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Influence of Mathematics Anxiety and Level of Motivation on the Academic Achievement of Public Senior High School Students

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ABSTRACT

Mathematics anxiety and motivation shape how senior high school students engage with mathematics, but their joint influence on achievement has received limited attention in Philippine public schools. Grounded in the Integrated Cognitive-Emotional Theory and Self-Determination Theory, this descriptive-correlational study examined the influence of mathematics anxiety and motivation level on the academic achievement of 109 Grade 11 and 12 students at General Santos City National High School in School Year 2025–2026. Anxiety was measured in four dimensions with an instrument adapted from the Abbreviated Math Anxiety Scale, motivation in three dimensions with items adapted from the Academic Motivation Scale (α = .78 to .85), and achievement through first- and second-quarter mathematics grades. Chi-square and Pearson correlation were applied. Anxiety was High in all dimensions, with emotional and cognitive anxiety highest (M = 3.23). Students' motivation was predominantly extrinsic (M = 3.30, Very High), followed by intrinsic motivation (M = 3.23, High), with amotivation Fair (M = 2.28). Achievement was Satisfactory and improved from 83.45 to 84.20. Age, sex, grade level, strand, and family income were associated with anxiety and motivation, while sex, grade level, and strand were associated with achievement. Anxiety was negatively related to achievement ($r = -.42$, $p = .001$), and motivation was positively related to it ($r = .38$, $p = .002$). The results are consistent with a model in which anxiety drains cognitive resources during evaluation while motivation sustains effort. A school mental health plan focusing on regulation at the point of performance, autonomous motivation, and family engagement is proposed.

Introduction

Achievement in mathematics depends on what students know and also on how they feel and why they try. Two students with the same preparation can produce very different results if one freezes under pressure and the other pushes through difficulty. Mathematics anxiety and motivation are therefore central to understanding why some learners succeed and others struggle. Anxiety has been linked to reduced confidence, motivation, and performance in STEM fields (Gunderson et al., 2023) and to lower test scores and course enrollment (Rachman et al., 2023). For senior high school students in the Philippines, who are choosing strands and preparing for college, these effects can narrow their future options.

Local studies have tended to examine anxiety in isolation (Colinares & Ucang, 2025; Ablian & Parangat, 2021), leaving open the question of how motivation shapes its influence. Senior high school is also a period of emotional strain, and today's learners entered it after school

closures and remote learning that, according to Filipino students themselves, took a toll on their mental health (Panela, 2025b). At General Santos City National High School, teachers and administrators observe recurring signs of anxiety among students in mathematics classes. An inquiry grounded in theory and focused on the specific mechanisms of anxiety and motivation was therefore needed.

This study examined the influence of mathematics anxiety and level of motivation on the academic achievement of public senior high school students. It was guided by three questions: (1) What are the students' levels of mathematics anxiety, motivation, and achievement? (2) Which personal and family characteristics are associated with these variables? (3) Are anxiety and motivation significantly related to achievement? The findings were intended to inform a school mental health plan.

Literature Review

A Cognitive-Emotional Account of Mathematics Anxiety

The Integrated Cognitive-Emotional Theory explains how anxiety disrupts mathematical thinking. Negative emotions and anxious thoughts occupy working memory, the limited system that holds and manipulates information during problem-solving, leaving fewer resources for the task itself (Ashcraft, 2002; Ashcraft, 2001). Empirical work supports each part of this account. Worry and intrusive thoughts reduce working memory capacity (Demedts et al., 2022), working memory mediates the effect of anxiety on performance (Finell et al., 2022), and anxious students update numerical information less efficiently (Pelegrina et al., 2020). Physiological arousal such as a racing heart, sweating, and tension draws further on attention (Esposito et al., 2025; Lievore et al., 2024; Luttenberger et al., 2018), and neural threat responses can begin with mere anticipation of a mathematics task (Marakshina et al., 2025). Emotional reactions of fear, helplessness, and frustration (Baas, 2020; Ramirez et al., 2025) and behavioral responses of avoidance and procrastination (Siaw, 2021; Choe et al., 2019; Suren, 2020) complete the picture of anxiety as a four-dimensional experience.

The theory also implies that anxiety is shaped by appraisal and regulation. Students who interpret their arousal as manageable, or who reappraise anxious feelings, experience smaller performance costs (Garcia, 2023; Cohen et al., 2021; Pizzie & Kraemer, 2021). Anxiety also has social origins: parents' and teachers' attitudes toward mathematics influence children's anxiety (Gunderson et al., 2022; Beilock & Maloney, 2020), stereotypes can heighten threat among some groups (Schmader et al., 2021; Lyons & Beilock, 2021), and early difficulties can set a lasting trajectory (Vanbinst et al., 2020; Ahmmed, 2024; Rubinsten et al., 2015).

Motivation as a Counterweight

Self-Determination Theory distinguishes intrinsic motivation, which arises from interest and satisfaction; extrinsic motivation, which arises from rewards, expectations, and requirements; and amotivation, a lack of intention to act. Intrinsically motivated students tend to be more persistent and resilient, while amotivated students disengage (Jeffry, 2025; Cohen et al., 2021).

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Self-efficacy strengthens motivation and lowers anxiety (Zou & Mustakim, 2025), and self-efficacy and emotional intelligence can buffer the effect of anxiety on performance (Demets et al., 2022). Motivated students can sustain achievement even when moderately anxious (Gunderson et al., 2023; Jameson, 2023). Motivation is therefore a plausible counterweight to anxiety.

Evidence on Achievement

The negative relationship between anxiety and achievement is among the most consistent findings in mathematics education (Barroso et al., 2020; Zhang et al., 2019). Filipino studies report the same pattern among senior high school students (Ablian & Parangat, 2021; Colinares & Ucang, 2025; Jeffry, 2025), and studies in Ghana and South Africa extend it to other developing contexts (Essuman et al., 2021; Mutodi & Ngirande, 2014). Supportive classrooms (Bicer et al., 2020), peer collaboration (Garba, 2019), and combined skill and anxiety interventions (Codding et al., 2023) improve outcomes. These findings are consistent with Philippine education policy, which calls for learner-centered instruction (DepEd, 2013), the removal of barriers to learning (Congress of the Philippines, 2001), and research-informed practice (DepEd, 2016).

Methodology

The study used a quantitative descriptive-correlational design to describe the variables and examine their relationships as they occurred, without manipulation. Because the design is non-experimental, the term “influence” is used here in the sense of a significant association, not a demonstrated cause.

The respondents were 109 Grade 11 and 12 students of General Santos City National High School in School Year 2025–2026, drawn through stratified random sampling to represent the school’s strands. Two mathematics teachers with at least three years of experience provided context on teaching practices.

Data were collected with a three-part questionnaire. Part I asked for age, sex, civil status, grade level, track, strand, parents’ education and occupation, and monthly family income. Part II measured mathematics anxiety with 20 items adapted from the Abbreviated Math Anxiety Scale and its modified version, five each for the emotional, physiological, cognitive, and behavioral dimensions. Part III measured motivation with 15 items adapted from the Academic Motivation Scale, five each for intrinsic motivation, extrinsic motivation, and amotivation. A four-point scale (1 = strongly disagree to 4 = strongly agree) was used, with means of 3.26–4.00 interpreted as Very High, 2.51–3.25 as High, 1.76–2.50 as Fair, and 1.00–1.75 as Low. Achievement was represented by first- and second-quarter mathematics grades drawn from school records. In a pilot test with 30 students of Fatima National High School, Cronbach’s alpha ranged from .78 (amotivation) to .85 (intrinsic motivation).

Following approval by the Graduate School, the Schools Division Superintendent, and the school head, the questionnaire was administered during class hours. Students received assurances of confidentiality to ease their initial hesitation, and schedules were adjusted around

class activities. Data were analyzed through frequency, percentage, weighted mean, chi-square, and Pearson's *r*, with significance set at .05; Shapiro-Wilk results ($p > .05$ for all dimensions) supported the use of parametric correlation. Informed consent and parental consent for minors were obtained, participation was voluntary, and data were handled confidentially in accordance with the Data Privacy Act of 2012 (Congress of the Philippines, 2012).

Results and Discussion

Family and Socioeconomic Background

Table 1

Family and Socioeconomic Characteristics of the Respondents (n = 109)

Characteristic	Category	f	%
Monthly family income	Below ₱10,000	28	25.69
	₱10,001–20,000	32	29.36
	₱20,001–30,000	20	18.35
	₱30,001–50,000	20	18.35
	Above ₱50,000	9	8.26
Father's education	High school graduate	25	22.94
	College graduate	17	15.60
Mother's education	High school graduate	28	25.69
	College graduate	16	14.68
Father's occupation	Skilled worker	25	22.94
	Professional	20	18.35
	Laborer	18	16.51
Mother's occupation	Professional	25	22.94
	Overseas Filipino worker	25	22.94
	Skilled worker	20	18.35

Note. Only the most frequent categories are shown for education and occupation.

The respondents were mostly 17 to 18 years old (53.21%), female (56.88%), single (97.25%), and enrolled in the Academic track (87.16%), with Grade 11 (51.38%) and Grade 12 (48.62%) almost evenly divided. STEM (27.52%), ABM (25.69%), and HUMSS (23.85%) were the largest strands. Their family background was modest (Table 1). More than half of the households (55.05%) earned ₱20,000 or less per month, and only 8.26% earned above ₱50,000. High school completion was the most common parental education level, and fewer than one in six parents held a college degree. Nearly a quarter of mothers (22.94%) worked overseas. From a cognitive-emotional perspective, this background matters because anxiety is learned partly from the home: parents' own anxiety and expectations about mathematics are transmitted to children (Gunderson et al., 2022; Beilock & Maloney, 2020). A parent abroad may also mean less day-to-day academic support, and economic strain can add to the stress students bring into the classroom.

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Levels of Anxiety, Motivation, and Achievement

Table 2

Summary of Mathematics Anxiety and Motivation Dimensions

Construct	Dimension	Mean	Interpretation	Rank
Mathematics anxiety	Emotional	3.23	High	1.5
	Cognitive	3.23	High	1.5
	Physiological	3.12	High	3
	Behavioral	2.95	High	4
Motivation	Extrinsic	3.30	Very High	1
	Intrinsic	3.23	High	2
	Amotivation	2.28	Fair	3

Note. 3.26–4.00 = Very High; 2.51–3.25 = High; 1.76–2.50 = Fair; 1.00–1.75 = Low.

Anxiety was High across its four dimensions (Table 2). The emotional and cognitive dimensions tied for the highest mean (3.23), followed by the physiological (3.12) and behavioral (2.95) dimensions. The most intense indicators were nervousness when solving problems in front of the class (3.40), a racing heart before a mathematics examination (3.35), difficulty recalling formulas during examinations (3.30), and fear of difficult topics (3.28), all Very High.

Read through the cognitive-emotional lens, this ranking describes the process by which anxiety reaches performance. The strongest reactions are emotional and cognitive, which are the two channels the theory holds most directly responsible for consuming working memory (Ashcraft, 2002). The specific symptom of forgetting formulas during examinations is a concrete instance of retrieval failure under load, consistent with evidence on the mediating role of working memory (Finell et al., 2022; Demedts et al., 2022; Pelegrina et al., 2020). Physiological arousal, especially before examinations, adds a second load on attention (Esposito et al., 2025; Lievore et al., 2024). Behavioral avoidance was the weakest dimension, so the students' anxiety disrupts their thinking during tasks more than it keeps them from attempting tasks. This matters for intervention: approaches that target appraisal and regulation, such as reappraisal and expressive techniques, are likely to help this group more than approaches aimed only at attendance or participation (Cohen et al., 2021; Pizzie & Kraemer, 2021).

Motivation showed a different profile. Extrinsic motivation was Very High (3.30), intrinsic motivation was High (3.23), and amotivation was Fair (2.28). Students studied mathematics most for good grades (3.40), future careers (3.38), and parents' expectations (3.30), while intrinsic satisfaction from understanding difficult concepts was also Very High (3.35). In terms of Self-Determination Theory, the students are clearly motivated, but their motivation leans toward controlled rather than autonomous forms. Controlled motivation can keep students working, but it also ties success to external judgment, which may sharpen the evaluative fear that dominated the anxiety results. The Very High satisfaction from understanding is a resource

that teaching can build on, since autonomous motivation supports persistence and resilience (Gunderson et al., 2023; Jameson, 2023; Zou & Mustakim, 2025).

Achievement was Satisfactory, with the mean grade improving from 83.45 to 84.20 between the first and second quarters (overall 83.83). Outstanding grades rose from 16.51% to 20.18%, and failing grades fell from 3.67% to 1.83%. That achievement held steady and slightly improved despite High anxiety is consistent with the counterweight role of motivation proposed above.

Characteristics Associated with Anxiety, Motivation, and Achievement

Table 3

Significance of Chi-Square Tests Between Profile Variables and Study Variables

Profile Variable	Anxiety	Motivation	Achievement
Age	Significant (.03)	Significant (.02)	ns (.11)
Sex	Significant (.04)	Significant (.04)	Significant (.04)
Civil status	ns (.32)	ns (.28)	ns (.33)
Grade level	Significant (.02)	Significant (.01)	Significant (.02)
Track	ns (.11)	ns (.08)	ns (.09)
Strand	Significant (.01)	Significant (.02)	Significant (.03)
Parents' educational attainment	ns (.06)	ns (.05)	ns (.08)
Parents' occupation	ns (.09)	ns (.12)	ns (.12)
Combined monthly family income	Significant (.02)	Significant (.01)	ns (.07)

Note. Values in parentheses are p values; ns = not significant at $\alpha = .05$.

Five profile variables were significantly associated with both anxiety and motivation: age, sex, grade level, strand, and family income (Table 3). The chi-square values for anxiety ranged from 8.15 (sex) to 12.28 (strand), and those for motivation from 7.65 (sex) to 12.41 (income). Achievement was associated with fewer variables: sex ($\chi^2 = 8.36$), grade level ($\chi^2 = 9.12$), and strand ($\chi^2 = 7.28$). Civil status, track, parents' education, and parents' occupation were unrelated to all three, although parents' education reached $p = .05$ for motivation and income reached $p = .07$ for achievement.

The response patterns behind these associations showed higher anxiety among younger students, females, Grade 11 students, STEM students, and lower-income students, and stronger motivation among older, Grade 12, STEM and ABM, and higher-income students. Several of these patterns fit the theory. The STEM strand carries the heaviest mathematical load, so its students face the most frequent evaluative pressure. Grade 11 students are newer to senior high school demands and may not yet have developed coping strategies. The higher anxiety reported by female students is consistent with local findings (Ablian & Parangat, 2021) and with research on stereotype threat (Schmader et al., 2021). Since a chi-square test does not establish direction, and since sex differences in questionnaire scores can partly reflect item functioning, a Rasch-based check of measurement invariance by sex, of the kind applied in recent Philippine instrument studies (Panela, 2025a), would strengthen such comparisons. Family income was related to how students feel about mathematics but not to their grades, which suggests that

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economic hardship acts on achievement indirectly, through emotion and motivation, rather than directly.

The Influence of Anxiety and Motivation on Achievement

Table 4

Correlation of Mathematics Anxiety and Motivation with Academic Achievement

Predictor Variable	r	p	Interpretation
Mathematics anxiety	−.42	.001	Moderate negative; significant
Level of motivation	.38	.002	Moderate positive; significant

Both relationships were significant (Table 4). Mathematics anxiety was moderately and inversely related to achievement ($r = -.42$, $p = .001$), and motivation was moderately and positively related to it ($r = .38$, $p = .002$). In practical terms, anxiety alone accounts for roughly 18% of the variation in grades, and motivation alone for about 14%.

These results support the theoretical model. The negative coefficient for anxiety is what the cognitive-emotional account predicts: when emotion and worry take up working memory, performance suffers (Ashcraft, 2002; Demedts et al., 2022). It also matches meta-analytic estimates and local findings (Barroso et al., 2020; Zhang et al., 2019; Jeffry, 2025; Colinares & Ucang, 2025). The positive coefficient for motivation is consistent with Self-Determination Theory and with evidence that motivation and self-efficacy protect performance under anxiety (Demets et al., 2022; Gunderson et al., 2023; Ramirez et al., 2023). The two forces are of similar size and opposite sign, which helps explain why a highly anxious cohort still achieved Satisfactory grades. The findings remain correlational: anxiety may lower achievement, but poor achievement may also raise anxiety in a reciprocal cycle (Ahmmed, 2024; Rubinsten et al., 2015).

Implications for a School Mental Health Plan

If anxiety works mainly through emotion and cognition during evaluation, and motivation works mainly through external incentives, a school plan should do three things. It should reduce the cognitive load of anxiety at the point of performance through relaxation and reappraisal before tests, low-stakes rehearsal of public problem-solving, and formula supports during early practice (Luttenberger et al., 2018; Pizzie & Kraemer, 2021). It should shift motivation toward autonomous forms by connecting lessons to real-life uses and careers, giving students choices, and celebrating understanding rather than only scores. And it should engage the home, helping parents, including those abroad, to encourage effort rather than demand results (Gunderson et al., 2022). Such a plan must be carried out by teachers, so it depends on their competencies; profiling these competencies first, as has been done with Philippine basic education teachers (Panela, 2025d), allows professional development to focus where it is needed.

Conclusion

Senior high school students at General Santos City National High School experience High mathematics anxiety, concentrated in emotional and cognitive reactions during evaluative

tasks. Their motivation is high but largely extrinsic, and their mathematics achievement is Satisfactory and slightly improving. Age, sex, grade level, strand, and family income are associated with both anxiety and motivation, while sex, grade level, and strand are associated with achievement. Mathematics anxiety is significantly and negatively related to achievement, and motivation is significantly and positively related to it, consistent with the Integrated Cognitive-Emotional Theory and Self-Determination Theory.

The school should adopt a mental health plan that integrates stress management before assessments, confidence-building and mistake-friendly instruction, peer mentoring and counseling, strand-specific support for STEM and ABM, relevance-based lessons, and parent workshops, together with equitable resources for lower-income learners and quarterly monitoring. Teachers should receive professional development in anxiety-informed and autonomy-supportive pedagogy, planned with attention to the practical constraints that commonly limit school-based capacity building (Panela, 2025e). Because teachers also carry heavy workloads, simple stress-relief supports, which have been associated with lower workplace stress among Filipino workers (Panela, 2026), merit inclusion. Continued attention to students' post-pandemic mental health is warranted (Panela, 2025c), and future studies should apply regression or path models and longitudinal designs to test the influence of anxiety and motivation more directly.

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