International Journal of Evaluation and Research in Education (IJERE)
Vol. 15, No. 5, October 2026, pp. 4456~4466
ISSN: 2252-8822, DOI: 10.11591/ijere.v15i5.39782

Mathematics anxiety and self-efficacy in pre-service teachers: implications for intervention

Ysmael V. Caballas[1], Reynald M. Cacho[2]
[1]Research and Publication Unit, Office of the Director for Research, Extension, Quality Assurance and Development, Philippine Normal University South Luzon, Lopez, Philippines
[2]Faculty of Teacher Development, Philippine Normal University South Luzon, Lopez, Philippines

Article Info

Article history:

Received Apr 2, 2026
Revised Aug 26, 2026
Accepted Sep 7, 2026

Keywords:

Intervention program
Mathematics anxiety
Mathematics self-efficacy
Mixed methods
Pre-service teachers
Teacher education

ABSTRACT

This study examined the relationship between mathematics anxiety and self-efficacy among pre-service teachers at a Philippine college of education and generated evidence to inform institutional intervention design. Addressing the limited mixed-methods evidence in the local teacher education context, the study used a convergent parallel mixed-methods design. Quantitative data were collected from 131 first- and second-year pre-service teachers using validated measures of mathematics anxiety and self-efficacy, while qualitative data were gathered through an open-ended prompt on students' mathematics learning experiences. Findings showed moderate to high mathematics anxiety, particularly in test and individual performance situations, alongside generally high self-efficacy in collaborative and familiar contexts. Pearson's correlation revealed a significant moderate negative relationship between mathematics anxiety and self-efficacy ($r=-0.349$, $p=0.001$). Through joint interpretation of the quantitative and qualitative findings, the study showed that supportive relationships, enjoyment of mathematics, real-life relevance, passion for the subject, and strong foundations supported self-efficacy, whereas fear of failure, perceived difficulty, skill gaps, and negative past experiences heightened anxiety. The study contributes context-sensitive evidence on the integration of affective factors in Philippine teacher education and informed the development of the empowering anxiety support and yearnings in mathematics (EASY-MATH) program, a proposed intervention grounded in the identified emotional, academic, and social support needs of pre-service teachers.

Corresponding Author:

Reynald M. Cacho
Faculty of Teacher Development, Philippine Normal University South Luzon
Lopez, Quezon 4316, Philippines
Email: cacho.rm@pnu.edu.ph

1. INTRODUCTION

Mathematics is a fundamental discipline underlying academic fields and real-world applications [1]–[3]. Despite its importance, many students experience mathematics anxiety [4], [5], marked by unease, worry, and physiological arousal [5], which can impair understanding, test performance, science, technology, engineering, and mathematics (STEM) participation, and self-efficacy [6]. In teacher education, this concern is especially critical because pre-service teachers' mathematics-related experiences may influence not only their own learning but also their future instructional practices.

This study is anchored in Bandura's self-efficacy theory, which emphasizes that individuals' beliefs in their capabilities shape how they approach tasks, respond to challenges, and persist in the face of difficulty [7]. In mathematics, self-efficacy refers to confidence in understanding concepts, solving problems, and reasoning effectively. Higher self-efficacy has been associated with stronger performance, motivation, and persistence [8]. From this perspective, mathematics anxiety and self-efficacy are closely related: anxiety may weaken confidence and engagement, whereas stronger self-efficacy may help learners manage difficulty and persist in mathematics.

Mathematics anxiety among pre-service teachers is, therefore, a teacher education issue with possible intergenerational implications. When left unaddressed, such anxiety may shape future instructional practices and contribute to a cycle in which teacher anxiety affects students' confidence, attitudes, and achievement in mathematics [6]. Standard mathematics instruction may intensify this concern when it emphasizes content mastery and performance while giving limited attention to the affective domain, including anxiety, fear of failure, and low confidence. In teacher education, emotional confidence in mathematics is as important as subject knowledge in shaping readiness to teach.

In Philippine higher education, addressing mathematics anxiety and improving self-efficacy are especially important because of their implications for academic performance and STEM development [9]. Filipino students face difficulties in mathematics associated with prior experiences, attitudes, and language-related barriers [10]–[12]. The Philippine context, where mathematics is often experienced as a high-stakes subject shaped by assessment pressure, language demands, and institutional expectations, may further intensify anxiety and affect students' beliefs in their mathematical capability [9], [12].

Prior studies have established mathematics anxiety and self-efficacy as important affective factors in mathematics learning [8], [13], [14]. However, local studies in Philippine teacher education have given limited integrated attention to how these two constructs operate together among pre-service teachers and how their combined quantitative and qualitative patterns may inform institutional intervention design. This gap is significant because teacher education institutions need context-sensitive programs that address both the emotional and academic dimensions of mathematics learning.

The novelty of this study lies in its use of a convergent parallel mixed-methods design as an integrated diagnostic model for examining mathematics anxiety and self-efficacy among Philippine pre-service teachers [15]–[17]. Unlike studies that rely only on scale-based measurement or broad affective descriptions, this research merges statistical relationships with students' written accounts to identify specific emotional, academic, and social support needs. Its contribution is the generation of locally grounded evidence for the empowering anxiety support and yearnings in mathematics (EASY-MATH) intervention, linking empirical findings directly to a proposed institutional support program for teacher education.

The study aimed to answer the following research questions:

- What is the level of mathematics anxiety among pre-service teachers?
- What is the level of mathematics self-efficacy among pre-service teachers?
- Is there a significant relationship between mathematics anxiety and self-efficacy?
- What factors influence these constructs based on their learning experiences?
- How can the findings guide the development of the EASY-MATH intervention program?

These questions were designed to connect measurement, explanation, and institutional application. Together, they frame the study as both an affective diagnostic inquiry and an intervention-oriented contribution to teacher education.

2. METHOD

This study employed a sound methodological approach to meet the research objectives and to examine levels of mathematics anxiety and self-efficacy among college students. Selected methods aimed to be sensitive to both the empirical patterns and personal meaning structures associated with these factors. Using a combination of qualitative and quantitative research data, this study conducted a robust investigation into the prevalence, associated factors, and environmental context of mathematics anxiety and self-efficacy. Figure 1 shows the flow of the convergent parallel mixed-methods design, from recruitment and concurrent data collection to separate analyses, integration, and joint interpretation.

2.1. Research design

The design of this study was mixed-methods, in particular, a convergent parallel mixed-methods design. In this approach, data were gathered both quantitatively and qualitatively simultaneously, handled independently, and then combined to provide a broader perspective on the research issue [15], [16]. Statistical results were supported by qualitative findings and enriched by rich, context-specific open-ended responses [18]–[20]. This approach demonstrated the value of concurrently collecting, independently

analyzing, and then merging quantitative and qualitative data to provide a broader, more comprehensive perspective on the research problem [17]. In the present study, the quantitative and qualitative strands were conducted during the same data collection period, analyzed separately, and integrated during interpretation through side-by-side comparison of statistical results and thematic findings. This process allowed the researchers to identify areas of convergence, complementarity, and nuance across the two data sources.

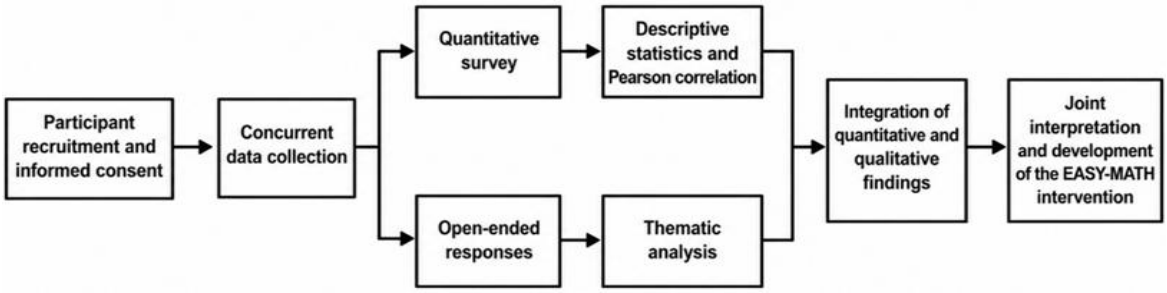

Figure 1. Flowchart of the convergent parallel mixed-methods design

2.2. Participants

The participants were 131 first- and second-year students from the bachelor of mathematics and science for elementary education (BMSEE) program, representing a 95.6% response rate of the 137 students enrolled in mathematics-based education programs. Purposive sampling selected students who: i) were taking mathematics courses and ii) volunteered to participate, ensuring they had relevant experiences [21]–[23]. Students were excluded if they were not first- or second-year BMSEE students, were not enrolled in mathematics-related coursework during the data collection period, did not provide informed consent, or submitted substantially incomplete responses. This aligns with recommendations for selecting information-rich cases in studies of specific educational phenomena [24]. The high response rate provided strong coverage of the target population and supported the sample's adequacy for analysis within this small teacher education institution. In addition, a priori power analysis using G*Power 3.1 indicated that n=131, assuming a medium effect size, would provide sufficient statistical power for a Pearson correlation analysis. This approach is consistent with recent guidance emphasizing that sample size decisions should consider research design, population size, statistical procedure, and power requirements [25]. Although purposive sampling was appropriate for selecting information-rich participants who were enrolled in mathematics-related coursework, this sampling approach limits the generalizability of the findings beyond the study context.

2.3. Data collection procedure

Participant eligibility and recruitment were established before data collection. Surveys were conducted online via Google Forms during the second semester of academic year 2024–2025 to ensure confidentiality, accessibility, and efficient data collection [26]–[31]. Before answering the questionnaire, participants were presented with an informed consent form explaining the study purpose, voluntary participation, confidentiality measures, anonymity, and their right to withdraw at any time without penalty. The 15–20-minute questionnaire included demographic information, the mathematics anxiety scale, the mathematics self-efficacy scale, and open-ended items on students' mathematics learning experiences. Only responses with completed consent were included in the analysis; responses with substantial missing data were excluded, while minor item nonresponse was handled through case screening before statistical analysis. The study received approval from the University Research Ethics Committee under REC Code 2025-025.

2.4. Demographic information

The first section of the survey collected background information such as age, gender, and prior mathematics performance to describe the study sample [24]. The aim of the study was limited to investigating mathematics anxiety and mathematical self-efficacy; therefore, demographic variables were used for context rather than in the main statistical analysis to ensure clarity in design and interpretation [32]. This information provided a descriptive profile of the participants while keeping the analytical focus on the primary affective constructs examined in the study.

2.5. Research instruments

A 7-item mathematics anxiety scale was adapted by the primary author to measure students' anxiety and was designed to be concise to increase completion rates. The scale was conceptually informed by the original mathematics anxiety rating scale and the abbreviated math anxiety scale, which remain foundational measures of mathematics anxiety [33], [34]. To address current psychometric developments, the adaptation was also guided by recent studies supporting the validity and reliability of brief mathematics anxiety measures across educational and cultural contexts [35], [36]. Validity was confirmed by three experts, with item-level validity index values ranging from 0.78 to 1.00, and a pilot test with 30 students showed high reliability (Cronbach's alpha=0.82) [37]. The use of brief, psychometrically sound instruments is supported by [35], [36], [38]. The adapted mathematics anxiety items were shortened and contextually reworded from existing instruments to fit the experiences of pre-service teachers and to reduce respondent burden. Items focused on common anxiety-provoking situations such as solving mathematics problems independently, participating in class, and taking examinations. Responses were scored on a 7-point Likert scale, with higher scores indicating higher mathematics anxiety.

The mathematics self-efficacy scale also included seven items assessing confidence in mathematics tasks and was designed to mirror the anxiety scale for comparability. The scale was informed by recent literature emphasizing the multidimensional, task-specific, and context-dependent nature of mathematics self-efficacy in learning contexts [39]–[41]. Validity was confirmed by three experts, with an item-level validity index of 0.78, and pilot testing showed strong reliability (Cronbach's alpha=0.86) [37]. The mathematics self-efficacy items were adapted to reflect students' perceived confidence in performing mathematics-related tasks in the classroom, problem-solving, and assessment contexts. The inclusion of self-efficacy items also recognizes that learners' beliefs about ability, challenge, and improvement may influence their persistence and confidence in academic tasks [42]. Responses were scored on a 7-point Likert scale, with higher scores indicating higher mathematics self-efficacy. While expert validation and pilot reliability testing supported content clarity and internal consistency, further construct validation through factor analysis was not conducted and should be considered in future studies.

The inclusion of an open-ended prompt enhanced the study's methodological rigor by enabling researchers to capture participants' lived experiences of mathematics anxiety and self-efficacy. Although quantitative scales were useful in determining levels and relationships, the qualitative responses offered richer insight into the personal meanings, contextual influences, and emotionally grounded experiences that standardized measures may overlook. To address this, an open-ended survey item invited participant to describe their experiences with mathematics anxiety or self-efficacy and to suggest possible forms of institutional support. Table 1 summarizes the research instruments used in the study, including the measured constructs, number of items, scale type, reliability coefficients, and supporting references.

Table 1. Study instruments and variables

Construct/variable	Instrument used	No. of items	Scale type	Reliability	References
Mathematics anxiety	Mathematics anxiety rating scale	7	7-point Likert	0.82	[36], [38]
Mathematics self-efficacy	Mathematics self-efficacy scale	7	7-point Likert	0.86	[40], [41]
Qualitative insights	Open-ended questions	2	Open-ended	N/A	Researcher-developed

2.6. Data analysis technique

This study used a convergent parallel mixed methods design, collecting quantitative and qualitative data independently but interpreting them jointly. Quantitative analyses measured the prevalence and relationships of mathematics anxiety and self-efficacy, while qualitative analyses provided deeper insight into students' experiences. Integrating both strands enabled the identification of patterns, the corroboration of findings, and richer conclusions.

2.7. Statistical analysis

Quantitative data were analyzed using IBM SPSS Statistics version 23. Descriptive statistics (frequencies, percentages, and means) were used to determine the prevalence and levels of mathematics anxiety and self-efficacy. Pearson's correlation was used to examine the relationship between the two continuous variables, assuming linearity and normality, with a two-tailed significance level of α=0.05. Before conducting Pearson's correlation, the assumptions of normality and linearity were checked through inspection of score distributions and scatterplot patterns. The data were found to be sufficiently appropriate for parametric correlation analysis. Correlation strengths were interpreted as small (r=0.10), medium (r=0.30), and large (r=0.50). A priori power analysis using G*Power 3.1 indicated that n=131 with a medium effect size (r=0.30) achieved a power≈of 0.92, confirming sufficient sample size. Although unmeasured

confounders (e.g., prior academic experiences, external stressors) could influence responses, standardized procedures and controlled data collection enhanced reliability.

2.8. Qualitative analysis

Qualitative data were also collected to offer a more holistic portrayal of the research problem using open-ended survey questions. The qualitative written responses were analyzed using thematic analysis to systematically identify, analyze, and report patterns within the data. The analysis followed contemporary guidance on thematic analysis, emphasizing familiarization with the data, generation of initial codes, theme development, review and refinement of themes, and coherent reporting of findings [43], [44]. The process involved: i) familiarizing with the responses by repeatedly reading them; ii) generating initial codes to capture key ideas; iii) grouping similar codes to identify overarching patterns; and iv) reviewing and refining these patterns into final themes, which were interpreted in relation to the quantitative findings to provide a richer understanding of participants' experiences. To enhance qualitative rigor, coding decisions were documented throughout the analysis process to provide an audit trail. Representative participant responses were also used in the interpretation phase to illustrate key themes. Although formal inter-coder agreement was not conducted, themes were reviewed carefully and iteratively in relation to the raw responses to improve consistency and interpretive trustworthiness.

3. RESULTS

3.1. Mathematics anxiety among pre-service teachers

Descriptive results showed that moderate to high mathematics anxiety was common among the pre-service teachers. As shown in Figure 2, participants reported mathematics anxiety in areas such as self-doubt, performance anxiety, intense worry, and avoidance. The highest anxiety indicators were observed in performance-related and test-related mathematics situations.

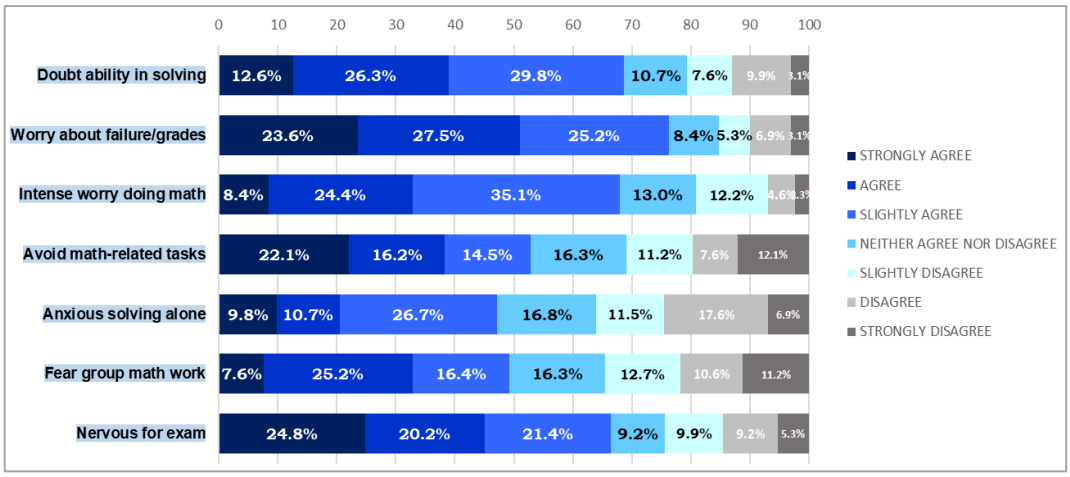

Figure 2. Prevalence of mathematics anxiety

3.2. Mathematics self-efficacy among pre-service teachers

Descriptive results showed that participants generally reported high mathematics self-efficacy in collaborative and familiar learning contexts. As shown in Figure 3, higher confidence was observed in group work, mastering concepts, solving complex problems, and engaging in challenging tasks. However, comparatively lower confidence was noted in independent problem-solving and examination contexts.

3.3. Relationship between mathematics anxiety and self-efficacy

Pearson's correlation analysis was conducted to determine the relationship between mathematics anxiety and mathematics self-efficacy. Table 2 presents the Pearson correlation result between the two variables, including the correlation coefficient and significance level. The result showed a statistically significant moderate negative correlation between mathematics anxiety and self-efficacy, r=-0.349, p=0.001, indicating that higher mathematics anxiety was associated with lower mathematics self-efficacy.

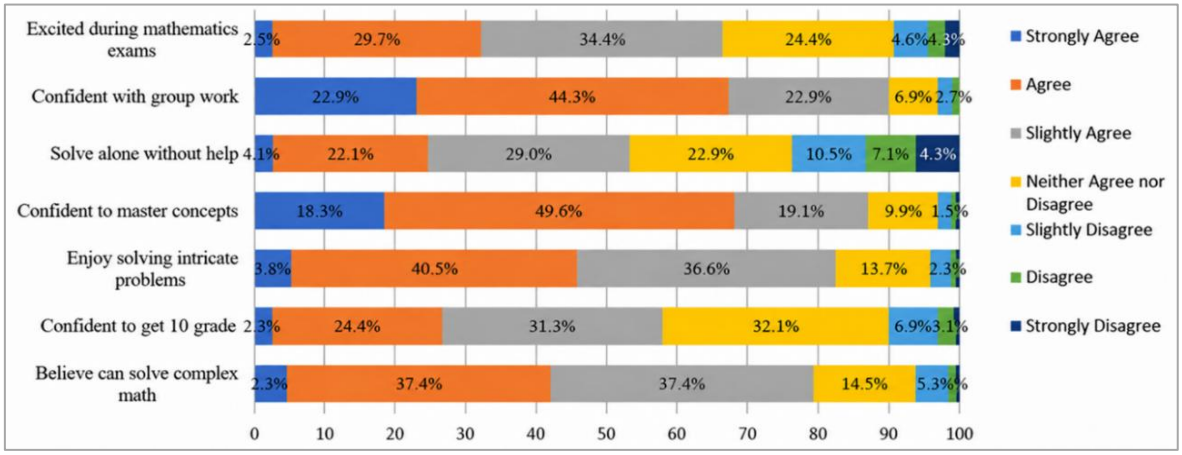

Figure 3. Level of mathematics self-efficacy

Table 2. Relationship between mathematics anxiety and mathematics self-efficacy

Research variables	Pearson correlation	Significance
Mathematics anxiety Mathematics self-efficacy	-0.349	Significant at the 0.05 level (2-tailed)

Note: Correlation is significant at the 0.05 level (2-tailed).

3.4. Qualitative themes on mathematics anxiety and self-efficacy

Thematic analysis identified several factors influencing mathematics anxiety and self-efficacy. Self-efficacy was supported by enjoyment of mathematics, teacher support, peer collaboration, strong foundational skills, and real-life applications. Mathematics anxiety was associated with fear of failure, performance pressure, perceived difficulty, negative past experiences, and skill gaps.

3.5. Integration of quantitative and qualitative findings

The quantitative and qualitative findings showed convergence in explaining the relationship between mathematics anxiety and self-efficacy. The negative correlation was supported by participants' written responses, which showed that fear of failure, perceived difficulty, and skill gaps heightened anxiety, while enjoyment, supportive relationships, and strong foundations strengthened confidence. A nuanced pattern also emerged, as some participants reported confidence in collaborative contexts while still experiencing anxiety in tests and independent performance situations.

4. DISCUSSION

4.1. Mathematics anxiety among pre-service teachers

The findings indicate that mathematics anxiety remains a significant affective concern among pre-service teachers, particularly in performance-based and evaluative mathematics situations. This pattern suggests that anxiety may reduce confidence and engagement, especially when learners are required to solve problems independently, participate publicly, or perform under assessment pressure. Such findings are consistent with previous studies showing that mathematics anxiety is associated with worry, avoidance, reduced confidence, and lower engagement in mathematics learning [13], [14], [45], [46].

The anxiety pattern also supports local findings that mathematics anxiety is experienced by Filipino learners and may affect their confidence and participation in mathematics-related tasks [47]. In the context of teacher education, this concern is especially important because pre-service teachers' anxiety may influence not only their own learning but also their future classroom practices [6]. If mathematics anxiety remains unaddressed, it may contribute to a cycle in which future teachers unintentionally transmit negative attitudes or low confidence in mathematics to their learners [6], [11], [16].

4.2. Mathematics self-efficacy among pre-service teachers

The findings also show that pre-service teachers generally demonstrated stronger self-efficacy in collaborative and familiar learning situations. This suggests that students may feel more capable when they receive peer support, work with classmates, or engage in tasks where the learning environment feels less threatening. This pattern is consistent with views of mathematics self-efficacy as task-specific and context-dependent rather than fixed across all mathematical situations [39]–[41].

However, lower confidence in independent and examination-related contexts suggests that self-efficacy may weaken when students face solitary problem-solving or evaluative pressure. This supports the idea that learners' beliefs about their ability, challenge, and improvement influence their persistence and confidence in academic tasks [42], [48]. The presence of confidence gaps in specific contexts also underscores the need for targeted support to strengthen students' independent problem-solving skills and emotional readiness during assessments [49].

4.3. Relationship between mathematics anxiety and self-efficacy

The significant inverse relationship between mathematics anxiety and self-efficacy indicates that students who experience higher mathematics anxiety tend to report lower confidence in their mathematical capability. This relationship supports previous research showing that anxiety can negatively affect self-confidence, engagement, and mathematics performance [50], [51]. Although the relationship was moderate, it provides meaningful evidence that affective factors should be addressed alongside content knowledge in teacher education.

This finding also aligns with the broader literature showing that mathematics anxiety and mathematics performance are closely connected, and that anxiety may interfere with learners' confidence and persistence [14], [16]. In this study, the relationship between anxiety and self-efficacy strengthens the argument that mathematics learning support should not focus only on remediation or skills practice. It should also include emotional, motivational, and confidence-building strategies that help pre-service teachers engage more positively with mathematics [52], [53].

4.4. Qualitative and integrated findings

The qualitative findings help explain the quantitative pattern by identifying the personal, academic, and contextual factors associated with mathematics anxiety and self-efficacy. Thematic analysis showed that self-efficacy was supported by enjoyment, teacher support, peer collaboration, strong foundational skills, and real-life applications, while anxiety was associated with fear of failure, performance pressure, perceived difficulty, negative experiences, and skill gaps [54]. These themes provide contextual explanations for why some students may feel capable in collaborative settings but still experience anxiety in independent or test-based situations.

These integrated findings align with Bandura's theory of self-efficacy, particularly the four sources of efficacy beliefs: mastery experiences, vicarious learning, verbal persuasion, and physiological or emotional states [7]. Supportive relationships and peer collaboration may strengthen self-efficacy through verbal persuasion and vicarious learning, while strong foundations may function as mastery experiences. At the same time, fear of failure and negative emotional states may intensify anxiety and weaken confidence, reinforcing the need for multidimensional support that addresses both cognitive and affective aspects of mathematics learning [7], [8], [14], [55].

4.5. Implications for the EASY-MATH program

The findings suggest that mathematics anxiety and self-efficacy should be addressed through an intervention that combines emotional, academic, and social support. Since anxiety was linked with fear of failure, performance pressure, perceived difficulty, and skill gaps, support mechanisms should go beyond content remediation and include confidence-building, scaffolded practice, and supportive feedback. These implications provide the basis for the EASY-MATH program, which is presented in section 4.7 as the proposed institutional intervention framework [7], [52], [53], [56].

4.6. Cultural and educational context

These findings should be interpreted within the Philippine educational context, where mathematics is often viewed as a high-stakes subject shaped by examination pressure, language demands, and strong social expectations. The use of English in mathematics instruction and assessment may intensify difficulty for some learners, while collectivist norms may help explain why confidence appears stronger in collaborative settings than in solitary or evaluative tasks. This interpretation is supported by local evidence showing that learners' academic struggles may be influenced not only by subject difficulty but also by English-language demands, confidence challenges, prior frustrations, study habits, and the need for peer- and teacher-supported remediation [57]. This context helps explain the coexistence of relatively high self-efficacy in group work and persistent anxiety in test situations. Teacher-centered instruction may discourage students from admitting misunderstanding, while strong peer orientation may support confidence in collaborative learning conditions. Addressing mathematics anxiety during teacher preparation is therefore important because pre-service teachers' confidence and competence may influence their future mathematics instruction, students' engagement, and broader readiness for STEM-related learning pathways.

4.7. Institutional intervention: the EASY-MATH program

To answer the fifth research question, the integrated quantitative and qualitative findings were used to guide the design of the EASY-MATH intervention program. The program "EASY-MATH" is a proposed multicomponent intervention aimed at reducing mathematics anxiety and strengthening self-efficacy among pre-service teachers. It responds to the identified emotional, academic, and social support needs of students, particularly those related to fear of failure, performance pressure, skill gaps, and the need for supportive learning environments.

Table 3 presents the structured framework of the EASY-MATH program, including its major components, proposed activities, and expected outcomes. The components include seminars and workshops, peer-led math club activities, collaborative learning, real-life mathematics integration, and teacher support strategies. Technology-supported learning may further enhance these support activities in teacher education [58]. These components were aligned with the study findings to ensure that the proposed intervention addresses both affective and academic dimensions of mathematics learning.

Table 3. Structured framework of the EASY-MATH program

Component	Activities	Expected Outcomes
Seminars and workshops	Cognitive-behavioral training	Reduced anxiety, improved mindset
Peer-led math club	Review sessions, group discussions, shared resources	Sense of community, shared strategies, higher engagement
Collaborative learning	Problem solving in groups	Boosted math self-efficacy, peer modeling
Real-life math integration	Real-world problem solving	Increased motivation, applied learning
Teacher support strategies	Inclusive language, non-threatening assessments	Improved classroom climate, student trust

The EASY-MATH program is theoretically grounded in Bandura's sources of self-efficacy [7]. Scaffolded problem-solving and formative assessment may strengthen mastery experiences, peer-led activities may promote vicarious learning, supportive feedback may reinforce verbal persuasion, and cognitive-behavioral strategies may address emotional states associated with mathematics anxiety. This theoretical alignment supports the relevance of EASY-MATH as an institutional intervention for improving confidence and reducing anxiety in mathematics learning.

The novelty of EASY-MATH lies in its integrated and context-sensitive design, which addresses emotional, social, and academic aspects of mathematics learning beyond traditional remediation. This is consistent with evidence supporting multi-component approaches for reducing mathematics anxiety and improving mathematics-related confidence [52], [53], [56]. Future research should pilot the program across campuses to examine its implementation, scalability, adaptability, and long-term effects on mathematics anxiety and self-efficacy among pre-service teachers. For such scaling to be feasible, EASY-MATH may also require institutional knowledge-sharing mechanisms among faculty, program leaders, and support units, since universities depend on effective knowledge flows to innovate practices and respond to emerging educational needs.

5. CONCLUSION

This study examined mathematics anxiety and self-efficacy among pre-service teachers and used the findings to inform the development of the EASY-MATH intervention program. The results showed that participants experienced moderate to high mathematics anxiety, particularly in evaluative and independent performance situations, while also reporting generally high self-efficacy in collaborative and familiar learning contexts. Pearson's correlation analysis revealed a significant moderate negative relationship between mathematics anxiety and self-efficacy, indicating that higher anxiety was associated with lower confidence in mathematics. Qualitative findings further showed that self-efficacy was supported by enjoyment, teacher support, peer collaboration, strong foundations, and real-life relevance, whereas anxiety was influenced by fear of failure, perceived difficulty, skill gaps, and negative past experiences.

These findings support the need for teacher education institutions to address both the emotional and academic dimensions of mathematics learning through structured interventions such as EASY-MATH. The study is limited by its single-institution setting, purposive sampling, and reliance on self-reported data; therefore, future research may include longitudinal, multi-institutional, and intervention-based studies to examine the program's effectiveness and scalability. Overall, the main contribution of this study is the generation of context-specific mixed-methods evidence that links mathematics anxiety and self-efficacy among Philippine pre-service teachers to a proposed institutional intervention program.

FUNDING INFORMATION

The authors declare that no financial support, grant, or funding was received for the conduct of this study, authorship, and/or publication of this article. All stages of the research were conducted without external financial sponsorship.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Ysmael V. Caballas	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Reynald M. Cacho		✓				✓		✓	✓	✓	✓	✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest. No personal, financial, or professional relationships influenced the conduct of the study. The authors affirm that the research process, analysis, and reporting of findings were carried out with objectivity and transparency.

ETHICAL APPROVAL

Ethical approval for this study was granted by the Philippine Normal University Research Ethics Committee under REC Code 2025-025 (issued May 7, 2025). Informed consent was secured from all participants before data collection. Participation was voluntary, participants could withdraw at any time without penalty, and confidentiality and anonymity were maintained throughout the study.

DATA AVAILABILITY

The data supporting the findings of this study are not publicly available in order to protect the privacy and confidentiality of the participants. However, anonymized data may be made available by the corresponding author upon reasonable request and with appropriate ethical consideration. This restriction is consistent with the ethical approval conditions and informed consent procedures implemented in the study.

REFERENCES

[1] J. Just and H.-S. Siller, "The role of mathematics in STEM secondary classrooms: a systematic literature review," *Education Sciences*, vol. 12, no. 9, p. 629, Sep. 2022, doi: 10.3390/educsci12090629.
[2] O. Fitzmaurice, N. O'Meara, and P. Johnson, "Highlighting the relevance of mathematics to secondary school students–why and how," *European Journal of STEM Education*, vol. 6, no. 1, p. 7, May 2021, doi: 10.20897/ejsteme/10895.
[3] T. Kaur, E. McLoughlin, and P. Grimes, "Mathematics and science across the transition from primary to secondary school: a systematic literature review," *International Journal of STEM Education*, vol. 9, no. 1, p. 13, Dec. 2022, doi: 10.1186/s40594-022-00328-0.
[4] D. Rozgonjuk, T. Kraav, K. Mikkor, K. Orav-Puurand, and K. Täht, "Mathematics anxiety among STEM and social sciences students: the roles of mathematics self-efficacy, and deep and surface approach to learning," *International Journal of STEM Education*, vol. 7, no. 1, p. 46, Dec. 2020, doi: 10.1186/s40594-020-00246-z.
[5] S. Luttenberger, S. Wimmer, and M. Paechter, "Spotlight on math anxiety," *Psychology Research and Behavior Management*, vol. 11, pp. 311–322, Aug. 2018, doi: 10.2147/PRBM.S141421.
[6] S. L. Beilock, E. A. Gunderson, G. Ramirez, and S. C. Levine, "Female teachers' math anxiety affects girls' math achievement," in *Proceedings of the National Academy of Sciences*, Feb. 2010, pp. 1860–1863, doi: 10.1073/pnas.0910967107.
[7] A. Bandura, *Self-efficacy: the exercise of control*. New York, NY: W. H. Freeman, 1997.
[8] C. Wang, Q. Xu, and W. Fei, "The effect of student-perceived teacher support on math anxiety: chain mediation of teacher–student relationship and math self-efficacy," *Frontiers in Psychology*, vol. 15, p. 1333012, Apr. 2024, doi: 10.3389/fpsyg.2024.1333012.
[9] Commission on Higher Education, *Policies, Standards and Guidelines (PSGs) for the Bachelor of Science in Mathematics (BS Math) and Bachelor of Science in Applied Mathematics (BS Applied Math) Programs*, CHED Memorandum Order No. 48,

Series of 2017. Accessed: Apr. 24, 2026. [Online]. Available: https://www.mathsociety.ph/images/pdf/2016/cmo48s2016-bs-appliedmath.pdf
[10] R. A. Mangarin and D. O. Caballes, "Difficulties in learning mathematics: a systematic review," *International Journal of Research and Scientific Innovation*, vol. 11, no. 9, pp. 401–405, 2024, doi: 10.51244/IJRSI.2024.1109037.
[11] E. Ampadu and D. Anokye-Poku, "Influence of personal, motivational and learning environment factors on students' attitudes toward mathematic," *International Journal of Research in Education and Science*, vol. 8, no. 2, pp. 378–392, May 2022, doi: 10.46328/ijres.2666.
[12] R. Cacho, S. A. Lladonez, R. Villenes, M. R. Macabuhay, and C. N. Valerio, "Influence of English and Filipino as assessment languages in word-problem performance," *OKARA: Jurnal Bahasa dan Sastra*, vol. 18, no. 1, pp. 54–70, May 2024, doi: 10.19105/ojbs.v18i1.12715.
[13] L. A. Mamolo, "Online learning and students' mathematics motivation, self-efficacy, and anxiety in the 'new normal,'" *Education Research International*, vol. 2022, pp. 1–10, Jan. 2022, doi: 10.1155/2022/9439634.
[14] J. M. Namkung, P. Peng, and X. Lin, "The relation between mathematics anxiety and mathematics performance among school-aged students: a meta-analysis," *Review of Educational Research*, vol. 89, no. 3, pp. 459–496, Jun. 2019, doi: 10.3102/0034654319843494.
[15] J. Schoonenboom and R. B. Johnson, "How to construct a mixed methods research design," *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, vol. 69, no. S2, pp. 107–131, Oct. 2017, doi: 10.1007/s11577-017-0454-1.
[16] J. Zhang, N. Zhao, and Q. P. Kong, "The relationship between math anxiety and math performance: a meta-analytic investigation," *Frontiers in Psychology*, vol. 10, p. 1613, Aug. 2019, doi: 10.3389/fpsyg.2019.01613.
[17] U. Östlund, L. Kidd, Y. Wengström, and N. Rowa-Dewar, "Combining qualitative and quantitative research within mixed method research designs: a methodological review," *International Journal of Nursing Studies*, vol. 48, no. 3, pp. 369–383, Mar. 2011, doi: 10.1016/j.ijnurstu.2010.10.005.
[18] S. Lundell, M. Tistad, B. Rehn, M. Wiklund, Å. Holmner, and K. Wadell, "Building COPD care on shaky ground: a mixed methods study from Swedish primary care professional perspective," *BMC Health Services Research*, vol. 17, no. 1, p. 467, Dec. 2017, doi: 10.1186/s12913-017-2393-y.
[19] R. Argent, P. Slevin, A. Bevilacqua, M. Neligan, A. Daly, and B. Caulfield, "Wearable sensor-based exercise biofeedback for orthopaedic rehabilitation: a mixed methods user evaluation of a prototype system," *Sensors*, vol. 19, no. 2, p. 432, Jan. 2019, doi: 10.3390/s19020432.
[20] E. N. Forde, L. Robinson, J. A. Ellis, and E. A. Dare, "Investigating the presence of mathematics and the levels of cognitively demanding mathematical tasks in integrated STEM units," *Disciplinary and Interdisciplinary Science Education Research*, vol. 5, no. 1, p. 3, Feb. 2023, doi: 10.1186/s43031-022-00070-1.
[21] A. K. Dhillon, H. L. Hattingh, A. Stafford, and K. Hoti, "General practitioners' perceptions on home medicines reviews: a qualitative analysis," *BMC Family Practice*, vol. 16, no. 1, p. 16, Dec. 2015, doi: 10.1186/s12875-015-0227-8.
[22] S. S. Najeeb and L. S. George, "Experiences and challenges faced by the working population during COVID-19 lockdown: a qualitative study," *Journal of Family Medicine and Primary Care*, vol. 11, no. 2, pp. 660–666, Feb. 2022, doi: 10.4103/jfmpc.jfmpc_1483_21.
[23] E. Darkwah, F. Annor, S. Oppong, and S. Hagan, "Exploring work-related experiences of newly hired hospital nurses in Ghana: a qualitative study," *SAGE Open Nursing*, vol. 10, pp. 1–13, Jan. 2024, doi: 10.1177/23779608241279911.
[24] J. W. Creswell and V. L. P. Clark, *Designing and conducting mixed methods research*, 3rd ed. Thousand Oaks, CA: SAGE Publications, Inc., 2018.
[25] S. K. Ahmed, "How to choose a sampling technique and determine sample size for research: a simplified guide for researchers," *Oral Oncology Reports*, vol. 12, p. 100662, Dec. 2024, doi: 10.1016/j.oor.2024.100662.
[26] T. Ermakova, B. Fabian, and R. Zarnekow, "Improving individual acceptance of health clouds through confidentiality assurance," *Applied Clinical Informatics*, vol. 7, no. 4, pp. 983–993, Oct. 2016, doi: 10.4338/ACI-2016-07-RA-0107.
[27] T. Gnambs and K. Kaspar, "Disclosure of sensitive behaviors across self-administered survey modes: a meta-analysis," *Behavior Research Methods*, vol. 47, no. 4, pp. 1237–1259, Dec. 2015, doi: 10.3758/s13428-014-0533-4.
[28] R. M. Hendricks-Sturrup, F. Zhang, and C. Y. Lu, "A survey of research participants' privacy-related experiences and willingness to share real-world data with researchers," *Journal of Personalized Medicine*, vol. 12, no. 11, p. 1922, Nov. 2022, doi: 10.3390/jpm12111922.
[29] K. Lavidas *et al.*, "Factors affecting response rates of the web survey with teachers," *Computers*, vol. 11, no. 9, p. 127, Aug. 2022, doi: 10.3390/computers11090127.
[30] V. Menon and A. Muraleedharan, "Internet-based surveys: relevance, methodological considerations and troubleshooting strategies," *General Psychiatry*, vol. 33, no. 5, p. e100264, Oct. 2020, doi: 10.1136/gpsych-2020-100264.
[31] P. R. Regmi, E. Waithaka, A. Paudyal, P. Simkhada, and E. van Teijlingen, "Guide to the design and application of online questionnaire surveys," *Nepal Journal of Epidemiology*, vol. 6, no. 4, pp. 640–644, May 2017, doi: 10.3126/nje.v6i4.17258.
[32] F. Kaliyadan and V. Kulkarni, "Types of variables, descriptive statistics, and sample size," *Indian Dermatology Online Journal*, vol. 10, no. 1, pp. 82–86, 2019, doi: 10.4103/idoj.IDOJ_468_18.
[33] D. R. Hopko, R. Mahadevan, R. L. Bare, and M. K. Hunt, "The abbreviated math anxiety scale (AMAS)," *Assessment*, vol. 10, no. 2, pp. 178–182, Jun. 2003, doi: 10.1177/1073191103010002008.
[34] F. C. Richardson and R. M. Suinn, "The mathematics anxiety rating scale: psychometric data," *Journal of Counseling Psychology*, vol. 19, no. 6, pp. 551–554, Nov. 1972, doi: 10.1037/h0033456.
[35] S. Malykh *et al.*, "Psychometric evaluation of the abbreviated math anxiety scale in Russian university students," *Frontiers in Education*, vol. 10, p. 1669267, Oct. 2025, doi: 10.3389/feduc.2025.1669267.
[36] M. I. Núñez-Peña and G. Guilera, "Development and validation of the brief math anxiety scale (BMAS) in university students," *Psicothema*, vol. 35, no. 4, pp. 406–413, Sep. 2023, doi: 10.7334/psicothema2022.434.
[37] M. Tavakol and R. Dennick, "Making sense of Cronbach's alpha," *International Journal of Medical Education*, vol. 2, pp. 53–55, Jun. 2011, doi: 10.5116/ijme.4dfb.8dfd.
[38] S. Caviola, C. Primi, F. Chiesi, and I. C. Mammarella, "Psychometric properties of the abbreviated math anxiety scale (AMAS) in Italian primary school children," *Learning and Individual Differences*, vol. 55, pp. 174–182, Apr. 2017, doi: 10.1016/j.lindif.2017.03.006.
[39] Y. Shimizu, "Relation between mathematics self-efficacy, mathematics anxiety, behavioural engagement, and mathematics achievement in Japan," *Psychology International*, vol. 7, no. 2, p. 36, Apr. 2025, doi: 10.3390/psycholint7020036.
[40] W. Yu, S. Zhou, and Y. Zhou, "Measuring mathematics self-efficacy: multitrait-multimethod comparison," *Frontiers in Psychology*, vol. 14, p. 1108536, Mar. 2023, doi: 10.3389/fpsyg.2023.1108536.

[41] K. E. S. Street, L.-E. Malmberg, and S. Schukajlow, "Students' mathematics self-efficacy: a scoping review," *ZDM – Mathematics Education*, vol. 56, no. 2, pp. 265–280, May 2024, doi: 10.1007/s11858-024-01548-0.
[42] C. S. Dweck, *Mindset: the new psychology of success*. New York, NY: Ballantine Books, 2016.
[43] V. Braun and V. Clarke, "Toward good practice in thematic analysis: avoiding common problems and be(com)ing a knowing researcher," *International Journal of Transgender Health*, vol. 24, no. 1, pp. 1–6, Jan. 2023, doi: 10.1080/26895269.2022.2129597.
[44] D. Byrne, "A worked example of Braun and Clarke's approach to reflexive thematic analysis," *Quality & Quantity*, vol. 56, no. 3, pp. 1391–1412, Jun. 2022, doi: 10.1007/s11135-021-01182-y.
[45] J. C. Cullano, "Factors influencing mathematics anxiety and mathematics performance: a scoping review towards learning optimization directives," *International Journal of Research and Innovation in Social Science*, vol. 8, no. 3S, pp. 4544–4573, 2024, doi: 10.47772/IJRISS.2024.803332S.
[46] P. J. B. Ongcoy, D. R. A. Jasmin, I. P. Guiamal, S. S. Guinita, and A. M. M. Iligan, "Experiences and mathematics anxiety of STEM students," *Journal of Mathematics and Science Teacher*, vol. 3, no. 1, p. em028, Jan. 2023, doi: 10.29333/mathsciteacher/12870.
[47] J. D. Ablian and K. B. Parangat, "Mathematics anxiety and mathematics self efficacy among senior high school students in public secondary schools," *International Journal of Computer Engineering in Research Trends*, vol. 9, no. 2, pp. 21–33, Feb. 2022, doi: 10.22362/ijcert/2022/v9/i02/v9i0201.
[48] J. Boaler, *Mathematical mindsets: unleashing students' potential through creative math, inspiring messages, and innovative teaching*. San Francisco, CA: Jossey-Bass, 2016.
[49] R. Pekrun *et al.*, "A three-dimensional taxonomy of achievement emotions," *Journal of Personality and Social Psychology*, vol. 124, no. 1, pp. 145–178, Jan. 2023, doi: 10.1037/pspp0000448.
[50] N. Süren and M. A. Kandemir, "The effects of mathematics anxiety and motivation on students' mathematics achievement," *International Journal of Education in Mathematics, Science and Technology*, vol. 8, no. 3, pp. 190–218, May 2020, doi: 10.46328/ijemst.v8i3.926.
[51] S. Guo and S. Liao, "The role of opportunity to learn on student mathematics anxiety, problem-solving performance, and mathematics performance," *Frontiers in Psychology*, vol. 13, p. 829032, Feb. 2022, doi: 10.3389/fpsyg.2022.829032.
[52] M. Shafiq, S. Ajmal, and R. Amin, "Effectiveness of cognitive behavioral group therapy in reducing math anxiety in adolescents," *Clinical and Counselling Psychology Review*, vol. 2, no. 2, pp. 38–49, Apr. 2021, doi: 10.32350/ccpr.22.04.
[53] R. E. Simamora, S. Saragih, and H. Hasratuddin, "Improving students' mathematical problem solving ability and self-efficacy through guided discovery learning in local culture context," *International Electronic Journal of Mathematics Education*, vol. 14, no. 1, pp. 61–72, 2019, doi: 10.12973/iejme/3966.
[54] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.
[55] A. Garba, N. Ismail, S. Osman, and M. R. M. Rameli, "Exploring peer effect on mathematics anxiety among secondary school students of Sokoto State, Nigeria through photovoice approach," *EURASIA Journal of Mathematics, Science and Technology Education*, vol. 16, no. 2, p. em1815, Oct. 2019, doi: 10.29333/ejmste/112622.
[56] M. Balt, M. Börnert-Ringleb, and L. Orbach, "Reducing math anxiety in school children: a systematic review of intervention research," *Frontiers in Education*, vol. 7, p. 798516, Feb. 2022, doi: 10.3389/feduc.2022.798516.
[57] R. M. Cacho, "It's not just English, it's complicated: approaching at-risk college students' academic language remediation," *International Journal of Research Studies in Language Learning*, vol. 4, no. 5, pp. 19–28, Mar. 2015, doi: 10.5861/ijrsll.2015.1247.
[58] R. M. Cacho, "Exploring the potentials and essentials of mobile-aided pedagogy in teacher education," *The Normal Lights*, vol. 11, no. 1, pp. 1–17, Jun. 2017, doi: 10.56278/tnl.v11i1.370.

BIOGRAPHIES OF AUTHORS

Ysmael V. Caballas is an assistant professor II at Philippine Normal University South Luzon and currently serves as head of the Research and Publication Unit. He is a mathematics educator with professional experience spanning basic education, higher education, and academic leadership. His research interests include mathematics education, pedagogy, and gender and development. He can be contacted at email: caballas.yv@pnu.edu.ph.

Reynald M. Cacho is a professor of Educational Management at the Faculty of Teacher Development of Philippine Normal University South Luzon. He is concurrently the Strategic Foresight Analyst at the Knowledge Management and Strategic Foresight Office, Philippine Normal University Manila. His research interests include generative AI in education, innovation and knowledge management, language and literacy, TPACK, graduate employability, and teacher education. He can be contacted at email: cacho.rm@pnu.edu.ph.