

THE MEDIATING ROLE OF GRIT IN THE RELATIONSHIP BETWEEN MATHEMATICS ANXIETY AND ACADEMIC PERFORMANCE IN GEOMETRY AMONG GRADE 10 STUDENTS

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ABSTRACT

This study examined the mediating role of grit in the relationship between mathematics anxiety and academic performance in Geometry among Grade 10 students. Using a descriptive-correlational design, 163 respondents were selected through simple random sampling from Taysan San Jose Integrated National High School in San Jose, Batangas, Philippines, for the school year 2025–2026. Mathematics anxiety was measured using the Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ), while grit was assessed through the Triarchic Model of Grit Scale (TMGS) adapted from Datu et al. (2017), covering perseverance of effort, consistency of interest, and adaptability to the situation. Academic performance was based on respondents' official second quarter Geometry grades. Data were analyzed using descriptive statistics, Pearson r correlation, Chi-Square test of independence, and Hayes' (2018) PROCESS Macro Model 4 via jamovi (v2.7.23.0). Results revealed an average level of mathematics anxiety, mostly gritty disposition, and a mean Geometry grade of 83.46 (Satisfactory). Socioeconomic status showed a significant moderate relationship with grit [$\chi^2(12, N = 163) = 52.5, p < 0.001$, Cramér's $V = 0.328$]. Grit significantly mediated the anxiety–performance relationship through competitive partial mediation, with an indirect effect of -0.4142 (95% CI $[-0.599, -0.245]$, $p < .001$) accounting for 55.5% of the total effect. The Grit Enhancement and Math Anxiety Program (GEMAP) was proposed based on these findings.

Keywords: *Grit, Mathematics Anxiety, Academic Performance, Geometry, Mediation*

INTRODUCTION

The 2022 Programme for International Student Assessment (PISA) exposed a critical gap in Philippine mathematics education: only 16% of Filipino students attained the minimum Level 2 proficiency in mathematics, far below the OECD average of 69%,

placing the country 76th out of 81 nations (OECD, 2023). This gap is most evident in Geometry, a subject that demands spatial reasoning, logical proof, and abstract thinking — skills that go far beyond simple computation (Danlami et al., 2025; Juman et al., 2022). In this study, Grade 10 students of Taysan San Jose Integrated National High School recorded a mean Geometry grade of 83.46, classified as Satisfactory, yet the most frequently occurring grade was 75.00 — the minimum passing mark — indicating that many students were barely meeting the baseline standard.

Among the factors driving poor mathematics performance, mathematics anxiety stands out as the most significant psychological barrier. Defined as feelings of tension, fear, and apprehension during mathematical tasks, math anxiety directly impairs working memory, triggers avoidance behaviors, and undermines persistence (Finell et al., 2022). A meta-analysis of 747 effect sizes confirmed a consistent negative relationship between math anxiety and math achievement (Barroso et al., 2021). In Philippine classrooms, this anxiety is intensified by the fear of being judged or embarrassed in front of peers, documented specifically among Filipino Grade 10 students (Salazar, 2025; Gonzales, 2024).

Research consistently shows that grit — defined as the sustained combination of perseverance of effort, consistency of interest, and adaptability to the situation (Datu et al., 2023) — can buffer students against the performance-degrading effects of anxiety. Yu et al. (2021) demonstrated that math anxiety erodes grit, and it is through this suppression of grit that academic performance ultimately declines. Despite the growing body of research on grit and math anxiety, most existing studies were conducted in Chinese and Western educational contexts and focused on mathematics in general rather than on a specific subject like Geometry. To the best of the researcher's knowledge, no study has yet examined the mediating role of grit between math anxiety and academic performance specifically among Filipino Grade 10 students in Geometry. This gap motivated the present investigation.

Background of the Study

The concepts of grit and mathematics anxiety play a crucial role in understanding how students learn mathematics. Mathematics is perceived by high school students as a useful yet inherently difficult, confusing, mentally demanding, and challenging subject based on their lived experiences (Bacong et al., 2023). Grit, characterized by perseverance and passion, has been construed to mediate math anxiety and performance (Yeager et al., 2022). Students with higher grit, often fostered by a growth mindset, are more likely to persist through challenges and achieve better math outcomes, even in the face of anxiety (Yu et al., 2021). The evidence suggests that interventions focusing on enhancing math-specific grit could mitigate the effects of math anxiety, paving the way for improved performance and fostering resilience in mathematics learning (Yu et al., 2021).

However, math anxiety among high school students is increasing. A significant research gap exists in understanding how grit specifically influences the relationship between math anxiety and performance in Geometry among Filipino public secondary students. While studies have explored the individual effects of grit, math anxiety, and

academic performance, limited research examines how grit mediates the relationship between students' math anxiety and their academic performance in this particular subject and context. Addressing these gaps can offer valuable insights into how to leverage grit as a tool for reducing math anxiety and improving performance, leading to more effective interventions in high school mathematics education.

Review of Related Literature and Studies

Socio-Economic Status and Grit

Research consistently links socioeconomic background to the development of grit among students. Yan and Gai (2022), using data from 139,422 students across 625 schools, found that low-SES students who maintained strong educational expectations and achievement-oriented motivation were significantly more likely to become academically resilient. Li et al. (2023) found that students from the lowest-income families showed the weakest perseverance and poorest academic outcomes, with perseverance mediating — but not fully compensating for — the effects of poverty on achievement. Huang et al. (2025) similarly found that students from lower-income households had weaker perseverance and lower grit than financially stable peers. Kwon (2021) argued that grit is not a class-neutral trait, as income-based socioeconomic differences shape the psychological sense of control that underpins grit development. Munir et al. (2023) found a positive link between higher SES and better academic performance, yet noted that parental involvement and school support could partially offset the disadvantages of low SES.

On Mathematics Anxiety

Mathematics anxiety is widely recognized as one of the most significant barriers to academic success in mathematics across all educational levels, with a consistent strong negative correlation between anxiety and performance (Bornaa et al., 2023). A meta-analysis by Barroso et al. (2021) of 747 effect sizes confirmed this negative relationship. Sorvo et al. (2022) found that anxiety hurts students both in the moment and over time, impairing arithmetic skill development. While Amam et al. (2019) found that low anxiety worked in students' favor, and Luu-Thi et al. (2021) found non-significant effects on achievement among Vietnamese Grade 10–12 students who used positive coping strategies, Caviola et al. (2021) confirmed in a meta-analysis of over 900,000 participants that math anxiety consistently and negatively affects performance across educational levels. In the Philippine context, Gonzales (2024) found that teacher personality and interactive classroom activities significantly shaped anxiety levels, while Flores (2019) found that anxiety was one of the strongest predictors of both elementary math and Geometry outcomes in Batangas.

On Grit

Grit — defined as perseverance of effort, consistency of interest, and adaptability to the situation — consistently predicts academic outcomes. Datu et al. (2023) found that higher grit was associated with better mathematics achievement, and that grit levels remain relatively stable across secondary grade levels, making early development

worthwhile. Allen et al. (2021) found perseverance of effort to be the dimension most consistently linked to achievement, attendance, and retention. Pratiwi et al. (2023) confirmed that grit was crucial for keeping students motivated and resilient during the shift to online learning. Yeoul et al. (2023) found that grit significantly predicted school adjustment through the reduction of anxiety over six months. Bibon (2021) found grit to be a strong predictor of academic persistence, particularly among students at risk of dropping out.

Link Between Grit and Math Anxiety

Yu et al. (2021) specifically demonstrated that math-specific grit — perseverance and sustained effort directed at mathematics — is a key factor protecting students from the performance-damaging effects of anxiety. Students who experienced higher math anxiety tended to have lower math-specific grit, leading to more procrastination and weaker outcomes. Ogden (2023) found that grittier college algebra students reported lower math anxiety, suggesting that the path to reducing anxiety may run through grit. Zhao et al. (2023) found that a growth mindset encourages students to hold out for long-term rewards through grit and self-efficacy as intermediary factors. Yalçın and Yilmaz (2023) found that a fixed mindset was negatively related to both perseverance and consistency of interest dimensions of grit, reinforcing the anxiety-grit connection.

Mathematics Performance in the Philippine Context

Bernardo et al. (2022) examined why Filipino students performed poorly in the 2018 PISA assessment, revealing that socioeconomic inequality and limited access to quality education particularly affected public school students. Silangan et al. (2023) found that teacher skills and instructional materials were the only significant predictors of math performance among Grade 10 students in the Philippines. Flores (2019) found that study habits, anxiety, and parental involvement were especially strong predictors of both elementary math and Geometry outcomes in Batangas — directly supporting the rationale for the present study. Peteros et al. (2019) found that mathematical self-concept had a significant positive relationship with Geometry grades among Grade 10 students in a Philippine public school.

Theoretical Framework

This study is anchored on Self-Determination Theory (SDT) of Deci and Ryan (2012) and Mindset Theory by Dweck (2000). SDT posits that people become self-determined when their needs for competence, connection, and autonomy are fulfilled. By fostering a positive learning environment that supports students' autonomy, teachers can enhance intrinsic motivation, contributing to increased grit and reduced math anxiety. Dweck's (2000) Mindset Theory distinguishes between fixed and growth mindsets, where individuals with growth mindsets believe intelligence is flexible and improvable through perseverance. By integrating these frameworks, this study advances understanding of how grit can be developed to lessen the detrimental effects of math anxiety and enhance student performance in Geometry.

Conceptual Framework

The conceptual framework of this study, illustrated in Figure 1, presents a mediation model in which grit functions as a mediating variable between mathematics anxiety (independent variable) and academic performance in Geometry (dependent variable). Socioeconomic status is included as a contextual variable linked to grit. The findings are intended to serve as the basis for the proposed Grit Enhancement and Math Anxiety Program (GEMAP).

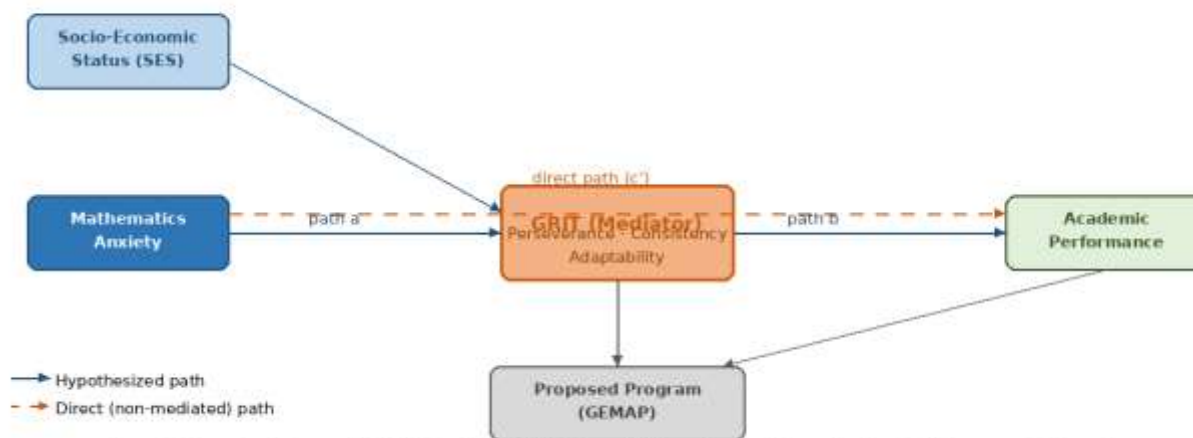


Figure 1. Conceptual Framework: Mediating Role of Grit Between Mathematics Anxiety and Academic Performance in Geometry

Figure 1. Research paradigm showing the mediating role of grit between mathematics anxiety and academic performance in Geometry, with socioeconomic status as a contextual variable and GEMAP as the proposed output.

Research Questions

Although a considerable body of scholarship has documented the negative impact of mathematics anxiety on learners' achievement and the positive contribution of grit to academic outcomes, what remains unresolved is how these two variables function together when one acts as a possible pathway for the other. Most investigations were carried out in Chinese, American, and European school systems using generalized mathematics measures rather than narrowing to a single content area like Geometry. The local urgency is evident at Taysan San Jose Integrated National High School, where the most frequently occurring Geometry grade among Grade 10 learners is 75.00 — the threshold of passing — suggesting that a meaningful share of students is performing only at the lowest acceptable standard. Accordingly, this investigation seeks to determine whether grit serves as a mediator between mathematics anxiety and academic performance in Geometry among 163 Grade 10 learners of Taysan San Jose Integrated National High School during school year 2025–2026.

This study sought to answer the following questions:

1. What is the socio-economic status of the respondents?
2. What is the respondents' level of mathematics anxiety along: (a) feeling towards Mathematics; and (b) test and performance anxiety in Mathematics?
3. What is the respondents' level of grit in terms of: (a) perseverance of effort; (b) consistency of interest; and (c) adaptability to the situation?
4. What are the respondents' academic performance in Geometry?
5. Is there a significant relationship between respondents': (a) socio-economic status and grit; (b) mathematics anxiety and grit; (c) mathematics anxiety and academic performance in Geometry; and (d) grit and academic performance in Geometry?
6. Does the respondents' level of grit significantly mediate the relationship between mathematics anxiety and academic performance in Geometry?
7. What program can be proposed to support and enhance the academic performance in Geometry of Grade 10 students?

Hypotheses

H₀₁: There is no significant relationship between respondents' socio-economic status and their level of grit.

H₀₂: There is no significant relationship between respondents' level of mathematics anxiety and their level of grit.

H₀₃: There is no significant relationship between respondents' level of mathematics anxiety and their academic performance in Geometry.

H₀₄: There is no significant relationship between respondents' level of grit and their academic performance in Geometry.

H₀₅: Grit does not significantly mediate the relationship between respondents' level of mathematics anxiety and their academic performance in Geometry.

Scope and Delimitations

This study focuses on the mediating role of grit on math anxiety and academic performance in Geometry among Grade 10 students of Taysan San Jose Integrated National High School, San Jose, Batangas, Philippines, during school year 2025–2026. The study is limited to 163 Grade 10 students only, and its findings are therefore confined to this premise. Generalizability does not apply to the entire high school population or to a broader population. The specific socio-economic context of the school — characterized by a significant proportion of low-income families — may influence results and limit their applicability to other school contexts.

METHODOLOGY

Research Design

This study employed a descriptive-correlational research design, which is a non-experimental design that explores the relationship between two or more variables without manipulating them (Creswell, 2014). This design was selected because the study aimed

to understand the correlational relationships among socio-economic status, mathematics anxiety, grit, and academic performance in Geometry, and to determine whether grit mediates the relationship between mathematics anxiety and academic performance.

Locale of the Study

The study was conducted at Taysan San Jose Integrated National High School, a public secondary school located in San Jose, Batangas, Philippines. The school is situated in the center of the municipality and serves a student body drawn predominantly from poor, low-income, and middle-class families, with some students receiving scholarships from private and government organizations. The school administration willingly cooperated with the conduct of the study, treating all student data as confidential.

Participants

The respondents of this study were 163 Grade 10 students (approximately 38.5% of the total Grade 10 population) selected through simple random sampling from Taysan San Jose Integrated National High School during the school year 2025–2026. Of the respondents, 54% were male and 46% were female. The majority of respondents were 15 years old (minimum age: 14; maximum age: 18). Most belonged to low-income and lower-middle-income households, consistent with the school's socioeconomic profile.

Instruments of the Study

Two validated instruments were used. The Mathematics Self-Efficacy and Anxiety Questionnaire (MSEAQ) from May (2009), a 16-item instrument, measured mathematics anxiety across two dimensions: (1) Feeling Towards Mathematics (8 items) and (2) Test and Performance Anxiety in Mathematics (8 items), rated on a five-point Likert scale (1 = Never to 5 = Usually). For overall anxiety level interpretation, the scale of Moroscallo and Naparota (2025) was used. The 12-item Triarchic Model of Grit Scale (TMGS) developed by Datu et al. (2017) measured grit across three subscales: perseverance of effort, consistency of interest, and adaptability to the situation, rated from 1 (Not Like Me at All) to 5 (Very Much Like Me), with Duckworth et al.'s (2007) scoring framework applied. Academic performance was measured using respondents' official second quarter Geometry grades under the DepEd grading system (DepEd Order No. 8, s. 2015). Both instruments were validated by three experts: two from research methodology and one licensed psychologist.

Data Gathering Procedure

Data collection was organized into three stages. In the pre-collection stage, the researcher secured approval from the Graduate School and school administration, obtained signed parental consent forms (as respondents were minors), and briefed the researcher's representative. All data were treated as confidential in accordance with the Data Privacy Act (RA 10173), and participation was entirely voluntary. In the collection proper stage, the researcher's representative administered the questionnaires face-to-

face during scheduled class hours, offering clarification as needed and collecting questionnaires immediately upon completion. In the post-collection stage, scanned copies of answered questionnaires were sent to the researcher, who encoded the raw data in Excel for computation using appropriate statistical tools.

Data Analysis

Frequency distributions and percentages described the socioeconomic status of respondents. Means and standard deviations described the respondents' levels of mathematics anxiety and grit. Frequency distribution, percentage, mean, standard deviation, and the DepEd 2015 grading scale (DepEd Order No. 8, s. 2015) evaluated academic performance in Geometry. Chi-Square with Cramér's V coefficient examined the relationship between SES and grit. Pearson product-moment correlation coefficients examined the relationships between mathematics anxiety and grit, mathematics anxiety and academic performance, and grit and academic performance. Hayes' (2018) PROCESS Macro Model 4, implemented through jamovi (v2.7.23.0) with 5,000 bootstrap samples, determined whether grit significantly mediates the relationship between mathematics anxiety and academic performance. All analyses were conducted at a significance level of $\alpha = 0.05$.

Ethical Considerations

Respondents received a detailed briefing on the purpose of the study and were not harmed nor forced to participate. The researcher secured approval from the school administrator and discussed data utilization with concerned teachers. Students, teachers, and administrators of Taysan San Jose Integrated National High School participated willingly. Before questionnaire administration, the researcher's representative explained all items to ensure respondent understanding and reliability of data. All gathered information was treated as strictly confidential in accordance with RA 10173 (Data Privacy Act). Participants retained the right to withdraw from the study at any point before publication. Any form of data alteration, misrepresentation, or prejudgment was strictly avoided.

RESULTS

1. Socio-Economic Status of the Respondents

Table 1: Respondents' Socio-Economic Status (N = 163)

Household Monthly Income (PIDS)	Socioeconomic Category	f	%
Less than ₱10,957	Poor	18	11.04
₱9,520 – ₱21,194	Low Income (but not poor)	68	41.72
₱21,194 – ₱43,828	Lower Middle Income	44	26.99
₱43,828 – ₱76,669	Middle Class	25	15.34

Household Monthly Income (PIDS)	Socioeconomic Category	f	%
₱76,669 – ₱131,484	Upper Middle Income	8	4.91
₱131,484 – ₱219,140	High Income (but not rich)	0	0.00
₱219,140 and above	Rich	0	0.00
	Total	163	100.00

Note. Based on Philippine Institute for Development Studies (PIDS) income classification.

2. Level of Mathematics Anxiety

2.1 Feeling Towards Mathematics

**Table 2.1: Level of Mathematics Anxiety
in Terms of Feeling Towards Mathematics**

Feeling Towards Mathematics	Mean	SD	Interpretation
1. I feel confident enough to ask questions in my mathematics class.	3.33	1.08	Sometimes
2. I worry that my mathematical skills may not be sufficient for my future career.	2.33	1.05	Seldom
3. I believe I can do well in answering all of the questions in mathematics.	3.45	1.11	Often
4. I believe I am the kind of person who is good at mathematics.	3.23	1.15	Sometimes
5. I feel stressed when listening to mathematics instructors in class.	2.15	0.95	Seldom
6. I believe I can learn well in a mathematics course.	3.72	0.99	Often
7. I believe I can think critically and logically in answering math problems.	3.56	1.07	Often
8. I feel confident when using mathematics outside of school.	3.25	1.08	Sometimes
Overall Mean	3.13	1.06	Sometimes

Note. Scale: 1.00–1.80 (Never); 1.81–2.60 (Seldom); 2.61–3.40 (Sometimes); 3.41–4.20 (Often); 4.21–5.00 (Usually).

2.2 Test and Performance Anxiety in Mathematics

Table 2.2: Level of Mathematics Anxiety in Terms of Test and Performance Anxiety in Mathematics

Test and Performance Anxiety in Mathematics	Mean	SD	Interpretation
9. I get tense when I prepare for a mathematics test.	2.39	1.04	Seldom
10. I believe I can follow the teacher's discussion in answering mathematics questions or tasks.	3.50	1.12	Often
11. I worry that I will not be able to get a good grade in my mathematics subject.	2.46	1.01	Seldom
12. I get nervous when taking a mathematics test.	2.14	0.98	Seldom
13. I worry that I will not be able to understand mathematics.	2.05	0.91	Seldom
14. Working on mathematics homework is stressful for me.	2.27	0.94	Seldom
15. I worry that I may struggle to understand mathematical concepts.	2.23	0.97	Seldom
16. I am afraid to give an incorrect answer during my mathematics class.	2.29	1.05	Seldom
Overall Mean	2.42	1.00	Seldom

Note. Scale: 1.00–1.80 (Never); 1.81–2.60 (Seldom); 2.61–3.40 (Sometimes); 3.41–4.20 (Often); 4.21–5.00 (Usually). Overall mathematics anxiety level = Average ($M = 2.77$), based on Moroscallo and Naparota (2025).

3. Level of Grit

3.1 Perseverance of Effort

Table 3.1: Level of Grit in Terms of Perseverance of Effort

Perseverance of Effort	Mean	SD	Interpretation
1. I keep trying even when I face difficult challenges.	3.98	1.04	Mostly Like Me
2. I am willing to work hard for a long period to reach my goals.	3.78	1.09	Mostly Like Me
3. When I make a mistake, I try my best to fix it and do better next time.	4.09	0.91	Mostly Like Me
4. I am not discouraged by criticism and try to improve.	3.69	1.17	Mostly Like Me

Perseverance of Effort	Mean	SD	Interpretation
Overall Mean	3.89	1.05	Mostly Like Me

Note. Scale: 1.00–1.80 (Not Like Me at All); 1.81–2.60 (Not Much Like Me); 2.61–3.40 (Somewhat Like Me); 3.41–4.20 (Mostly Like Me); 4.21–5.00 (Very Much Like Me).

3.2 Consistency of Interest

Table 3.2: Level of Grit in Terms of Consistency of Interest

Consistency of Interest	Mean	SD	Interpretation
5. I tend to become intensely interested in certain ideas or projects for a brief period, but I often lose that interest over time.	2.56	1.25	Not Much Like Me
6. I frequently set a goal but later decide to pursue a different one.	2.48	1.27	Not Much Like Me
7. I feel proud of my ability to remain committed to my goals and interests, even when they become difficult.	3.84	1.12	Mostly Like Me
8. I follow through on my commitments to my interests, even when they become challenging.	3.56	1.08	Mostly Like Me
Overall Mean	3.11	1.18	Somewhat Like Me

Note. Scale: 1.00–1.80 (Not Like Me at All); 1.81–2.60 (Not Much Like Me); 2.61–3.40 (Somewhat Like Me); 3.41–4.20 (Mostly Like Me); 4.21–5.00 (Very Much Like Me). Items 5 and 6 are reverse-scored.

3.3 Adaptability to the Situation

Table 3.3: Level of Grit in Terms of Adaptability to the Situation

Adaptability to the Situation	Mean	SD	Interpretation
9. I appreciate and embrace new opportunities that arise in my life.	3.79	1.06	Mostly Like Me
10. I believe that adjusting my plans or strategies is essential for achieving my long-term goals.	3.93	1.06	Mostly Like Me
11. Failure makes me stronger and more determined to succeed.	3.50	1.14	Mostly Like Me
12. When faced with challenges, I seek advice and guidance from others I trust.	3.69	1.16	Mostly Like Me

Adaptability to the Situation	Mean	SD	Interpretation
Overall Mean	3.73	1.10	Mostly Like Me

Note. Scale: 1.00–1.80 (Not Like Me at All); 1.81–2.60 (Not Much Like Me); 2.61–3.40 (Somewhat Like Me); 3.41–4.20 (Mostly Like Me); 4.21–5.00 (Very Much Like Me).

4. Academic Performance in Geometry

Table 4: Academic Performance in Geometry of Grade 10 Respondents, Second Quarter (N = 163)

Grading Scale	Frequency	Percentage (%)	Performance Level
90–100	33	20.25	Outstanding
85–89	42	25.77	Very Satisfactory
80–84	40	24.54	Satisfactory
75–79	44	26.99	Fairly Satisfactory
Below 75	4	2.45	Did Not Meet Expectations

Note. Mean = 83.46; SD = 6.43; Mode = 75.00; Min = 70.00; Max = 96.00. DepEd grading scale (DepEd Order No. 8, s. 2015).

5. Hypothesis Testing

5.1 Relationship Between Socio-Economic Status and Grit

Table 5.1: Chi-Square Test Results and Cramér's V: Socio-Economic Status and Grit Level

SES Category	Not at all Gritty	Slightly Gritty	Somewhat Gritty	Mostly Gritty	Extremely Gritty	Total
Poor	0	3	5	9	1	18
Low-Income	0	3	35	19	11	68
Lower Middle-Income	0	0	9	34	1	44
Middle-Income	0	0	4	17	4	25
Upper Middle-Income	0	0	1	3	4	8
Total	0	6	54	82	21	163

Note. $\chi^2(12, N = 163) = 52.5$, $p < .001$, Cramér's $V = 0.328$. Decision: Reject H_0 . There is a significant moderate relationship between socio-economic status and grit. Cramér's V : 0.00–0.10 (Negligible); 0.11–0.30 (Weak); 0.31–0.50 (Moderate); 0.51–1.00 (Strong).

5.2 Relationship Between Mathematics Anxiety and Grit

Table 5.2: Pearson r Correlation: Mathematics Anxiety and Grit

Statistic	Value
α (significance level)	0.05
Confidence Interval	95%
Pearson r value	–0.410
p-value	< .001
Decision	Reject H_0 — Significant moderate negative relationship

Note. Correlation strength (Evans, 1996): 0.00–0.19 (Very Weak); 0.20–0.39 (Weak); 0.40–0.59 (Moderate); 0.60–0.79 (Strong); 0.80–1.00 (Very Strong).

5.3 Relationship Between Mathematics Anxiety and Academic Performance

Table 5.3: Pearson r Correlation: Mathematics Anxiety and Academic Performance in Geometry

Statistic	Value
α (significance level)	0.05
Confidence Interval	95%
Pearson r value	–0.052
p-value	0.510
Decision	Fail to Reject H_0 — No significant direct relationship

Note. Correlation strength (Evans, 1996): 0.00–0.19 (Very Weak); 0.20–0.39 (Weak); 0.40–0.59 (Moderate); 0.60–0.79 (Strong); 0.80–1.00 (Very Strong).

5.4 Relationship Between Grit and Academic Performance

Table 5.4: Pearson r Correlation: Grit and Academic Performance in Geometry

Statistic	Value
α (significance level)	0.05
Confidence Interval	95%
Pearson r value	0.557

Statistic	Value
p-value	< .001
Decision	Reject H_0 — Significant moderate positive relationship

Note. Correlation strength (Evans, 1996): 0.00–0.19 (Very Weak); 0.20–0.39 (Weak); 0.40–0.59 (Moderate); 0.60–0.79 (Strong); 0.80–1.00 (Very Strong).

6. Mediating Role of Grit

Table 6.1: Mediating Role of Grit in the Relationship Between Mathematics Anxiety and Academic Performance in Geometry

Effect	Label	Estimate	SE	95% CI Lower	95% CI Upper	z	p
Indirect	$a \times b$	-0.4142	0.0898	-0.599	-0.245	-4.615	<.001
Direct	c'	0.3326	0.1127	0.117	0.557	2.951	.003
Total	$c + a \times b$	-0.0816	0.1165	-0.304	0.153	-0.700	.484

Note. Bootstrap sample size = 5,000. Confidence intervals are bias-corrected and accelerated (BCa). CI = Confidence Interval; SE = Standard Error.

Table 6.2: Path Estimates of the Mediation Model

Path	Label	Estimate	SE	95% CI Lower	95% CI Upper	z	p
Mathematics Anxiety → Grit	a	-0.632	0.1213	-0.865	-0.389	-5.21	<.001
Grit → Academic Performance	b	0.655	0.0623	0.538	0.784	10.52	<.001
Mathematics Anxiety → Academic Performance (Direct)	c'	0.333	0.1127	0.117	0.557	2.95	.003

Note. All paths estimated using Hayes (2018) PROCESS Macro Model 4 via jamovi (v2.7.23.0). Decision: Reject H_0 . Grit significantly mediates the relationship between mathematics anxiety and academic performance in Geometry, following a competitive partial mediation pattern.

DISCUSSION

1. Socioeconomic Status

The majority of respondents came from economically disadvantaged households, with 79.75% belonging to the Poor, Low Income, and Lower Middle-Income categories (Table 1). This profile is characteristic of public secondary schools in rural Batangas.

Kwon (2021), Li et al. (2023), and Huang et al. (2025) collectively found that students from lower-income households tend to have weaker non-cognitive resources, making it harder to sustain academic effort. Conversely, Yan and Gai (2022) found that low-SES students who maintained strong educational expectations could still demonstrate academic resilience, and Munir et al. (2023) noted that school-based support can partially moderate the negative effects of economic disadvantage.

2. Level of Mathematics Anxiety

Respondents demonstrated an overall Average level of mathematics anxiety ($M = 2.77$). The Feeling Towards Mathematics dimension yielded a higher overall mean of 3.13 (Sometimes), while Test and Performance Anxiety posted a lower mean of 2.42 (Seldom; Tables 2.1 and 2.2). The highest-rated item was Item 6 — 'I believe I can learn well in a mathematics course' ($M = 3.72$, Often) — suggesting that despite occasional anxiety, respondents maintained confidence in their capacity to learn. The lowest-rated item was Item 13 — 'I worry that I will not be able to understand mathematics' ($M = 2.05$, Seldom). These findings align with Luu-Thi et al. (2021) and Amam et al. (2019), who found that low-to-moderate anxiety levels can have a positive or neutral effect on learning. However, Sorvo et al. (2022) and Caviola et al. (2021) cautioned that even moderate anxiety can still quietly affect performance, particularly during high-pressure examinations.

3. Level of Grit

Respondents demonstrated a high overall level of grit. Perseverance of Effort ($M = 3.89$) was the highest dimension, followed by Adaptability to the Situation ($M = 3.73$), while Consistency of Interest ($M = 3.11$) was the lowest (Tables 3.1–3.3). The highest-rated item was Item 3 — 'When I make a mistake, I try my best to fix it and do better next time' ($M = 4.09$), reflecting strong self-directed error-correction. The lower Consistency of Interest scores reflect that students were moderately vulnerable to goal-switching — consistent with Yalçın and Yilmaz (2023), who found that consistency of interest is more easily affected by external factors. Datu et al. (2023) confirmed that grit levels are relatively stable across secondary grade levels, making early investment in grit development worthwhile.

4. Academic Performance in Geometry

The overall mean Geometry grade was 83.46 ($SD = 6.43$), classified as Satisfactory (Table 4). However, the mode of 75.00 — the minimum passing mark — reveals that many students were performing only at the baseline standard. This pattern aligns with the systemic challenges in Philippine public school mathematics documented by Bernardo et al. (2022). The standard deviation of 6.43 indicates considerable variability in achievement, which may be explained by differences in grit levels and anxiety profiles among the respondents.

5.1 Relationship Between SES and Grit

A Chi-Square test of independence revealed a significant moderate relationship between SES and grit [$\chi^2(12, N = 163) = 52.5, p < .001$, Cramér's $V = 0.328$], leading to rejection of H_{01} (Table 5.1). The directional trend showed that as family income increased,

students were more likely to demonstrate higher grit levels. These findings support Kwon (2021), Li et al. (2023), and Huang et al. (2025), who collectively documented that financial instability weakens the non-cognitive resources underpinning grit. However, Yan and Gai (2022) showed that school-based support and internal motivation can still foster grit behaviors regardless of economic background, suggesting that targeted interventions at the school level can help bridge this gap.

5.2 Relationship Between Mathematics Anxiety and Grit

A significant moderate negative correlation was found between mathematics anxiety and grit ($r = -0.410$, $p < .001$), leading to rejection of H_{02} (Table 5.2). Students who reported higher mathematics anxiety tended to exhibit lower grit. This inverse relationship confirms that the psychological burden of math anxiety actively works against perseverance, consistency, and adaptability. This finding is congruent with Yu et al. (2021) and Ogden (2023), who confirmed that higher grit is associated with lower math anxiety and that grit functions as an active buffer against anxious responding. However, Casinillo et al. (2022) found no significant relationship between mathematical resilience and anxiety among Grade 11 students, suggesting that this relationship may vary across contexts and constructs.

5.3 Relationship Between Mathematics Anxiety and Academic Performance

No significant direct relationship was found between mathematics anxiety and academic performance in Geometry ($r = -0.052$, $p = .510$), and H_{03} was not rejected (Table 5.3). Although the direction was negative, the magnitude was negligible. This non-significant result becomes interpretable within the mediation framework: math anxiety does not exert a meaningful direct influence on Geometry grades; rather, its consequences are transmitted indirectly through the suppression of grit. This finding is consistent with Casinillo et al. (2022) and Etcuban et al. (2019) in the Philippine context, as well as Flores (2019), who noted that anxiety's effect on performance is rarely direct. Contrasting findings from Zhang et al. (2019), Caviola et al. (2021), and Bornaa et al. (2023) in broader international samples are best explained by the mediating presence of grit in this study.

5.4 Relationship Between Grit and Academic Performance

A significant moderate positive correlation was found between grit and academic performance ($r = 0.557$, $p < .001$), leading to rejection of H_{04} (Table 5.4). Students with higher grit consistently obtained higher Geometry grades, making grit the most substantively significant direct predictor of academic performance in this study. This finding is consistent with Datu et al. (2023), Pratiwi et al. (2023), and Allen et al. (2021), who all documented higher grit as predictive of better academic outcomes. However, Almeida et al. (2019) found that grit alone did not predict success among first-generation college students, suggesting that institutional support and broader context also matter.

6. Mediating Role of Grit

The mediation analysis confirmed a competitive partial mediation pattern, wherein grit significantly mediates the relationship between mathematics anxiety and academic

performance in Geometry (Tables 6.1 and 6.2), leading to rejection of H_{05} . The indirect effect was -0.4142 (95% CI $[-0.599, -0.245]$, $p < .001$), accounting for 55.5% of the total effect. The direct effect of mathematics anxiety on academic performance, after controlling for grit, remained significant at $\beta = 0.3326$ ($p = .003$), accounting for the remaining 44.5%. The non-significant total effect ($p = .484$) confirms that the overall anxiety-performance relationship is primarily driven through grit. Math anxiety significantly and negatively predicted grit ($a = -0.632$, $p < .001$), while grit significantly and positively predicted academic performance ($b = 0.655$, $p < .001$). The opposing directions of the direct and indirect effects explain the competitive suppression pattern: while anxiety suppresses grit and thereby reduces performance through the indirect path, it also exerts a small positive direct pressure on performance — possibly because a degree of evaluative concern motivates greater effort during assessments.

These findings are supported by Yu et al. (2021), Ogden (2023), and Yeoul et al. (2023), who all confirmed that grit actively reduces the harmful effects of anxiety on learning. In the context of Grade 10 Geometry, where abstract concepts and cognitive demands often trigger anxiety, these findings underscore that nurturing perseverance and goal commitment is not only beneficial but necessary for helping students overcome the challenges that math anxiety brings.

Summary of Findings

The following summarizes the key findings of this study:

- 1. Socioeconomic Status:** The majority (79.75%) of respondents came from Low Income, Lower Middle Income, and Poor categories, consistent with the typical public secondary school profile in rural Batangas.
- 2. Mathematics Anxiety:** The overall level of mathematics anxiety was Average ($M = 2.77$). Feeling Towards Mathematics ($M = 3.13$, Sometimes) was higher than Test and Performance Anxiety ($M = 2.42$, Seldom).
- 3. Level of Grit:** Respondents were mostly gritty overall. Perseverance of Effort was highest ($M = 3.89$), followed by Adaptability ($M = 3.73$), with Consistency of Interest lowest ($M = 3.11$).
- 4. Academic Performance:** The overall mean Geometry grade was 83.46 (Satisfactory), with a modal grade of 75.00 (the minimum passing mark) and a wide range (70 to 96).
- 5.1 SES–Grit:** A significant moderate relationship was found [$\chi^2(12) = 52.5$, $p < .001$, Cramér's $V = 0.328$]. Higher SES was associated with higher grit.
- 5.2 Anxiety–Grit:** A significant moderate negative correlation was found ($r = -0.410$, $p < .001$). Higher anxiety was associated with lower grit.
- 5.3 Anxiety–Performance:** No significant direct relationship was found ($r = -0.052$, $p = .510$).
- 5.4 Grit–Performance:** A significant moderate positive correlation was found ($r = 0.557$, $p < .001$). Higher grit predicted better Geometry grades.
- 6. Mediation:** Grit significantly and competitively partially mediates the relationship between mathematics anxiety and academic performance. The indirect effect ($\beta = -0.4142$, $p < .001$) accounts for 55.5% of the total effect.

7. Proposed Program: GEMAP (Grit Enhancement and Math Anxiety Program) was developed, comprising GEMAP-S for students and GEMAP-E for educators.

Conclusions

1. The majority of Grade 10 respondents came from economically disadvantaged households, with nearly 80% classified under the Poor, Low Income, and Lower Middle-Income categories. This socioeconomic profile significantly shapes students' non-cognitive resources, including grit.

2. Respondents experienced a moderate-low level of mathematics anxiety overall, with test and performance anxiety registering lower than general feelings toward mathematics. While not severely distressing, this level of anxiety can still quietly affect academic engagement and performance.

3. Respondents demonstrated a high overall level of grit. Perseverance of Effort and Adaptability were strongest, while Consistency of Interest was comparatively lower — indicating that sustaining long-term goal commitment remains an area for further development.

4. The respondents' mean Geometry grade of 83.46 falls within the Satisfactory range, yet the mode of 75.00 reveals that a substantial proportion of students are performing barely at the baseline standard.

5. Socio-economic status has a significant moderate association with grit, indicating that financial background shapes — but does not fully determine — students' grit. School-based support can help bridge this gap.

6. Mathematics anxiety and grit are significantly and moderately negatively correlated, establishing that heightened anxiety undermines students' capacity for perseverance, consistency, and adaptability in Geometry learning.

7. Mathematics anxiety does not significantly predict academic performance in Geometry in isolation. Its academic consequences are channeled through its erosion of grit rather than operating directly on grades.

8. Grit is a significant and moderate positive predictor of academic performance in Geometry, making it the most practically meaningful lever for improving student outcomes in this study.

9. Grit significantly and competitively partially mediates the relationship between mathematics anxiety and academic performance. Math anxiety reduces academic performance primarily by suppressing grit, which constitutes the dominant pathway through which anxiety impairs Geometry outcomes.

Recommendations

For Students. Students are encouraged to take deliberate steps toward developing grit — especially perseverance of effort and adaptability to the situation. This may include setting realistic academic goals, treating mistakes as diagnostic information rather than judgments of ability, and proactively seeking support when Geometry concepts become difficult. Cultivating the discipline to persist through discomfort is one

of the most effective strategies for managing mathematics anxiety and improving academic performance over time.

For Teachers. Teachers are encouraged to design instructional approaches that intentionally build grit alongside mathematical content. This includes establishing goal-setting routines, incorporating tasks that require sustained effort, and framing assessment as an opportunity for growth rather than a source of fear. Calibrating assessments to be appropriately challenging — rather than overwhelming — creates conditions where grit can develop naturally alongside content mastery.

For School Administrators. School administrators are encouraged to adopt and institutionalize the Grit Enhancement and Math Anxiety Program (GEMAP) for Grade 10 students. GEMAP-S is a three-term structured student program delivered across six program days annually, encompassing awareness, reinforcement, coaching, and recognition phases. GEMAP-E is a three-day educator workshop held during the school opening block to equip mathematics teachers and guidance counselors with grit-informed pedagogy and anxiety reduction strategies. Given the significant SES–grit relationship, GEMAP should be designed with deliberate attention to students from low-income households who may require additional psychological and relational support.

For Future Researchers. Future researchers are encouraged to replicate this study using a larger and more geographically diverse sample to strengthen the generalizability of findings. Longitudinal designs tracking grit, mathematics anxiety, and academic performance across multiple school years would strengthen causal interpretation. Researchers may also explore additional mediating variables — including self-efficacy, academic resilience, and learning motivation — in the anxiety–performance relationship. Qualitative methodologies may further deepen understanding of how students personally experience and navigate mathematics anxiety and how grit develops as a lived academic resource.

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