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Interplay between Mathematics Attitudes and Achievement of Non-Mathematics Major Teacher Education Students in Leyte, Philippines

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Abstract

The study of attitudes toward mathematics has become a significant concern for scholars across various cultural contexts and educational settings. While further research is needed on teacher education students who do not specialize in mathematics, understanding their attitudes is crucial, as it may significantly influence their success in the subject. This study examined the attitudes toward mathematics among non-mathematics major teacher education students, focusing on enjoyment, motivation, self-confidence, perceived value, and mathematics achievement. This study was conducted at a government-run higher education institution in Leyte, the Philippines. Utilizing a quantitative approach, this study employed surveys as the primary tool, following descriptive and correlational designs. The study involved 244 students selected through stratified random sampling, followed by a simple random sampling technique. Adopted Attitudes toward Mathematics Inventory (ATMI) and secondary data on students' mathematics achievement were used to analyse the associations between the study variables. The results revealed that while students generally exhibited slightly favourable attitudes regarding enjoyment and motivation in mathematics, their self-confidence was notably low. Despite this, they recognized the subject's value and demonstrated a generally good level of mathematical achievement. The result of the analyses also indicated significant yet weak positive associations between enjoyment [r_s=0.245, p<.001], motivation [r_s=0.214, p<.001], and value [r_s=0.164, p=.010] with mathematics achievement, while self-confidence was not significantly related to mathematics outcomes [r_s=-0.088, p=.173]. These weak associations suggest that other factors beyond attitude play a more significant role in shaping students' mathematics achievement, necessitating further exploration to confirm the results.

Keywords: Enjoyment, Mathematics Achievement, Mathematics Attitudes, Motivation, Self-Confidence, Value.

Introduction

Mathematics constitutes a fundamental component of the teacher education curriculum, particularly for students undertaking studies in various disciplines, regardless of whether or not they are majoring in mathematics. It assists students in enhancing their critical thinking skills and problem-solving abilities, which may be applied in several scientific fields (1). However, many students often perceive mathematics as a challenging and daunting subject. One study also noted that students, especially those not majoring in mathematics, view the subject as tedious, which decreases their motivation and engagement (2). In the same way, non-mathematics teacher education students found it challenging to understand the relevance of required mathematics courses to their fields of interest or expertise (3). As a result, their negative perceptions and lack of motivation may lead to lower confidence and achievement in mathematics, further reinforcing their apprehension toward the subject (4-6). In a particular teacher education school in the Philippines, it was observed that non-mathematics majors often view mathematics as complex, which contributes to increased stress during their studies. More specifically, when the terms "Algebra", "Calculus", "Geometry", "Trigonometry" , or "Mathematics" in general are mentioned, many students find these areas to be challenging or demanding. Consequently, gaining insights into students' perceptions of mathematics is essential, as it can significantly influence their engagement,

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motivation, and mathematics achievement. Several studies reported that students' attitudes toward mathematics impact their ability to solve mathematical problems (7-9). Nonetheless, as students advance in their education, their attitudes toward mathematics often become more unfavorable, leading to a decline in their overall enjoyment of the subject (10-12). This shift in attitude may impede students' willingness to engage with the complexities of mathematics, subsequently affecting their academic outcomes. Furthermore, previous studies have demonstrated that students' attitudes toward mathematics significantly influence their scholastic performance (13-16). Identifying these attitudes early is essential to mitigating the development of negative perceptions that may hinder learning outcomes. Studies conducted across diverse educational settings have examined the factors shaping students' perspectives on mathematics, highlighting the role of course level, instructor quality, and resource availability in shaping attitudes (17-20). Additionally, unresolved attitudinal challenges, low motivation levels, socio-emotional factors, and external influences contribute to undesirable perceptions of mathematics among students and affect their attitudes toward the subject (21-22).

Recent international research also supports the urgent need to understand the experiences of non-mathematics majors, who often struggle with mathematics anxiety and low perceived competence (23-25). Despite growing global interest, studies remain limited in contextualizing these challenges within the Philippine setting. Locally, the Philippine National Achievement Test (NAT) and international assessments like PISA reflect underperformance in mathematics among Filipino students, with attitudes, teacher preparedness, and curriculum alignment identified as contributing factors (26-28). In rural and government-run higher education institutions, particularly in the Philippines' Leyte province, non-mathematics majors often exhibit increased levels of stress and disengagement in mathematics subjects, further emphasizing the need for evidence-based strategies to address this issue.

Indeed, mathematics is a practical discipline that shapes everyday decision-making and professional pursuits while serving as a cornerstone of various scientific fields. Despite its fundamental importance, many students, particularly those not specializing in mathematics, often show little interest in the subject, perceiving it as abstract or irrelevant. This perception may contribute to their reluctance to pursue mathematics as a field of specialization. Although several studies have explored student attitudes in general, there is still a notable knowledge gap in examining the mathematics attitudes of non-mathematics major teacher education students and how these relate to their achievement in mathematics. Most existing literature focuses on math majors, secondary students, or general college populations. Thus, there is insufficient understanding of how non-mathematics majors perceive and perform in mathematics, especially in the Philippine context. This study seeks to address this gap by examining how attitudes, specifically concerning enjoyment, motivation, self-confidence, and perceived value, influence mathematics achievement within this particular population.

In light of the rationale presented, this study examined the attitudes and achievements in mathematics among non-mathematics major teacher education students at a government-run higher education institution in Leyte, Philippines. Specifically, it aimed to assess the extent of students' attitudes toward mathematics in terms of enjoyment, motivation, self-confidence, and perceived value; determine their mathematics achievement; and analyze the associations between their attitudes and achievement in mathematics. Building on the existing literature and empirical evidence, some presenting mixed or inconclusive findings, this study postulates significant associations between the study variables.

The findings of this study are expected to assist various stakeholders in education, particularly those involved in curriculum development, instructional strategies, and teacher training. For educators, understanding non-mathematics major students' attitudes toward mathematics can provide insights into creating a more engaging and supportive learning environment, ultimately improving student motivation and achievement. Teacher education institutions can use the results to refine their mathematics courses, ensuring they address common misconceptions and learning difficulties from non-mathematics majors.

Additionally, policymakers and curriculum developers may find the study beneficial for designing more effective pedagogical approaches that promote positive attitudes toward mathematics, even among students who do not specialize in the field. The students may also benefit from recognizing how their attitudes impact their mathematical performance. This study asserts that students' attitudes toward mathematics, specifically in enjoyment, motivation, self-confidence, and perceived value, play a crucial role in enhancing their academic outcomes.

Theoretical Grounding

This present study is theoretically anchored on Ajzen's Theory of Planned Behavior (TPB), which suggests that an individual's actions are shaped by their attitudes toward the behavior, subjective norms, and perceived behavioral control (29). This theory extends the Theory of Reasoned Action by incorporating perceived behavioral control, which accounts for external and internal constraints on behavior. TPB posits that an individual's behavior is influenced by three key components: attitudes (beliefs about the behavior and its consequences), subjective norms (perceived social pressures), and perceived behavioral control (confidence in one's ability to perform the behavior). TPB provides a firm theoretical grounding since this study examines students' attitudes, self-confidence, motivation, and perceived value of mathematics concerning their achievement.

In the context of this study, students' attitudes toward mathematics (enjoyment, motivation, self-confidence, and value) align with the attitude component of TPB, influencing their intention to engage with the subject. Motivation and self-confidence can be linked to perceived behavioral control, as students who believe they can succeed in mathematics are likelier to perform well. Additionally, subjective norms, such as peer and instructor influence, may shape students' perceptions of mathematics and their willingness to persist despite challenges. Using TPB as a framework, this study examines how these psychological factors contribute to students' academic outcomes in mathematics, emphasizing the need for practical strategies to strengthen self-confidence and motivation to enhance academic success.

Methodology

Research Design

This study incorporated surveys as the primary tool, following descriptive and correlational designs. The descriptive design was used to depict the extent of the students' attitudes toward mathematics regarding their enjoyment, motivation, self-confidence, value, and mathematics achievement. In this study's context, descriptive designs are particularly effective in capturing the nuances of students' mathematics attitudes and facilitating a comprehensive understanding of how enjoyment, motivation, self-confidence, and value influence achievement in mathematics. Meanwhile, the correlational design was utilized to analyze the associations between the students' attitudes and achievement in mathematics.

Selection and Study Setting

The study was conducted at a teacher education department of a government-run higher education institution in Leyte, the Philippines. Using Cochran's formula, two hundred forty-four [244] first-year teacher education students enrolled in non-mathematics major programs were selected as study respondents. This study focused on first-year non-mathematics majors to examine their initial attitudes toward mathematics as they are in the foundational stage of their teacher education journey. Understanding their perspectives at this stage is crucial, as early interventions can help encourage more positive attitudes and enhance their academic achievement in the subject.

Further, we used a stratified random sampling technique to ensure that the sample accurately reflected the diversity of non-mathematics major teacher education students enrolled in a public higher education institution in Leyte, Philippines. Stratification was based on the academic program or field of specialization, as also presented in Table 1, which served as the basis for dividing the population into distinct subgroups or strata. It ensured that each program was proportionally represented in the sample, reducing selection bias and enhancing the generalizability of findings (30,31).

Table 1: Profiles of Non-Mathematics Major Teacher Education Students

Profiles	Category	f (n=244)	Percent (%)
Age	18 years old	74	30.33
	19 years old	105	43.03
	20 years old	33	13.52
	21 years old	13	5.33
	22 years old	9	3.69
	≥ 23 years old	10	4.10
Sex	Male	54	22.13
	Female	190	77.87
Program	Bachelor of Secondary Education Major in Science	33	13.52
	Bachelor of Culture and Arts Education	16	6.56
	Bachelor of Physical Education	41	16.80
	Bachelor of Elementary Education	64	26.23
	BTVTEd major in Garments, Fashion and Design	12	4.92
	BTVTEd major in Food and Service Management	14	5.74
	BTLEd major in Industrial Arts	37	15.16
	BTLEd major in Home Economics	27	11.07

Note: BTVTEd= Bachelor of Technical-Vocational Teacher Education; BTLEd= Bachelor of Technology and Livelihood Education

Once stratification was completed by academic program, the proportional allocation was applied. The number of respondents selected from each stratum was determined based on the size of the student population in that program relative to the total population of non-mathematics major students. Within each stratum, simple random sampling was employed to select individual participants. A list of enrolled students in each program was obtained from the registrar's office, and a random number generator was used to identify respondents, ensuring equal chances of selection and minimizing bias.

The samples were collected from various programs, namely: Bachelor of Secondary Education Major in Science [33], Bachelor of Culture and Arts Education [16], Bachelor of Physical Education [41], Bachelor of Elementary Education [64], Bachelor of Technical-Vocational Teacher Education major in Garments, Fashion and Design [12], Bachelor of Technical-Vocational Teacher Education major in Food and Service Management [14], and Bachelor of Technology and Livelihood Education major in Industrial Arts [37] and Bachelor of Technology and Livelihood Education major in Home Economics [27].

Instrumentations

A short form of the Attitudes toward Mathematics Inventory (ATMI) was adopted to assess the extent of the students' attitudes toward mathematics (32). The short ATMI comprised 19 statements divided into four constructs: enjoyment [5 statements], motivation [4], self-confidence [5], and value [5]. Sample statements include, for enjoyment, "I have usually enjoyed studying mathematics in school"; for motivation, "I am willing to take more than the required amount of mathematics"; for self-confidence, "I feel a sense of insecurity when attempting mathematics"; and for value, "College mathematics lessons would be very helpful no matter what I decide to study in the future." Responses were measured on a five-point Likert scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree nor Disagree (NAD), 4 = Agree (A), and 5 = Strongly Agree (SA), which were then qualitatively interpreted within this study's context as 1 = Very Unfavorable (VU), 2 = Unfavorable (U), 3 = Slightly Favorable (SF), 4 = Favorable (F), and 5 = Very Favorable (VF).

To ensure cultural relevance and clarity, three professionals in mathematics education and educational psychology subjected the instrument to expert validation. The experts reviewed the items for clarity, relevance, and alignment with the intended constructs. Based on their feedback, minor modifications were made to improve phrasing and contextual suitability without altering the original meaning of the items. Following expert validation, the instrument was pilot-tested among non-sampled 30 first-year students enrolled in Bachelor of Arts in English Language and Bachelor of Arts in Filipino programs at the same institution. No substantial

semantic issues emerged during the pilot test, indicating strong face validity for the local context. Cronbach's alpha coefficients were calculated to determine the instrument's reliability. The results showed good internal consistency for enjoyment [α = 0.827], Self-Confidence [α = 0.805], and value [α = 0.873], whereas motivation [α = 0.749] indicated acceptable internal consistency. The overall Cronbach's alpha value across the four constructs was 0.779, reflecting acceptable internal consistency. In addition, the students' mathematics achievement was determined using the university's grading system, which categorized achievement levels as follows: Excellent [1.0–1.4], Superior [1.5–1.9], Very Good [2.0–2.4], Good [2.5–2.9], Passed [3.0], Conditional Failure [3.1–4.0], and Failure [4.1–5.0]. The study also collected student profile data, including age, sex, and program.

Data Collection and Ethical Considerations

This study adhered to ethical standards to protect the students' rights, maintain data confidentiality, and uphold the integrity of the research process. Before data collection, we obtained written authorization from the college dean and the head of the institution to conduct the study. Informed consent was also secured from each non-mathematics major teacher education student participating in the survey, ensuring ethical compliance and voluntary participation. The consent form clearly outlined the study's nature and objectives, detailing students' rights, including their right to withdraw at any time without penalty. Data collection for the ATMI was conducted through face-to-face sessions to ensure clarity and engagement and to create a more interactive environment, encouraging students to reflect on their attitudes toward mathematics and allowing ample time [15 to 20 minutes] for thoughtful survey completion.

Meanwhile, we obtained the necessary approval to collect data on the students' mathematics achievement from the institution's teacher education department. All data obtained for this study were securely stored in an encrypted, password-protected directory accessible only to the researchers, ensuring the confidentiality and security of the data. Data collection occurred during the second semester of the 2023-2024 academic years.

Data Analysis

The collected data on mathematics attitudes and achievement were presented in tabular and textual formats. Descriptive statistical measures, including frequency counts, percentages, medians, mean, and standard deviations, determined the extent of the students' attitudes toward mathematics and their achievement. The Spearman rank correlation coefficient was employed to examine the associations between students' attitudes toward mathematics and their achievement. This non-parametric test was deemed appropriate because the attitude scores were derived from ordinal Likert-scale items. Spearman's rho measures the strength and direction of monotonic relationships between the study variables without requiring normality or interval scaling assumptions. Data analysis was conducted using MS Excel and JAMOVI statistical software.

Results and Discussion

Attitudes toward Mathematics among Non-Mathematics Major Teacher Education Students

Table 2 revealed that non-mathematics major teacher education students generally exhibited slightly favorable attitudes toward mathematics regarding enjoyment [50.40%] and motivation [49.20%], with median scores of 3 in both categories. This suggests that while they do not strongly dislike mathematics, their enthusiasm and engagement with the subject remain slightly favorable. In contrast, their self-confidence was notably lower, as indicated by the high percentage of unfavorable [38.50%] and very unfavorable [11.50%] responses, resulting in a median score 2. This lack of confidence may hinder their achievement, as previous studies suggest that self-efficacy is a key determinant of success in mathematics (33-35). Nonetheless, students overwhelmingly recognized the value of mathematics, with 46.70% reporting favorable and 38.10% very favorable attitudes, underscoring their awareness of its relevance despite their struggles in other areas.

Table 2: The Extent of Mathematics Attitudes in Terms of Enjoyment, Motivation, Self-Confidence, and Value among Students

Level	Enjoyment		Motivation		Self-Confidence		Value	
	F	%	F	%	F	%	F	%
Very Favorable	13	5.33	9	3.69	8	3.28	93	38.11
Favorable	62	25.41	79	32.38	20	8.20	114	46.72
Slightly Favorable	123	50.41	120	49.18	94	38.52	34	13.93
Unfavorable	38	15.57	31	12.70	94	38.52	3	1.23
Very Unfavorable	8	3.28	5	2.05	28	11.48	0	0.00

Note: N=244; Median Values (Mdn): Mdn (Enjoyment)= 3 (SF); Mdn (Motivation)= 3 (SF); Mdn (Self-Confidence) = 2 (U); Mdn (Value)= 4 (V)

Although students recognize the importance of mathematics, their diminished self-confidence may be a significant barrier to their achievement. Mathematics educators could leverage students' awareness of the discipline's value by integrating real-life applications, active learning strategies, and confidence-building exercises, including scaffolding and peer support (36, 37). Addressing the self-confidence deficit could promote positive attitudes, enhancing students' engagement and success in mathematics.

Consistent with the results of this present study, one study asserted that student motivation is significantly linked to perceptions of teaching practices and the availability of study resources (38). This link may result from students demonstrating a slightly higher level of motivation, which aligns with their generally positive views on the teaching practices in mathematics and the resources available at their educational institutions. Furthermore, more motivated students will likely experience greater satisfaction with these elements, improving their learning conditions. While this level of motivation is encouraging, it highlights the importance of maintaining high-quality teaching practices and providing adequate resources to sustain and further enhance student motivation in mathematics.

Further, the results regarding the favorable level of the value of mathematics support previous studies, indicating that students who recognize the necessity of studying mathematics are more likely to engage with the subject (39-41). A high value placed on learning mathematics implies that students view the subject as essential and relevant, which may contribute to increased motivation and effort in their studies. This favorable perception is critical, as it encourages a productive learning environment and enhances overall academic achievement in mathematics. Therefore, the significant value students attribute to learning mathematics highlights the need for continued emphasis on the importance and relevance of the subject to sustain and further cultivate this positive attitude toward mathematics.

Mathematics Achievement among Non-Mathematics Major Teacher Education Students

Table 3 illustrates the distribution of students' mathematics achievement ratings, showing that a majority exhibited good to superior performance. A proportion of students [27%] received ratings in the 2.5–2.9 range (Good), followed by 21.30% in the 2.0–2.4 category (Very Good) and 18.90% in the 1.5–1.9 range (Superior). Despite not majoring in mathematics, most students exhibit a competent grasp of mathematical skills essential for their academic advancement and future professional endeavors. Additionally, 7.40% attained an "Excellent" rating, indicating a small yet notable group of high achievers. Conversely, 8.20% of students received a "Passed" rating [3.0], while 17.20% fell into the "Conditional Failure" category [3.1–4.0].

Table 3: Distribution of the Students' Mathematics Achievement Rating

Rating	Frequency	Percent (%)	Qualitative Equivalent
1.0 – 1.4	18	7.40	Excellent
1.5 – 1.9	46	18.90	Superior
2.0 – 2.4	52	21.30	Very Good
2.5 – 2.9	66	27.00	Good
3.0	20	8.20	Passed

3.1 – 4.0	42	17.20	Conditional Failure
4.1 – 5.0	–	–	Failure

Note: N=244; Mean Grade = 2.5 (Good); Std. Dev. = 0.679

Interestingly, no students received outright failure ratings [4.1–5.0]. The calculated mean grade of 2.5 (Good) suggests that non-mathematics major teacher education students demonstrate satisfactory achievement in mathematics; however, the presence of struggling students was indicated by the standard deviation of 0.679, reflecting score dispersion. These results suggest that while most students perform at an acceptable level, a significant proportion still face challenges, as evidenced by the 17.20% in "Conditional Failure" and 8.20% who barely passed. This could be ascribed to the earlier result of low self-confidence, which may contribute to weaker achievement in the subject.

Associations between Attitudes and Achievement in Mathematics among Non-Mathematics Major Teacher Education Students

The results presented in Table 4 revealed significant positive associations between selected attitudes toward mathematics and students' mathematics achievement. Specifically, enjoyment of mathematics showed a significant association with achievement [r_s=0.245, p<.001], suggesting that students who derive satisfaction from learning mathematics tend to perform slightly better. Similarly, motivation also yielded a positive link with achievement [r_s=0.214, p<.001], indicating that more motivated students may be more likely to attain higher academic outcomes in mathematics. These results are consistent with prior studies highlighting the roles of intrinsic motivation and enjoyment in academic success (42-45). However, the magnitude of these associations (r_s) is notably weak, following Evans' benchmark for interpreting the strength of association (46). This that positive attitudes alone are insufficient determinants of academic achievement in mathematics. Other contributing factors, such as instructional quality, prior knowledge, and study strategies, may likely play more substantial roles in influencing the mathematics achievement of non-mathematics majors.

Table 4: Associations between Attitudes and Achievement in Mathematics among Students

		Mathematics Achievement	Enjoyment	Motivation	Self-Confidence	Value	Overall Attitudes
Mathematics Achievement	Spearman's rho	—					
	p-value						
Enjoyment	Spearman's rho	0.245***	—				
	p-value	< .001					
Motivation	Spearman's rho	0.214***	0.631***	—			
	p-value	< .001	< .001				
Self-Confidence	Spearman's rho	-0.088	0.148*	0.043	—		
	p-value	0.173	0.021	0.503			
Value	Spearman's rho	0.164*	0.274***	0.313***	-0.123	—	
	p-value	0.010	< .001	< .001	0.055		
Overall Attitudes	Spearman's rho	0.148*	0.796***	0.713***	0.264***	0.294***	—
	p-value	0.021	< .001	< .001	< .001	< .001	

*Note: * p < .05, ** p < .01, *** p < .001; N=244*

Interestingly, self-confidence did not show a statistically significant association with achievement [r_s=−0.088, p=.173], contrary to established literature which often regards self-efficacy as a key determinant of performance (47, 48). This discrepancy could reflect cultural or

institutional factors in the Philippine context, where students may report high confidence due to societal expectations or performative attitudes yet lack foundational competencies or effective learning strategies. Additionally, the result may reflect methodological influences, such as limitations in self-reported data or the possibility that self-confidence among non-math majors is not deeply rooted in actual math competence. This study's result invites further investigation, perhaps through mixed methods or qualitative inquiry, to unpack the nuance of confidence versus competence in mathematics performance.

The perceived value of mathematics was positively associated with achievement [r_s=0.164, p=.010], suggesting that students who recognize the importance of mathematics in their academic and professional lives are more inclined to invest effort in mastering the subject. This aligns with previous research emphasizing how the subject's perceived utility motivates students' educational endeavors (49-51). However, the strength of the association remains weak, and caution must be taken not to overstate predictive claims. While students valuing mathematics is essential, its impact on performance likely operates in combination with more proximal factors such as time management, academic preparation, and instructional clarity.

Within this study's context of mathematics attitudes and achievement, the Theory of Planned Behavior (TPB) offers a valuable interpretive lens for the results of this study. The significant associations of enjoyment and motivation with achievement align with the TPB's proposition that attitudes influence intentions and, in turn, behavior. Prior studies in mathematics education have similarly found that enjoyment and intrinsic motivation are strong attitudinal predictors of students' intention to engage in mathematics-related tasks, which subsequently relate to performance (52-54). Students who enjoy mathematics and feel internally motivated may be more inclined to persist in challenging tasks and dedicate time to learning, leading to better academic outcomes.

However, the non-significant role of self-confidence challenges the assumption that perceived behavioral control (a key TPB component) always translates into performance. This disconnect could stem from external constraints such as inadequate learning support or ineffective teaching strategies, highlighting the importance of context in applying TPB. Similarly, the positive association between value and achievement resonates with the TPB's focus on attitudinal beliefs but also suggests the need to recognize that valuing a subject alone does not automatically result in success. Thus, while TPB provides a meaningful framework, its application may benefit from expansion to account for cultural, contextual, and institutional variables that shape how attitudes materialize into academic behavior in specific educational settings.

The overall association between attitudes and mathematics achievement was significant but weak [r_s=0.148, p=.021], supporting this study's hypothesis yet reinforcing the idea that attitudes are only one-factor influencing mathematics. While classroom strategies aimed at promoting enjoyment, motivation, and valuing mathematics may yield benefits, they must be complemented by improvements in instruction, learning resources, and academic support services.

Furthermore, this study's results corroborate previous studies, indicating a link between students' attitudes toward mathematics and mathematics achievement (55-59). One study mentioned that attitude is a crucial predictor of students' academic success in mathematics, emphasizing the link between attitude toward mathematics and achievement (60). Interventions to improve students' attitudes toward mathematics, such as promoting enjoyment and highlighting the subject's value, could enhance performance. However, the impact may be limited if other influential factors are not addressed. Educators should also focus on building a supportive learning environment and effective instructional practices, as attitudes alone may not be enough to boost performance significantly. Nonetheless, responses in this study were limited to predefined scales in the survey questionnaire, which might hinder the depth of the insights gathered. Using qualitative data to gather views or perceptions among non-mathematics education students could provide a more refined understanding of attitudes toward mathematics.

Conclusion

This study examined the mathematics attitudes of non-mathematics major teacher education students, focusing on their enjoyment, motivation,

self-confidence, and perceived value of the subject. It also determined their mathematics achievement and analyzed the associations between their attitudes and achievement. The results revealed that the students generally have slightly favorable attitudes toward mathematics, particularly regarding enjoyment and motivation, while demonstrating low self-confidence. Despite this, they recognize the value of mathematics, which may contribute to their overall satisfactory achievement in the subject. The weak but positive significant overall associations between mathematics attitudes and achievement suggest that students with more favorable attitudes perform slightly better in mathematics. However, the relatively weak association implies that other factors, such as instructional strategies and prior experiences, may substantially influence mathematics achievement. These results highlight the importance of addressing students' self-confidence issues and reinforcing their recognition of mathematics' value to enhance learning outcomes.

Grounded on the results of this study, mathematics educators are urged to integrate contextualized real-life applications of mathematics lessons and active learning strategies to sustain and enhance students' motivation and engagement. Further studies are encouraged to explore other potential determinants of mathematics achievement, such as teaching methodologies, learning environments, and prior mathematical exposure. A mixed-methods approach that includes qualitative insights from students could provide a deeper understanding of their attitudes toward mathematics, ultimately guiding the development of more effective instructional strategies to optimize learning outcomes for non-mathematics major teacher education students.

Abbreviations

ATMI: Attitudes Toward Mathematics Inventory, BTLEd: Bachelor of Technology and Livelihood Education, BTVTEd: Bachelor of Technical-Vocational Teacher Education, TBP: Ajzen's Theory of Planned Behavior.

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Author Contributions

JJP Marabe: conceptualization, investigation, contributed to the methodology, data gathering, analysis, interpretation, implications, prepared the initial manuscript draft, JC Cabuquin: data curation, formal analysis, interpretation, implications, methodology development, resource acquisition, software utilization, supervision, validation, literature review update, refined the manuscript through critical revisions. TA Peros Jr: writing the initial manuscript draft, discussing the results, interpreting findings, shaping the initial conclusions, recommendations, JA Taberara: writing the initial manuscript draft, discussing the results, interpreting findings, shaping the initial conclusions, recommendations, KC Anino: data gathering, investigation, literature review updates, MLN Poe: literature review, critical interpretation of results, validation, and technical resources, MAST Acidre: literature review, critical interpretation of results, validation, and technical resources.

Conflict of Interest

The authors confirm that this manuscript is original, has not been previously published, and is not under consideration by any other journal. Furthermore, this work has not been released as a preprint. The authors declare no actual or potential conflicts of interest related to this study.

Ethics Approval

This study was conducted in compliance with ethical research standards. The research protocol received approval from the head of the institution where data collection took place. Prior to data collection, informed consent was obtained from all student respondents. They were fully informed of the study's objectives, procedures, the voluntary

nature of their participation, and their right to withdraw at any time without penalty. For student achievement data obtained from institutional records, permission was secured from the appropriate school authority, and student identities were anonymized to ensure confidentiality. All data were securely stored, and strict confidentiality and anonymity were maintained throughout the research process to safeguard participants' privacy.

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