

Equations of the heart and mind: a path analysis of psychological factors influencing mathematics performance

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ABSTRACT

Mathematics performance remains a significant concern in higher education, as learners' affective and motivational factors critically shape their achievement outcomes. In this context, the present study explored how anxiety, attitude, motivation, and academic well-being influence students' performance in mathematics using a quantitative descriptive-correlational design with path analysis. Using a validated researcher-made questionnaire, data were gathered from 369 undergraduate students. The instrument demonstrated sound reliability and validity. Statistical analyses comprising descriptive measures and structural equation modeling (SEM) were conducted to identify both direct and mediated relationships among variables. Findings showed that students generally experienced moderate levels of mathematics anxiety and favorable levels of motivation and academic well-being. Correlation results revealed that anxiety was negatively linked to all other factors, whereas attitude, motivation, and academic well-being were positively associated with mathematics performance. Path analyses further indicated that motivation and academic well-being directly enhanced performance, while anxiety negatively affected achievement indirectly by lowering students' attitudes and motivation. The final model demonstrated an excellent fit, suggesting that emotional and motivational mechanisms play a vital role in determining mathematics success. These results underscore the need for educational strategies that help students manage anxiety and strengthen their motivation and well-being to support sustained academic achievement.

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1. INTRODUCTION

University life in the 21st century unfolds within a demanding and complex academic landscape shaped by rapid social, technological, and economic change. Students today navigate environments often described as disruptive, volatile, uncertain, complex, ambiguous, and diverse conditions that profoundly influence their learning experiences and personal development [1]. For many learners, particularly those enrolled in public universities, higher education represents a critical transition into adulthood marked by heightened academic expectations, expanding responsibilities, and significant emotional adjustments. These cumulative pressures have contributed to rising mental health concerns among university students, which are

frequently associated with negative learning attitudes, diminished motivation, and, in severe cases, suicidal ideation [2].

At the global level, declining academic performance in mathematics has intensified concerns regarding students' preparedness to meet the intellectual demands of contemporary society. International large-scale assessments continue to report troubling trends. The Programme for International Student Assessment (PISA) documented a 15-point decline in average mathematics performance among Organisation for Economic Co-operation and Development (OECD) countries between 2018 and 2022 [3]. More alarmingly, students from socio-economically disadvantaged backgrounds were found to be seven times more likely to perform below basic proficiency levels than their more advantaged peers [4]. These patterns highlight widening educational inequities and underscore the urgency of examining factors that influence mathematics achievement beyond traditional instructional and cognitive explanations.

Within the Philippine context, these challenges are further compounded by heavy academic workloads in higher education institutions, where students commonly enroll in 21 to 27 academic units per semester [5]. Such demands make it increasingly difficult for learners to sustain high performance across subjects, particularly in mathematics, which continues to be perceived as one of the most challenging disciplines. This perception is reflected in the persistently low mathematics scores of Filipino students in international assessments. Although some narrowing of performance gaps has been observed, a substantial proportion of learners still fail to meet expected proficiency standards. These persistent outcomes suggest that mathematics achievement cannot be fully explained by cognitive ability alone, pointing instead to the critical influence of affective and psychological factors [6].

Research increasingly emphasizes that academic performance emerges from the interaction of psychological constructs such as anxiety, attitude, motivation, and academic well-being [7]. These interrelated factors shape how students regulate emotions, allocate cognitive resources, and engage with academic tasks, particularly in mathematically demanding contexts. Mathematics anxiety has been shown to negatively affect students' emotional stability, confidence, and attentional control, thereby reducing engagement and learning satisfaction. High levels of anxiety also impair working memory and problem-solving processes, resulting in weaker academic performance [8]–[10].

Conversely, a positive attitude toward mathematics supports perseverance, optimism, and emotional balance, strengthening students' self-efficacy and overall academic well-being. Motivation further reinforces these processes by driving sustained engagement and effort, with intrinsically motivated learners demonstrating greater resilience and satisfaction when confronting challenging tasks [11], [12]. Together, attitude and motivation contribute to academic well-being, which serves as a critical mechanism through which emotional and motivational states influence academic success. Students with strong academic well-being are more focused, confident, and capable of sustained effort, whereas those experiencing heightened anxiety often struggle to perform effectively [13], [14]. As such, the dynamic interplay among anxiety, attitude, and motivation plays a decisive role in shaping academic well-being and, ultimately, mathematics performance.

To conceptualize these relationships, the present study is anchored in two complementary theoretical frameworks: Walberg's theory of academic achievement and Elger's theory of academic performance (ToP). Walberg's theory posits that academic outcomes are determined by the interaction between individual learner characteristics and the surrounding psychological and instructional environment [15]. Key predictors identified by Walberg include motivation, prior achievement, instructional quality, classroom climate, and social support. Within this framework, the psychological environment is closely aligned with academic well-being, encompassing students' emotional balance, engagement, and perceived competence in learning contexts [16], [17].

Elger's ToP, meanwhile, offers a dynamic systems-oriented perspective that emphasizes the reciprocal relationship between the performer and the performance environment [18], [19]. Elger identified six core factors influencing performance—context, knowledge, skills, identity, personal factors, and fixed factors—and articulated three axioms for improvement: growth mindset, active engagement, and reflective practice [20]–[22]. Together, Walberg's and Elger's theories converge on the view that academic performance, particularly in mathematics, is the product of continuous interaction between internal psychological processes and external learning conditions. Learners who exhibit strong motivation, positive attitudes, and stable academic well-being are therefore better positioned to cope with academic challenges, engage adaptively with mathematical tasks, and achieve sustained academic success.

The novelty of this study advances prior SEM-based research by integrating Walberg's theory of academic achievement and Elger's ToP into a single, theory-driven path model that simultaneously examines motivation, attitude, anxiety, and academic well-being as interconnected predictors of mathematics performance. Whereas earlier SEM studies typically investigated these variables in isolation or emphasized cognitive determinants alone, the present research uniquely positions academic well-being as a central

mediating mechanism linking emotional and motivational processes to achievement. By empirically validating this integrative framework within a higher education context, the study offers a more comprehensive and theoretically grounded explanation of mathematics performance, thereby extending existing models that have not fully captured the dynamic interplay among psychological, emotional, and environmental dimensions of learning.

Given this synthesis, the present study recognizes that mathematics performance cannot be explained by a single variable alone. Instead, it must be viewed as a holistic construct shaped by students' anxiety, motivation, attitude, academic well-being, and contextual experiences. Addressing these dimensions can lead to the development of more responsive, student-centered strategies that promote both academic success and mental wellness.

This study aims to investigate the extent to which anxiety, attitude, motivation, and academic well-being influences the mathematics performance of university students. It seeks to provide a deeper understanding of how these psychological variables interact to shape learners' academic outcomes. In particular, the study endeavors to answer the following research questions:

- What are the levels of anxiety, attitude, motivation, academic well-being, and mathematics performance among university students?
- Which best-fit structural model can effectively explain the direct and indirect relationships among the identified psychological factors such as anxiety, attitude, motivation, and academic well-being and their collective impact on students' mathematics performance?

2. METHOD

2.1. Research design

The purpose of this study was to assess the levels of anxiety, attitude, motivation, academic well-being, and mathematics performance among university students, and to establish the most suitable model explaining the direct and indirect connections among these psychological factors and students' performance in mathematics. To accomplish these objectives, the researchers utilized a path analysis approach within the framework of structural equation modeling (SEM). As explained by Kvintova *et al.* [23], path analysis is a powerful statistical technique that enables the examination of intricate relational patterns by identifying both the direct and indirect effects of independent variables on a dependent variable. In alignment with this, Nadella [24] emphasized that SEM extends beyond conventional regression analysis by allowing the simultaneous assessment of multiple interrelated variables and latent constructs. Moreover, SEM integrates model fit indices, which serve to determine how accurately the proposed theoretical model aligns with the empirical data, thereby ensuring the robustness and validity of the study's findings.

Through this analytical method, the researchers examined the interrelationships among anxiety, attitude, motivation, and academic well-being in influencing mathematics performance. The application of path analysis offered a comprehensive view of the direct and mediating effects of these psychological dimensions, resulting in a well-defined model that captures the interconnected roles of emotional, motivational, and well-being factors in predicting students' mathematical achievement.

2.2. Participants

The study involved 369 first-year college students enrolled during the first semester of academic year 2024–2025 at Iloilo Science and Technology University (ISAT-U), Iloilo City. The participants represented academic programs. Specifically, there were 38 students from Bachelor of Science (BS) mathematics, 42 from Bachelor of Secondary Education (BSEd) mathematics, 70 from BS architecture, 38 from BS mechanical engineering, 40 from BS electrical engineering, 78 from BS civil engineering, and 63 from BS electronics engineering, comprising a total of 369 respondents. A random sampling technique was utilized to guarantee fair representation of students across various academic programs and to reduce potential sampling bias.

The sample size of 369 was justified based on established methodological standards for SEM. Olanrewaju [25] recommends having at least 20 participants per estimated parameter to achieve stable model estimation and avoid issues related to underpowered analyses. Given the complexity of the model used in this study, the sample exceeded this threshold, ensuring that parameter estimates were statistically reliable. Furthermore, previous researchers assert that SEM typically requires a sample ranging from 100 to 400 to generate robust and valid results, depending on model complexity and variable distribution [26]. The sample of 369 not only falls well within this recommended range but also leans toward the higher end, which enhances the precision of estimates and reduces the likelihood of model misfit. Additionally, the relatively large and diverse sample strengthens the generalizability of the findings across different academic programs. By capturing a broad spectrum of student backgrounds and mathematical experiences, the study ensures that the resulting conclusions more accurately reflect the population of first-year college students at ISAT-U.

To ensure adherence to ethical research standards, participants were thoroughly informed about the study's objectives and procedures. Informed consent was obtained through a written form detailing the study's purpose, data-gathering process, and confidentiality protocols. Participation was entirely voluntary, and respondents were assured that their identities would remain anonymous. All collected information was treated with strict confidentiality and utilized exclusively for academic and research purposes.

2.3. Data gathering instrument

2.3.1. Researcher-made questionnaire

The instrument developed for this study was a structured, researcher-made questionnaire designed to capture the key psychological constructs under investigation. It consisted of four main sections: the first measured mathematics anxiety, the second assessed attitudes toward mathematics, the third evaluated mathematics motivation, and the fourth examined students' academic well-being. Each section was composed of items rated on a 5-point Likert Scale, ranging from 1 (strongly disagree) to 5 (strongly agree), allowing respondents to express the degree of their agreement with each statement.

This format facilitated the quantification of psychological factors and provided a consistent basis for statistical analysis and interpretation. The instruments are consisting of 25 items for each part. The questionnaire was reviewed for face and content validity by two guidance counselors, one mathematics expert, one curriculum specialist, and one English grammarian, all of whom are doctoral degree holders. Adjustments were made based on their recommendations. Reliability testing through Cronbach's alpha yielded a coefficient ranging from 0.846 to 0.880, indicating strong internal reliability, as values of 0.70 or higher are generally considered acceptable [27].

2.3.2. Entrance exam data

The study also incorporated data retrieved from institutional records to measure mathematics performance. The ISAT university admission test (UAT) served as the basis for mathematics performance, with a perfect score of 60 and a lowest possible score of zero. Data were obtained from the Office of Student Affairs and Services (OSAS) during the first semester of academic year 2024–2025 through a formal request. Table 1 presents an overview of the instruments employed in the study, including the variables and their corresponding indicators, the type of response or Likert scale applied, and the level of measurement for each indicator.

Table 1. Instruments, variables, and measurement details

Instruments	Variables with indicators	Responses/Likert scale	Level of measurement
A. Researcher-made questionnaire (1 set)	I. Psychological aspects		
	- Mathematics anxiety	4.50–5.00 “very high”, 3.50–4.49 “high”,	Ratio
	- Attitudes toward mathematics	2.50–3.49 “moderate”, 1.50–2.49 “low”, and	Ratio
	- Mathematics motivation	1.00–1.49 “very low.”	Ratio
B. Entrance exam data (1 set)	- Academic well-being		Ratio
	II. Entrance exam data		
	- Academic performance in mathematics	48.01–60.00 “outstanding,” 36.01–48.00 “very satisfactory,” 24.01–36.00 “satisfactory,” 12.01–24.00 “fair,” and 0.00–12.00 “poor.”	Ratio

2.4. Procedure and intervention

This study employed a three-phase research design to ensure methodological rigor and accuracy throughout the process phase: preliminary, data collection, and data analysis.

2.4.1. Preliminary

Before the formal conduct of the study, the researchers secured the necessary approval by submitting an official request to the University President of ISAT-U and to the respective deans of the College of Engineering and Architecture, College of Arts and Sciences, and College of Education. Once permission was granted, detailed information about the study including its objectives, the purpose of data collection, confidentiality protocols, and ethical safeguards was communicated to both faculty members and the target participants. To ensure the quality and validity of the instrument, the researcher-made questionnaire underwent expert validation, during which revisions were incorporated based on the evaluators' feedback and recommendations. The finalized and validated instrument was subsequently administered in face-to-face sessions, ensuring clarity of instructions and consistency in data gathering procedures.

2.4.2. Data collection

Data collection was conducted with coordination from faculty members in charge of the assigned classrooms. The purpose, procedures, and ethical safeguards of the study were clearly explained to the participants prior to the administration of the instruments. Privacy, confidentiality, and voluntary participation were emphasized following institutional ethics and data protection protocols. After the survey administration, the completed questionnaires were checked for missing responses and encoded carefully for accuracy. Subsequently, the researcher sought permission from the OSAS to obtain the official results of the UAT-mathematics for students officially enrolled during the first semester of academic year 2024–2025. These scores were used to determine each participant's mathematics performance, which was computed based on their mean UAT score. All participant identifiers, such as name and section, were kept strictly confidential.

2.4.3. Data analysis

Descriptive statistics, including mean and standard deviation, were used to summarize students' levels of mathematics anxiety, attitude, motivation, academic well-being, and performance, providing a clear view of central tendencies and variability. To examine the structural relationships among these constructs, path analysis was conducted using statistical package for the social sciences (SPSS) and analysis of moment structures (AMOS), allowing the assessment of both direct and indirect effects and the identification of a best-fitting model that captures the complex interplay of emotional, motivational, and cognitive factors influencing mathematics performance. Model validity was evaluated through multiple goodness-of-fit indices, such as χ^2 , root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), Tucker–Lewis index (TLI), comparative fit index (CFI), and normed fit index (NFI), with established criteria guiding the determination of acceptable fit, alongside parsimonious fit assessed through relative chi-square (χ^2/df). This rigorous methodological approach underscores the study's commitment to accuracy and dependability, ensuring that results are credible and informative for future research and educational practice [28], [29].

This systematic and rigorous procedure underscores the study's commitment to ensuring the accuracy, validity, and dependability of its findings. By adhering to ethical standards and employing meticulous data collection and analytical processes, the research guarantees that the results are credible and reflective of actual conditions. Such methodological precision enhances the trustworthiness of the conclusions and provides a sound basis for developing insights that may inform future studies and educational practices, particularly in understanding the psychological and academic factors influencing students' mathematics performance. However, it is also recognized that students' responses may be influenced by perspective bias, as self-reported measures can be shaped by individual perceptions, emotions, or social desirability tendencies. Acknowledging this potential bias further reinforces the study's transparency and integrity in interpreting the results within the context of human subjectivity in educational research.

2.5. Limitation

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional research design limits the ability to establish causal relationships among anxiety, attitude, motivation, academic well-being, and mathematics performance. Although path analysis provides evidence of directional associations, causal inferences cannot be definitively drawn. Second, the use of self-reported data introduces the possibility of perspective bias, including social desirability effects and subjective interpretation of survey items, which may influence the accuracy of reported psychological states. Third, the sample was confined to first-year students from a single public university, which may limit the generalizability of the results to other academic levels or institutional contexts. Finally, mathematics performance was measured using entrance examination scores, which reflect prior academic preparation rather than ongoing university-level learning outcomes. These limitations highlight the need for cautious interpretation and point to opportunities for methodological refinement in future research.

3. RESULTS AND DISCUSSION

3.1. Levels of anxiety, attitude, motivation, academic well-being, and mathematics performance

Table 2 summarizes the levels of anxiety, attitude, motivation, academic well-being, and mathematics performance of the 369 first-year students, reflecting their psychological readiness and mathematics entrance examination outcomes. Overall, the results indicate a balanced affective profile among the participants as they enter university-level mathematics. Students demonstrated a moderate level of mathematics anxiety ($M=2.89$, $SD=0.66$), suggesting the presence of apprehension toward mathematics that remains manageable and does not severely impair performance. Such levels of anxiety may heighten

alertness during problem-solving, although excessive anxiety is known to hinder cognitive processing [30]. This finding aligns with recent evidence showing that post-pandemic cohorts commonly experience moderate but stable anxiety levels as academic routines normalize, particularly in quantitative subjects [31].

Participants also reported a moderate attitude toward mathematics ($M=3.48$, $SD=0.58$), indicating generally balanced perceptions of the subject. This result supports earlier findings that students' attitudes toward mathematics are shaped by prior learning experiences and self-beliefs [32]. While digital tools and flexible instructional approaches increasingly influence learners' perceptions, recent literature similarly notes that attitudes remain moderate rather than strongly positive [33].

In contrast, students exhibited a high level of mathematics motivation ($M=4.04$, $SD=0.50$), reflecting strong engagement and persistence in learning mathematics. Motivation is a key driver of sustained effort and academic engagement, and the high motivation observed may be attributed to students' intrinsic goals and the structured demands of university learning [34], [35]. Consistent with recent findings, first-year students appear to demonstrate heightened motivation compared to pre-pandemic cohorts, likely due to increased emphasis on academic stability and career preparation [36].

Students likewise reported a high level of academic well-being ($M=3.85$, $SD=0.58$), indicating positive emotional experiences, satisfaction, and perceived competence in their academic environment [37], [38]. High academic well-being supports resilience and sustained engagement in challenging subjects such as mathematics [39]. Recent studies suggest that improved institutional support systems and mental health initiatives in post-pandemic settings have contributed to enhanced student well-being, a trend consistent with the present findings [40], [41].

With respect to achievement, students' mathematics performance on the ISAT-UAT was rated as satisfactory ($M=26.67$, $SD=7.31$), reflecting adequate foundational skills but room for growth in higher-order reasoning. This level of performance is consistent with evidence showing that affective factors, particularly anxiety and motivation, meaningfully influence test outcomes [42]. The combination of moderate anxiety and high motivation and well-being among participants may help explain their satisfactory performance, a pattern also observed in prior studies of standardized mathematics assessments [43]. Overall, the findings indicate that students enter university with manageable anxiety, moderately positive attitudes, and strong motivation and academic well-being, providing a stable foundation for further mathematical learning. However, the satisfactory level of performance underscores the need for targeted instructional strategies and emotional support mechanisms to further strengthen students' confidence, conceptual understanding, and mastery in mathematics.

Table 2. Levels of anxiety, attitude, motivation, academic well-being, and mathematics performance

Variables with indicators	N	SD	M	Interpretation
I. Psychological aspects				
- Mathematics anxiety	369	0.66	2.89	Moderate
- Attitudes toward mathematics	369	0.58	3.48	Moderate
- Mathematics motivation	369	0.50	4.04	High
- Academic well-being	369	0.58	3.85	High
II. Entrance exam data				
- Mathematics performance	369	7.31	26.67	Satisfactory

Note: the scale interpretations are detailed in Table 1.

3.2. Path analysis model

Table 3 presents the statistical indices assessing the goodness-of-fit of the hypothesized model, which illustrates the direct and indirect effects of mathematics anxiety, attitude, motivation, and academic well-being on students' mathematics performance. The overall results reveal that the proposed model demonstrates an excellent fit with the observed data, supported by the absolute, incremental, and parsimonious fit indices. According to Howard *et al.* [44], assessing model fit should involve the use of multiple indicators rather than relying on a single measure, as this approach provides a more comprehensive and reliable evaluation of how well a theoretical model corresponds with empirical data. In this study, several absolute fit indices were utilized including the Chi-square (χ^2), RMSEA, and GFI all of which met the accepted thresholds for model adequacy. The non-significant chi-square value ($p=0.999$) indicates that the observed covariance matrix does not significantly deviate from the expected matrix, thereby affirming the model's robustness and adequacy [45].

Additionally, the RMSEA value of 0.000, which is well below the recommended cutoff value of 0.08 [46], demonstrates an exceptionally close fit between the proposed model and the actual data. The GFI value of 1.000 further strengthens this conclusion, showing that the model successfully explains nearly all the

variance among the observed variables. Furthermore, the incremental fit indices which assess the improvement of the proposed model over a baseline (null) model also demonstrated excellent results. The computed values, AGFI (1.000), CFI (1.000), TLI (1.020), and NFI (1.000), all surpass the commonly accepted threshold of 0.90, confirming a strong incremental fit and reinforcing the validity of the final model [47]. Together, these indices provide compelling evidence that the proposed structural model effectively represents the underlying relationships among the study’s psychological and performance variables.

These results imply that the relationships among psychological constructs and mathematics performance are well-explained within the structural model, aligning with findings by Sajjad *et al.* [48] who emphasized that high CFI and TLI values demonstrate both robustness and theoretical consistency in path models. Furthermore, the parsimonious fit index, represented by the ratio of Chi-square to degrees of freedom ($\chi^2/df=0.010$), is significantly below the recommended value [49]. This indicates that the model achieves a good balance between simplicity and explanatory power, avoiding overfitting while effectively representing the data structure.

Table 3. Fit indices and statistical measures of the structural model

Category	Measure	Acceptable values	Model’s fit index
Absolute fit	χ^2	>0.05	0.999
	RMSEA	<0.08	0.000
	GFI	>0.90	1.000
Incremental fit	AGFI	>0.90	1.000
	CFI	>0.90	1.000
	TLI	>0.90	1.020
	NFI	>0.90	1.000
Parsimonious fit	χ^2/df	<5	0.010

Note: acceptable values are based on Yadav *et al.* [49].

Figure 1 illustrates how anxiety, attitude, and motivation collectively influence academic well-being and, subsequently, mathematics performance. Anxiety shows negative direct effects on both attitude and academic well-being, indicating that higher anxiety tends to lower students’ emotional balance and confidence. In contrast, attitude and motivation exert positive effects on academic well-being, with motivation showing the strongest contribution. The model also demonstrates that academic well-being serves as a significant mediator between the three predictors and mathematics performance. Additionally, both anxiety and attitude have direct paths to mathematics performance, though these effects are relatively small. The strongest direct predictor of mathematics performance is academic well-being. Overall, the model highlights that students’ motivation and attitude bolster their well-being and performance, while anxiety undermines these outcomes, making academic well-being a central mechanism linking emotional and motivational factors to mathematics achievement.

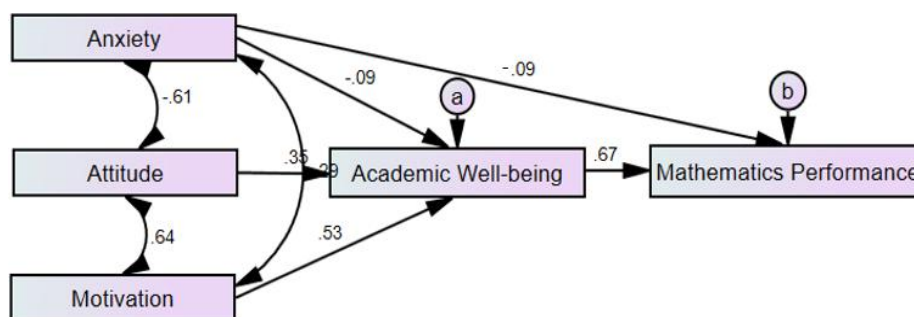


Figure 1. Best-fitting model indicating significant pathways

3.3. Path analysis of the exogenous variables’ direct, indirect, and mediated effects on the endogenous construct

Table 4 illustrates the decomposition of effects of the exogenous variables such as anxiety, attitude, motivation, and academic well-being on the endogenous variable, mathematics performance, as represented in the revised path model. This analysis distinguishes between direct effects, which represent the immediate influence of each variable on mathematics performance, and indirect effects, which operate through mediating constructs within the model. By examining both types of relationships, the study provides a clearer

understanding of how psychological factors interact to shape students' mathematical achievement. The results highlight the relative strength and direction of each variable's contribution, offering a comprehensive view of the underlying dynamics that drive academic performance in mathematics.

The model distinguishes among direct, indirect, and total effects to clarify how each psychological construct contributes to students' academic outcomes. Standardized beta coefficients (β) are used to express the magnitude and direction of influence, where positive coefficients signify a facilitating relationship and negative ones denote inhibitory effects [49]. Overall, the model underscores the interconnected nature of students' psychological states and academic outcomes, illustrating that well-being and motivation serve as crucial mediators between affective and cognitive dimensions of mathematics learning.

Table 4. Decomposition of effects between exogenous and endogenous constructs

Exogenous variables	Endogenous variable	Direct effect	Indirect effect	Total effect	p-value
Anxiety	Academic well-being	-0.092	0.000	-0.092	0.011
Attitudes	Academic well-being	0.347	0.000	0.347	0.000
Motivation	Academic well-being	0.529	0.000	0.529	0.000
Anxiety	Mathematics performance	-0.094	-0.062	-0.156	0.067
Attitudes	Mathematics performance	0.234	0.000	0.234	0.019
Motivation	Mathematics performance	0.357	0.000	0.357	0.033
Academic well-being	Mathematics performance	0.674	0.000	0.674	0.000

3.3.1. Direct effect of anxiety on academic well-being

Findings reveal that anxiety exerts a direct negative effect on academic well-being ($\beta=-0.092$). Elevated anxiety levels appear to undermine students' psychological wellness by increasing tension, self-doubt, and cognitive overload during learning. This finding suggests that high anxiety interferes with concentration and emotional regulation, reducing students' sense of satisfaction and engagement in academic life. Empirical studies consistently support this result. Liu *et al.* [50] and Wan *et al.* [51] noted that anxiety diminishes self-efficacy and emotional stability, leading to maladaptive coping and poor adjustment in school. Similarly, it emphasized that excessive academic anxiety erodes intrinsic motivation and self-belief, creating a cycle of stress and underperformance.

3.3.2. Direct effect of attitude on academic well-being

The results show that attitude has a positive direct effect on academic well-being ($\beta=0.347$). Students who maintain positive beliefs and feelings toward learning tend to experience greater fulfillment, persistence, and optimism in academic tasks. A favorable attitude not only nurtures enthusiasm for learning but also strengthens emotional balance and satisfaction [52]. Similarly, Klapp *et al.* [53] argued that students who view learning as a growth opportunity rather than a test of ability experience enhanced well-being and greater academic confidence. Campoamor-Olegario *et al.* [54] further noted that valuing education promotes a stronger sense of competence and purpose, reinforcing overall well-being.

3.3.3. Direct effect of motivation on academic well-being

Motivation demonstrates a strong positive direct effect on academic well-being ($\beta=0.529$). This implies that motivated students approach learning with greater purpose, perseverance, and enjoyment, leading to enhanced mental health and satisfaction. High motivation promotes a sense of achievement and meaning, which supports emotional stability in academic contexts. This result is well supported by self-determination theory, which posits that intrinsic motivation enhances both performance and psychological wellness. Similarly, Yang *et al.* [55] observed that motivated learners demonstrate better emotional regulation and resilience against academic stress, viewing challenges as opportunities for personal growth.

3.3.4. Direct and indirect effects of anxiety on mathematics performance

Anxiety exhibited both direct and indirect negative influences on students' mathematics performance. The indirect effect was recorded at $\beta=-0.062$, while the direct effect was slightly stronger at $\beta=-0.094$, yielding a total combined effect of -0.156 . This indicates that higher levels of anxiety are consistently associated with lower mathematics performance. This suggests that high anxiety not only impairs mathematical reasoning and focus but also undermines performance indirectly through reduced motivation and well-being. Numerous studies confirm that math anxiety disrupts working memory and problem-solving efficiency [56]. Zuo *et al.* [57] further argued that persistent anxiety redirects mental resources toward emotion regulation rather than cognitive processing, thereby lowering mathematical achievement.

3.3.5. Direct effect of attitude on mathematics performance

Attitude exerts a direct positive effect on mathematics performance ($\beta=0.234$), indicating that students with favorable perceptions of mathematics tend to perform better. A positive attitude enhances persistence, focus, and engagement, all of which contribute to improved problem-solving and achievement outcomes. This aligns with findings by Cagulada and Ucang [58], who demonstrated that students' positive dispositions toward mathematics predict both stronger academic persistence and higher test scores. Similarly, Macalisang and Bonghawan [59] noted that constructive classroom experiences and teacher encouragement amplify the positive relationship between attitude and achievement.

3.3.6. Direct effect of motivation on mathematics performance

Motivation shows a strong direct positive effect ($\beta=0.357$) on mathematics performance. Highly motivated students exert more effort, adopt effective learning strategies, and exhibit persistence even in challenging tasks. Motivation thus serves as both a cognitive and affective driver of success. Consistent with prior research, Piyakun and Phusee-Orn [60] found that intrinsic and mastery-oriented motivation significantly enhance mathematics achievement. It also highlighted that motivated learner tend to embrace a growth mindset, improving both persistence and cognitive engagement in learning mathematics.

3.3.7. Indirect effect of academic well-being on mathematics performance

Academic well-being demonstrates a strong indirect positive effect on mathematics performance ($\beta=0.674$). Students who report higher levels of well-being characterized by engagement, optimism, and emotional balance are more capable of maintaining focus and persistence in solving mathematical problems. Recent studies corroborate this result. Siebecke [61] found that academic well-being predicts both achievement and learning persistence. Pham [62] emphasized that emotionally healthy students exhibit higher self-regulation and fewer cognitive distractions, facilitating better academic outcomes. It is further noted that well-being fosters adaptive coping and sustained engagement, which are vital for mathematics success.

4. CONCLUSION

This study established that motivation, attitude toward mathematics, academic anxiety, and academic well-being collectively and significantly influence students' mathematics performance through both direct and indirect pathways. Addressing the research questions, the findings confirm that psychological variables are strong predictors of mathematics achievement, with motivation and academic well-being emerging as the most influential positive factors, while academic anxiety consistently exerts a negative effect on performance. Academic well-being functioned as a key mediating variable, linking students' emotional states and motivational orientations to their academic outcomes, as learners with higher well-being demonstrated greater concentration, persistence, and adaptive problem-solving behaviors. A positive attitude toward mathematics further enhanced engagement and enjoyment, whereas elevated anxiety disrupted emotional regulation and depleted cognitive resources necessary for effective mathematical reasoning. Collectively, these results reinforce theoretical models that conceptualize learning as a multidimensional process in which cognitive performance is deeply intertwined with motivation, affect, and psychological wellness.

From a practical standpoint, the findings underscore the need for teacher education institutions and schools to implement holistic, learner-centered instructional frameworks that move beyond traditional content-focused approaches. Integrating motivation-enhancing strategies, anxiety-reduction interventions, and well-being-oriented teaching practices such as mastery-oriented feedback, collaborative learning, reflective activities, and supportive classroom climates can meaningfully improve students' engagement and mathematics performance. At the same time, the study is subject to several limitations, including its cross-sectional design, reliance on self-reported measures, and the context-specific nature of the sample, which may limit causal inference and generalizability. Future research should therefore adopt longitudinal and experimental designs to examine causal mechanisms and long-term effects of targeted interventions, while also exploring how digital technologies, socio-emotional learning frameworks, and personalized learning environments can further strengthen academic well-being and reduce anxiety. By aligning theoretical insights with evidence-based practice, future studies can contribute to the development of resilient, motivated learners who approach mathematics with confidence, persistence, and sustained academic engagement.

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C : Conceptualization

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CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data in this study were obtained from West Visayas State University and are subject to access restrictions. These datasets were used under a licensed agreement and not publicly available. However, access to the data may be granted upon reasonable request and with the authorization of West Visayas State University via: <https://drive.google.com/drive/u/1/folders/1M3jKooHNPY4Ff0RwDV4ERzbp-pEq471t>.




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