxiety
2. Taking a math test.	3.86	1.02	Quite a bit of Anxiety
3. Thinking about a math test the day before you take it.	3.63	.96	Quite a bit of Anxiety
4. Being given math homework with lots of difficult questions that you have to hand in the next day.	3.39	1.06	Moderate Anxiety
5. Having to complete a worksheet by yourself.	2.87	1.04	Moderate Anxiety
6. Listening to the teacher talk for a long time in math.	2.83	1.08	Moderate Anxiety
7. Watching the teacher work out a math problem on the board.	2.78	1.02	Moderate Anxiety
8. Starting a new topic in math.	2.70	1.05	Moderate Anxiety
9. Listening to another student in your class explain a math problem.	2.62	1.04	Moderate Anxiety
Overall Mathematics Anxiety	3.19	.61	Moderate Anxiety

The finding revealed that students' overall mathematics anxiety was moderate indicated that the stress was noticeable but not universally debilitating. However, anxiety was highly context-dependent, peaking significantly during evaluative settings such as surprise quizzes and tests. This heightened response in high-stakes situations suggested that anticipatory stress and the fear of failure intensified students' emotional reactions. Theoretically, this moderate level of anxiety was concerning because, as proposed by Attentional Control Theory (ACT) (Eysenck et al., 2007), worry-related thoughts consumed limited cognitive resources (working memory) away from mathematical task processing. This cognitive interference meant that even moderate anxiety could reduce learning effectiveness and lead to underachievement. The variation across indicators therefore implied that interventions should focus not only on teaching strategies but also on reducing evaluative stress and improving students' emotional regulation during high-pressure tasks.

The results strongly aligned with the established understanding of mathematics anxiety's detrimental role. Consistent with the cognitive interference mechanism, Bernardo et al. (2022) previously found that anxiety particularly hindered Filipino students' ability to tackle complex problems that required deeper reasoning. Furthermore, the significant negative relationship found in the current study was mirrored by Colinares and Ucang (2025), who also reported a significant negative correlation between mathematics anxiety and performance, emphasizing that even moderate levels meaningfully affected achievement. Finally, the lower anxiety levels observed during collaborative activities like listening to another student explain a problem, suggested that a supportive environment mitigated emotional barriers. This observation was consistent with the local research of Villafane and Garcia (2019), who demonstrated that peer-assisted learning environments significantly reduced students' mathematics anxiety and built confidence.

4.2 Level of Grit

Table 2 presents the level of grit. The overall mean score was 3.13 (SD = 0.38), interpreted as "Moderate Grit," meaning that students sometimes persevered but may lose interest over time. The highest-rated item was "I finish whatever I begin" (M = 3.52), categorized as "High Grit," indicating that many students demonstrated perseverance when pursuing tasks. However, most items, such as "I have achieved a goal that took years of work" (M = 3.38) and "I am a hard worker" (M = 3.37), were rated as "Moderate Grit." Items reflecting consistency of interests, such as "My interests change from year to year" (M = 2.82) and "I have been obsessed with a certain idea or project for a short time but later lost interest" (M

= 2.81), received some of the lowest ratings, indicating that maintaining long-term focus remained a challenge for many students.

Table 2. Level of Grit

	Indicator	Mean	SD	Description
1.	I finish whatever I begin.	3.52	.99	High Grit
2.	I have achieved a goal that took years of work.	3.38	.99	Moderate Grit
3.	I am a hard worker.	3.37	.91	Moderate Grit
4.	I am diligent.	3.37	.98	Moderate Grit
5.	I have overcome setbacks to conquer an important challenge	3.33	.96	Moderate Grit
6.	Setbacks don't discourage me	3.16	.94	Moderate Grit
7.	I become interested in new pursuits every few months. *	3.01	.90	Moderate Grit
8.	New ideas and projects sometimes distract me from previous ones. *	2.96	.93	Moderate Grit
9.	I have difficulty maintaining my focus on projects that take more than a few months to complete. *	2.95	1.02	Moderate Grit
10.	I often set a goal but later choose to pursue a different one. *	2.93	.93	Moderate Grit
11.	My interests change from year to year. *	2.82	.99	Moderate Grit
12.	I have been obsessed with a certain idea or project for a short time but later lost interest. *	2.81	.96	Moderate Grit
	Overall Grit	3.13	.38	Moderate Grit

The data suggest that students possess a moderate level of perseverance and passion for long-term goals. They are generally able to sustain effort in the short term, as seen in their ability to complete tasks they start, but their motivation tends to decrease over extended periods. The contrast between relatively higher perseverance-related scores and lower consistency-related scores implies that while students are willing to exert effort, they struggle to maintain focus and commitment to long-term objectives. This pattern is common among adolescents, who often face competing interests and evolving priorities, which can disrupt sustained engagement. The findings indicate that while students exhibit resilience and determination in the face of immediate academic demands, cultivating long-term commitment remains an area for growth.

The moderate level of grit among the respondents suggests that although students have the capacity to persevere through challenges, their inconsistent focus could limit their academic potential, particularly in mathematics, which requires sustained effort over time. According to Self-Regulation Theory (Zimmerman & Schunk, 2016), successful learning is facilitated by the ability to regulate one's thoughts, emotions, and behaviors toward long-term goals. Students with only moderate grit may give up more easily when encountering setbacks or may frequently change goals, hindering their academic growth. This underscores the importance of designing interventions that strengthen both components of grit, namely perseverance of effort and consistency of interest, to help students develop resilience and persistence, especially in demanding subjects like mathematics.

These findings are consistent with the broader literature emphasizing grit as a crucial predictor of academic success. Duckworth et al. (2007) originally conceptualized grit as perseverance and passion for long-term goals, highlighting its importance in sustaining effort despite obstacles. Subsequent research has shown that while grit contributes to achievement, its perseverance component plays a more significant role in predicting academic outcomes (Credé, Tynan, & Harms, 2017). This is evident in the present findings, where students scored relatively higher on perseverance-related items than on consistency-related ones.

Postigo et al. (2021) also supported this view in a longitudinal study, demonstrating that students with higher grit maintained better academic performance over time, underscoring the importance of developing this trait during adolescence. Moreover, Amistad–Sarzadilla (2025) reported that grit significantly correlated with science performance among students at risk of dropping out, while Datu et al. (2024) found that grit predicted persistence and engagement in STEM subjects, including mathematics. These studies collectively reinforce the present study's conclusion that students' moderate grit levels may limit their sustained engagement and achievement and highlight the potential benefits of

interventions designed to cultivate perseverance and long-term focus.

4.3 Level of Motivation

Shown in Table 3 the level of motivation. The overall mean score was 3.20 with standard deviation of 0.55, interpreted as "Moderate Motivation." This means that students demonstrate an average level of engagement in mathematics, with effort and persistence varying across contexts. The highest-rated item, "When I am confused about something in mathematics, I go back and try to figure it out" (M = 3.50), falls under "High Motivation," indicating active engagement and persistence when faced with challenges. Most items, such as "Learning mathematics will help me in my future career" (M = 3.45) and "Mathematics is useful for solving real-life problems" (M = 3.39), were rated as "Moderate Motivation." The lowest mean scores were observed in "I believe I can earn a good grade in mathematics" (M = 2.72) and "I am confident I can understand the most complex topics in mathematics" (M = 2.63), revealing weaker self-beliefs and confidence in mathematical ability.

Table 3. Level of Motivation

Indicator	Mean	SD	Description
1. When I am confused about something in mathematics, I go back and try to figure it out.	3.50	.93	High Motivation
2. If I don't understand a math concept, I do something to help myself understand it better.	3.48	.97	Moderate Motivation
3. I will use mathematics in many ways throughout my life.	3.48	.98	Moderate Motivation
4. Learning mathematics will help me in my future career.	3.45	.98	Moderate Motivation
5. Mathematics is useful for solving real-life problems.	3.39	.95	Moderate Motivation
6. I like learning new things in mathematics.	3.32	.90	Moderate Motivation
7. When studying mathematics, I try to connect different concepts together.	3.32	.84	Moderate Motivation
8. When learning mathematics, I try to relate new ideas to things I already know.	3.27	.94	Moderate Motivation
9. I find mathematics interesting.	3.25	.89	Moderate Motivation
10. I enjoy learning mathematics.	3.20	.92	Moderate Motivation
11. I expect to do well in mathematics classes.	3.09	.87	Moderate Motivation
12. I am sure I can learn the skills taught in mathematics.	3.02	.91	Moderate Motivation
13. I enjoy the challenge of solving mathematics problems.	2.89	.97	Moderate Motivation
14. I believe I can earn a good grade in mathematics.	2.72	.93	Moderate Motivation
15. I am confident I can understand the most complex topics in mathematics.	2.63	.94	Moderate Motivation
Overall Motivation	3.20	.55	Moderate Motivation

The results indicated that students are moderately motivated to learn mathematics, showing engagement and persistence but with noticeable variation in intensity. Students appear to value mathematics for its practical applications and future career relevance, as reflected in moderately high scores on utility-value items. However, their lower ratings on confidence-related items point to self-efficacy as a potential barrier. The findings imply that although students are motivated to engage in mathematics learning, their motivation is not yet strong enough to sustain deep and persistent engagement, particularly when tasks become more complex. This aligns with Expectancy-Value Theory (Pintrich & De Groot, 1990), which posits that motivation depends on students' expectations for success and the value they assign to a task.

The results of this study reflect established findings on the role of motivation in mathematics achievement. Ryan and Deci (2017) emphasized that motivation, both intrinsic and extrinsic, is essential for sustained learning, engagement, and perseverance. Students who are highly motivated are more likely to adopt effective learning strategies and persist through difficulties, which is consistent with the relatively high engagement students showed when faced with confusion in mathematics. Zimmerman and Schunk (2016) also found that motivated learners engage in more self-regulated learning behaviors, which enhance both understanding and performance.

4.4 Level of Mathematics Achievement

Displayed in Table 4 is the level of mathematics achievement of Grade 11 students. The overall mean score was 84.20 with standard deviation of

3.44, interpreted as "Satisfactory." This indicates that students demonstrated adequate understanding of mathematical concepts and skills but still showed areas requiring improvement.

Table 4. Level of Mathematics Achievement

Indicator	Mean	SD	Description
Mathematics Achievement	84.20	3.44	Satisfactory

The "Satisfactory" level of performance indicates that students are meeting minimum expectations but are not consistently excelling in mathematics. This suggests the presence of gaps in conceptual understanding, problem-solving skills, or the application of knowledge in unfamiliar contexts. The result also reflects broader patterns observed in national and international assessments, where Filipino students often score below the proficiency benchmark. Factors such as moderate motivation, moderate grit, and the presence of mathematics anxiety, as seen in earlier findings of this study, may contribute to this outcome. These non-cognitive factors can significantly influence students' engagement, persistence, and performance in mathematics.

The results of this study reflect the broader trends documented in both global and local research on mathematics performance. The OECD (2019) and Martin et al. (2023) reported that Filipino students consistently score below international averages in mathematics, with many demonstrating only basic competency, a result attributed to systemic issues such as large class sizes, insufficient resources, and limited access to technology. Cruz and Javier (2021) further observed that many students struggle with complex problem-solving because instruction often emphasizes memorization rather than deep conceptual understanding.

4.5 Relationships Between Mathematics Anxiety (MA), Grit (G), Motivation (M), and Academic Achievement (MA)

Table 5 presented the correlation analysis between mathematics anxiety, grit, motivation, and mathematics achievement. The results showed a significant negative relationship between mathematics anxiety and mathematics achievement (r = -0.391, p = .001). This finding indicated that higher levels of anxiety were associated with lower achievement, leading to the rejection of the null hypothesis stating that H1: There is no significant relationship between mathematics anxiety and mathematics achievement.

In contrast, both grit and motivation demonstrated significant positive relationships with mathematics achievement. Grit exhibited a very high positive correlation (r = 0.720, p = .001), suggesting a robust link between perseverance and performance, which resulted in the rejection of the null hypothesis stating that H2: There is no significant relationship between grit and mathematics achievement. Motivation also showed a significant, moderate positive correlation (r = 0.411, p = .001), leading to the rejection of the null hypothesis stating that H3: There is no significant relationship between motivation and mathematics achievement. Overall, grit had the strongest positive correlation, while mathematics anxiety had the strongest negative correlation with achievement.

Table 5. Correlation Analysis Between Mathematics Anxiety (MA), Grit (G), Motivation (M), and Academic Achievement (MA)

Predictors	Correlation Coefficient	P-value	Degree	Remark
MA	-.391**	.001	Slight	Significant
Grit	.720**	.001	Very High	Significant
Motivation	.411**	.001	Moderate	Significant

***Correlation is significant at the 0.01 level (2-tailed).*
Interpretation: ±1.0- Perfect; ±0.91-±0.99- Very High; ±0.71-±0.90- High; ±0.41-±0.70- Moderate; ±0.21-±0.40- Slight; ±0.00-±0.20- Negligible

The correlation analysis revealed that all three non-cognitive variables were significantly associated with mathematics achievement. The influence of these factors varied markedly in strength and direction. Grit emerged as the strongest correlate, showing a very high positive relationship, followed by Motivation with a moderate positive relationship. In contrast, Mathematics Anxiety exhibited a significant, although slight, negative relationship, indicating that as anxiety increased, performance tended to decrease. The strength of grit's correlation suggested that persistent effort and sustained focus were key factors that could compensate for

other limitations, including anxiety or lower cognitive ability.

The negative relationship between mathematics anxiety and achievement strongly supported the idea that anxiety diverted cognitive resources away from task processing, impairing problem-solving. This finding was consistent with the cognitive interference model demonstrated by Ashcraft and Moore (2019), which showed anxiety disrupting working memory capacity. Furthermore, the strong positive correlation between grit and achievement provided compelling validation for Self-Regulation Theory (SRT) (Zimmerman & Schunk, 2016). SRT emphasized the role of self-control and sustained effort in learning success. The data supported the local finding of Rosete and Olua (2024), who also reported that higher non-cognitive factors were associated with stronger academic outcomes. Critically, the result aligned with Yu et al. (2021), who established that grit was positively associated with achievement and helped to mitigate the detrimental effects of anxiety, underscoring its pivotal role in mathematical success.

4.6 Multiple Linear Regression Analysis of Mathematics Anxiety, Grit, and Motivation on Mathematics Achievement

Table 6 presented the multiple linear regression analysis examining the predictive power of mathematics anxiety, grit, and motivation on mathematics achievement. The overall regression model was statistically significant, F(3, 162) = 66.656, p < .001, and accounted for 55.3% of the variance in mathematics achievement (R^2 = .553). This outcome led to the rejection of the null hypothesis stating that H4: Mathematics anxiety, grit, and motivation do not significantly predict mathematics achievement.

Among the individual predictors, Grit (β = 0.636, t = 10.866, p < .001) was identified as the strongest and statistically significant positive predictor, indicating that higher perseverance strongly improved mathematics performance. Mathematics anxiety (β = -0.150, t = -2.545, p = .012) also significantly predicted mathematics achievement, but in a negative direction, meaning higher anxiety reduced performance. In contrast, Motivation (β = 0.088, t = 1.442, p = .151) was not a statistically significant predictor when controlling for the other variables in the model.

The multiple regression equation derived from the results was as follows:

$$\hat{Y} = 67.324 - 0.840X_1 + 5.680X_2 + 0.550X_3$$

Where: $\hat{Y}$ = predicted mathematics achievement, X_1 = mathematics anxiety, X_2 = grit, and X_3 = motivation.

The model indicated that the constant term ($\hat{Y}$ =67.324) represented the predicted achievement when all predictors were zero. The unstandardized coefficient for grit (β = 5.680) revealed that a one-unit increase in grit predicted a 5.680-point increase in mathematics achievement. Conversely, the coefficient for mathematics anxiety (β = -0.840) suggested that a one-unit increase in anxiety predicted a 0.840-point decrease in achievement.

Table 6. Multiple Linear Regression Analysis of Mathematics Anxiety (MA), Grit (G), and Motivation (M) on Mathematics Achievement (MA)

Model	B	SE	β	t	p
C	67.324	2.353		28.612	.001*
MA	-.840	.330	-.150	-2.545	.012*
G	5.680	.523	.636	10.866	.001*
M	.550	.381	.088	1.442	.151

$R = .743$ $R^2 = .553$ $Std.Error = 2.321$ $f - value = 66.656$ $p - value = .001$

Significant at p<.05

The multiple linear regression analysis confirmed the combined and distinct predictive power of the non-cognitive factors, leading to the rejection of the overall null hypothesis (H4). These findings revealed that while all three variables were correlated, grit and mathematics anxiety exerted the most substantial and direct predictive effects on student achievement. The results strongly highlighted the necessity of perseverance and emotional regulation. The formidable predictive power of grit supported Self-Regulation Theory (Zimmerman & Schunk, 2016), emphasizing that sustained effort and goal-directed behavior were paramount for academic success in mathematics.

This finding was consistent with Credé et al. (2017), who consistently reported that

perseverance was a key driver of achievement, and Segal and Kalfon-Hakhmigari (2025), who found grit helped maintain performance even with lower cognitive ability. Furthermore, the significant negative effect of mathematics anxiety validated Attentional Control Theory (Eysenck et al., 2007), showing that anxiety consumed working memory and impaired cognitive function, a finding mirrored by Ashcraft and Moore (2019). The limited predictive power of motivation was consistent with Tabigne (2025), suggesting that motivation's effect is often mediated by factors like perseverance. Collectively, these results underscored that building perseverance and managing anxiety were the most effective strategies for improving mathematics achievement.

5. CONCLUSIONS

Based on the results of the study, several conclusions were drawn.

Students exhibited a moderate level of mathematics anxiety, particularly in situations involving tests and assessments. This indicates that while anxiety is present, it is not overwhelmingly high but may still influence their performance.

The level of grit among students was also moderate, showing that they are capable of perseverance and effort but may struggle to sustain consistent interest over extended periods.

Students demonstrated a moderate level of motivation, suggesting that they value mathematics and make efforts to engage with it, although their confidence in mastering more complex topics remains limited.

The overall mathematics achievement of the students was satisfactory, showing that they possess adequate understanding of mathematical concepts but have room for improvement in achieving higher levels of mastery.

Mathematics anxiety, grit, and motivation were all significantly related to mathematics achievement. Anxiety had a significant negative relationship with performance, while grit and motivation were positively associated, with grit showing the strongest correlation.

Lastly, mathematics anxiety and grit were found to be significant predictors of mathematics achievement, with grit emerging as the strongest predictor. Motivation, although correlated with achievement, did not significantly predict performance when combined with the other variables.

6. RECOMMENDATIONS

Based on the findings and conclusions, the following recommendations are proposed.

Mathematics Anxiety showed a moderate level and increased during tests. Students may lessen anxiety by using simple strategies such as short breathing exercises or brief mindfulness activities before quizzes and exams. Teachers may support this by giving low-stakes assessments, offering guided steps before high-stakes tasks, and creating a classroom environment that reduces fear of making mistakes.

Grit was also moderate and was affected by students' difficulty in maintaining long-term focus. Students may strengthen their grit by following structured study routines that include clear goals, scheduled practice time, and regular self-checks. Teachers may assign long-term projects that require steady effort, while parents may help by encouraging consistent study habits at home.

Motivation, especially self-efficacy, was found to be moderate. Teachers may raise motivation by emphasizing mastery instead of speed and by helping students recognize their progress through short reflections or progress trackers. Activities that highlight improvement and celebrate small wins may gradually build students' confidence in their ability to succeed in mathematics.

Mathematics Achievement reached a satisfactory level but still has room for improvement. Schools may raise achievement by integrating socio-emotional learning activities into the curriculum and offering workshops that help students develop perseverance and emotional regulation. These programs can provide students with tools to manage challenges that affect their academic performance.

Since grit was the strongest positive predictor and anxiety was the strongest negative predictor of mathematics achievement, interventions should focus on building grit and reducing anxiety. Teachers may use a simple weekly goal-setting routine where students write a clear math goal, track their progress, and reflect on what helped them improve. This builds steady effort without overwhelming them. To reduce anxiety, teachers may begin each class with a short one-minute

breathing exercise and provide practice tests that help students become familiar with exam conditions. Supportive feedback that highlights progress rather than errors may further lower anxiety. These simple steps offer a practical and efficient way to improve students' achievement in mathematics.

Given that motivation did not significantly predict achievement in the regression model, future studies may examine its indirect effects or explore additional variables such as self-efficacy, mindset, or classroom environment that could mediate its relationship with mathematics performance. Longitudinal studies could also track how interventions targeting anxiety and grit affect achievement over time.

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