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Pre-Service Early Grade Teachers Attitude Towards Mathematics in Ghana*

Abstract. This study assessed the reliability of the Attitudes Towards Mathematics Inventory (ATMI) among first-year pre-service early-grade teachers from two Colleges of Education in Ghana. The research involved data collection, instrument adaptation, and statistical analysis. The ATMI, originally consisting of 40 items on a 5-point Likert scale, was used. However, the Likert scale was modified to a 4-point version by eliminating the neutral point. A total of 172 participants took part in the study, and the items demonstrated good internal consistency, with Cronbach's alpha exceeding 0.70, indicating the reliability of the ATMI for use in the Ghanaian context.

The study also employed Exploratory Factor Analysis (EFA) to analyse the ATMI data effectively and identified 28 out of the 40 items. These 28 items were organised into four unique factors: enjoyment, confidence, the usefulness of mathematics, and parent/teacher expectations of mathematics influencing self-efficacy in mathematics among pre-service early-grade teachers.

Contribution: This study offers a systematic evaluation of the reliability of the ATMI, which is an essential step in ensuring the validity of assessments related to attitudes toward mathematics. It provides insights into the suitability of this inventory for use in mathematics education, specifically among future early-grade teachers, to enhance teaching and learning.

Introduction

The attitudes of teachers and students toward mathematics play a critical role in shaping their engagement and success in the subject. Emotional experiences

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in mathematics classrooms, including enjoyment, anxiety, and motivation, significantly influence these attitudes. For example, Barroso et al. (2021) conducted a comprehensive meta-analysis demonstrating a significant negative relationship between mathematics anxiety and achievement. They found that mathematics anxiety often consumes cognitive resources needed for problem-solving, hindering engagement and success in mathematics. This highlights the importance of addressing emotional barriers to create supportive learning environments that foster positive attitudes toward the subject for teachers and students. Similarly, Bieg et al. (2017) highlighted this dynamic by analysing how different teaching methods impact students' emotional responses. They found that interactive and student-centred approaches, such as group work, foster positive, emotions. Cultivating a positive attitude towards any subject or the act of learning itself is just as vital to the educational process as it is for imparting knowledge or teaching that particular subject (Attard, 2012). Moreover, when learners recognise mathematics's real-life relevance and importance, they become more engaged, positive and committed to their learning process (Moenikia & Zahed-Babelanb, 2010). This indicates that perceiving the practical applications of mathematics fosters a positive connection between students and the subject matter, ultimately enhancing their overall learning experience. Similarly, Kele and Sharma (2014) establish that learning mathematics encompasses thinking and reasoning and relies significantly on learners' attitudes towards the subject. The Attitude Towards Mathematics Inventory (ATMI) is essential for probing individuals' sentiments, beliefs, and perceptions regarding mathematics. As a subject, mathematics has wide-reaching implications for various aspects of education and everyday life, often eliciting a range of attitudes that can either catalyse or hinder one's engagement and performance in the field. The ATMI was developed to explore this complex interplay between personal attitudes and mathematical comprehension. The inventory offers valuable insights into the cognitive and affective dimensions of mathematical learning by assessing factors such as confidence, value, anxiety, enjoyment and motivation, and responses towards mathematics (Tapia & Marsh, 2004).

Attitude towards mathematics

Han and Carpenter (2014) define attitudes as a combination of cognitive, affective, and behavioural responses that individuals exhibit towards an object or environment based on their feelings or interests. In this context, the cognitive component of behaviour (Mensah et al., 2013) refers to what individuals think or feel about mathematics. Meanwhile, the affective element of attitudes (Ingram, 2015) pertains to the thoughts and emotions associated with learning mathematics. Therefore, the affective aspect serves as the driving force behind students' interest and engagement in mathematics.

Mensah et al. (2013) argued that the relationship between the teaching and learning mathematics through affective variables is multifaceted and extends to other fields of study. However, the connection between these variables holds particular significance in mathematics education (Hannula et al., 2018). Students who possess a good attitude and a sense of confidence in their mathematical abilities are more likely to succeed in it. Nicolaidou and Philippou (2003) and Mazana, Suero Montero and Olifage (2019) investigated students' attitudes toward mathematics learning, and they observed a clear correlation between attitude and achievement in mathematics. Their study revealed that students with a good attitude toward mathematics performed better than those without. If students harbour negative attitudes toward mathematics, their performances are likely to suffer, and such negative attitudes could be seen as barriers to successful learning (Zan & Di Martino, 2007). However, when learners recognise mathematics's real-life relevance and importance, they become more engaged, positive, and committed to their learning process (Attard, 2012). This indicates that perceiving the practical applications of mathematics fosters a positive connection between students and the subject matter, ultimately enhancing their overall learning experience.

Mathematics anxiety among learners

Mathematics anxiety refers to the sensation of apprehension or stress about learning mathematical concepts and potentially hindering an individual's capability to engage in mathematical activities (Ashcraft, 2002). Thus, it is crucial to identify instances of mathematics anxiety in children to avert the development of fear that could detrimentally influence their mathematical learning experience (Aarnos & Perkkilä, 2012). The authors study anxiety in preservice teachers (cf. Gresham, 2007) and assert that the intensity of anxiety can vary, falling into categories of high, moderate, or low. When anxiety levels are low or moderate, learners tend to concentrate on mathematical calculations and problem-solving. Similarly, Hembree (1990) conducted a comprehensive meta-analysis that highlighted the detrimental effects of mathematics anxiety on achievement and engagement with the subject. His findings revealed that high levels of anxiety significantly hinder performance and create a negative perception of mathematics, which could extend into teaching practices. Conversely, heightened anxiety levels lead to considerable tension, preventing learners from actively participating in mathematical tasks. Aldrup, Klusmann, and Lüdtke (2020) also found a correlation between mathematics anxiety and performance, stating that high mathematics anxiety leads to low achievement.

Confidence in learning mathematics

Confidence entails a favourable mindset exhibited by individuals who possess a belief in their capabilities and have the potential to cultivate a positive perception of their environment (Suhardita, 2011). This implied believing in one's competencies and being fully conscious of the capacity one possesses to put these competencies into practice effectively. Similarly, students with robust self-efficacy are more likely to realise their latent potential as an inherent capability that significantly influences their academic performance. This notion aligns with Stankov (2013), who emphasised the significance of confidence in students' successful engagement with mathematics learning. However, Rizqi et al. (2021) reaffirm that in the context of learning mathematics, students with high confidence demonstrate elevated motivation and enthusiasm towards studying mathematics, consequently optimising their overall achievement in the subject. Studies have shown a positive association between confidence in learning mathematics and mathematics achievements (Yaniawati et al., 2020; Çiftçi & Yildiz, 2019).

According to Ainley and Ainley (2011), enjoyment in mathematics refers to the positive emotional experiences and pleasures individuals derive from engaging with mathematical activities and concepts. It encompasses a sense of interest, satisfaction and engagement while working on mathematical problems or exploring mathematical ideas. Enjoyment represents the positive emotional response and satisfaction that students experience when interacting with mathematical activities.

Value of mathematics

Schoenfeld (2002) discusses the significance of students' attitudes and values toward mathematics education and argues that students' beliefs about mathematics play a critical role in their learning experiences and outcomes. When students perceive mathematics as valuable and relevant to their lives, they are more likely to engage with the subject, persist in problem-solving, and seek connections between mathematical concepts and real-world situations. Similarly, negative attitudes or perceptions of mathematics can lead to disengagement and hinder learning. The author emphasises that fostering a positive value of mathematics among students is essential for promoting their active participation and success in the subject. It highlights the relationship between students' attitudes, beliefs, and their learning experiences in mathematics.

Motivation in learning mathematics

Ryan and Deci (2000) believe that students are more motivated when they feel a sense of autonomy, competence, and relatedness in their learning experiences. In mathematics, they suggest that students who feel a sense of control over their learning, perceive themselves as capable, and see the relevance of mathematical concepts are more likely to be motivated to engage with mathematics. Moyano, Quílez-Robres, and Cortés Pascual (2020) also found high student intrinsic motivation to be a predictor of mathematics achievement.

Research Question

This study aims to determine if the Attitude Towards Mathematics Inventory (ATMI) questionnaire is reliable for measuring pre-service early-grade teachers' attitudes towards mathematics in the Ghanaian context.

Methodology

This study examined the first-year pre-service early-grade teachers' attitudes toward mathematics in Ghana. To achieve this, the quantitative research approach was adopted, which allowed us to systematically collect and analyse numerical data, providing valuable insights into the participants' perceptions.

Participants

The participants in this study consisted of 190 first-year pre-service early-grade teachers from two Colleges of Education in Ghana. The purposive sampling technique was used to select the participants (Tongco, 2007) as this research focused on early-grade pre-service teachers' attitudes towards mathematics in the Ghanaian context. After the test application, the number of participants declined to 172 because of some problems with the responses. Independent of this decline, the final number of pre-service teachers was used for the study.

Instrumentation

The Attitudes Towards Mathematics Inventory (ATMI) questionnaire developed by (Tapia Marsh, 2004) was administered to the participants. The primary goal of this testing was to assess the instrument's reliability to measure pre-service early-grade teachers' attitudes towards mathematics in the Ghanaian context.

Data Collection

An introduction letter was sent to the Principals of the two Colleges of Education to seek permission to administer the questionnaires. Participants' consent was sought, ensuring their willingness to participate in the study. Identifiers were removed from the data during analysis and reporting to protect the participants' confidentiality and anonymity.

Two mathematics tutors were trained on the survey's purpose and procedures and collected data from the two Colleges of Education in Ghana. They administered the questionnaire to the pre-service early-grade teachers, ensuring that the process was standardised across both institutions and that the data collection period spanned one week to allow sufficient time for participants to respond thoughtfully.

Data Collection Instrument

The study adopted the Attitudes Towards Mathematics Inventory (ATMI), developed by Tapia and Marsh in 2004. The ATMI consisted of 40 items on a 5-point Likert scale: 1 – strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, and 5 – strongly agree. The questionnaire comprised six sub-dimensions: confidence, anxiety, value, enjoyment, motivation, and parent/teacher expectations. However, the Likert scale was altered to a 4-point version by eliminating the neutral point. This modification was made because the neutral midpoint could compromise the accuracy of results for several reasons. Firstly, respondents might utilise this category for purposes other than expressing a middle-of-the-road stance, such as when they lack an opinion, are hesitant to reveal their actual viewpoint, do not comprehend the question, encounter a question that does not apply to them, and other similar scenarios (Kulas et al., 2008; Raaijmakers et al., 2000). Additionally, it can be complex to linguistically convey the concept of neutrality within the continuum of response choices (González-Romá & Espejo, 2003). Moreover, there are instances when the information provided by an intermediate neutral point category lacks informative value (Andrich, 1978). Therefore, adopting a four-point response format becomes particularly appealing when concerns about social desirability affect the intended construct to be measured and when the respondents possess varying abilities to differentiate among the categories (Asún et al., 2016).

Testing

The Attitudes Towards Mathematics Inventory (ATMI) was administered to 190 first-year pre-service early-grade teachers from two Colleges of Education in Ghana, the number of participants declined to 172 because of some problems with the responses. The inventory was subjected to Alpha Cronbach and Exploratory Factor Analysis.

The Alpha Cronbach represents if the internal validation of the questionnaire in the context of teachers' responses was maintained (Fink et al., 2021; Hayes et al., 2019). Calculating the alpha in the investigation, the value was 0.964.

The Cronbach's alpha of the original test was 0.963; therefore, localising the test did not reduce the reliability of the test, and all questions contributed to the result.

To describe the ATMI data, some statistical tools were used. However, in this context, there was the need to consider that different variables affected the development of self-efficacy. Simultaneously analysing all these aspects and identifying these characteristics and prominent traits could be costly and time-consuming. In this sense, it is necessary to use statistical tools for multivariate analysis, specifically Exploratory Factor Analysis (EFA), to search for the most relevant aspects that influence the development of self-efficacy in mathematics based on students' responses to questionnaires.

In this regard, Matos and Rodrigues (2019) highlight that factor analysis is an empirical technique, meaning that it is purely based on questionnaire responses as the criterion for grouping variables. However, the factors found at the end of the process are expected to make theoretical sense. EFA is one of the most widely used multivariate statistical procedures in research related to questionnaires in various domains (psychology, sociology of education, public management, and health, among others). The main objective of EFA is to reduce the dimensionality of the analysis and determine the number and nature of latent variables present in a questionnaire or test items, namely the factors that explain the covariance between a set of observed measures, that is, the questionnaire items or test items (Matos & Rodrigues, 2019). The observed measures are correlated because they share a common cause the same construct (Matos & Rodrigues, 2019; Brown, 2015). Therefore, factor analysis seeks to assess the dimensionality of a set of indicators, obtaining the smallest number of interpretable factors less than the total number of measures required to interpret the possible correlations between them (Brown, 2015).

The first step of the EFA was analysing how questions can be used for the data analyses.

From the EFA, we identified questions that were not significant for analysing responses to the questionnaire. In analysing the factor scores (less than 0.5) and the questions, 12 non-significant issues were identified. After removing the questions, the EFA was recalculated, and the results are described in Table 1.

Table 1: First EFA to Identify Usable Questions

	Factor			
	1	**2**	**3**	**4**
Q29	,781	,318	,169	-,029
Q30	,775	,230	,026	-,004
Q38	,752	,196	,177	,040
Q32	,746	,051	,172	,049
Q22	,724	,310	-,002	-,079
Q17	,722	,420	,093	-,005
Q24	,709	,446	,219	,124
Q40	,666	,342	,200	,081
Q23	,664	,303	,042	,189
Q27	,641	,322	,050	,095
Q31	,622	,312	,242	,015
Q26	,620	,276	,155	,178
Q16	,616	,496	,130	,037
Q18	,608	,220	,006	,042
Q33	,605	,037	,168	,271
Q37	,566	,136	,199	,094
Q35	,495	,069	,386	,294
Q19	,471	,145	,246	-,020
Q3	,416	,147	,370	-,206
Q11	,372	,753	,068	,143
Q14	,215	,746	,036	,148
Q13	,147	,740	-,010	,177
Q15	,267	,733	,025	,112
Q7	,257	,707	,107	,021
Q20	,248	,697	,069	-,152
Q6	,292	,677	,044	,083
Q10	,255	,645	,058	,004
Q21	,266	,630	,110	-,249
Q25	,231	,564	,278	-,196
Q28	,325	,545	,092	-,086
Q34	,153	-,336	-,045	,250
Q5	,036	,010	,706	,074
Q4	,125	,064	,641	-,030
Q2	,025	,015	,596	,038
Q8	,126	,119	,567	,366
Q39	,357	,055	,523	,244
Q12	,180	,034	,502	-,008
Q1	,028	,141	,475	-,143
Q9	,207	,060	,406	,405
Q36	,270	,023	,404	,368

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

To confirm if EFA could be used, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were applied to verify if the selected data were appropriate for factor analysis. The results confirmed that this type of analysis could be used. Results from Kaiser–Meyer–Olkin (KMO) and Bartlett's test are presented in Table 2.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.931
Bartlett's Test of Sphericity	Approx. Chi-Square	3038.759
	Df	378
	Sig.	.000

Results from Table 2 show that Kaiser–Meyer-Olkin (KMO) was 0.931, indicating the appropriateness of the sample for the analysis, citing the cut of 0.6. Additionally, Bartlett's test of sphericity was statistically significant, $\chi^2(378) = 3038$, $p < 0.000$, indicating the appropriateness of the analysis. Finally, with all assumptions not violated, parallel analysis was carried out to determine which factors to be retained, as indicated in Figure 1.

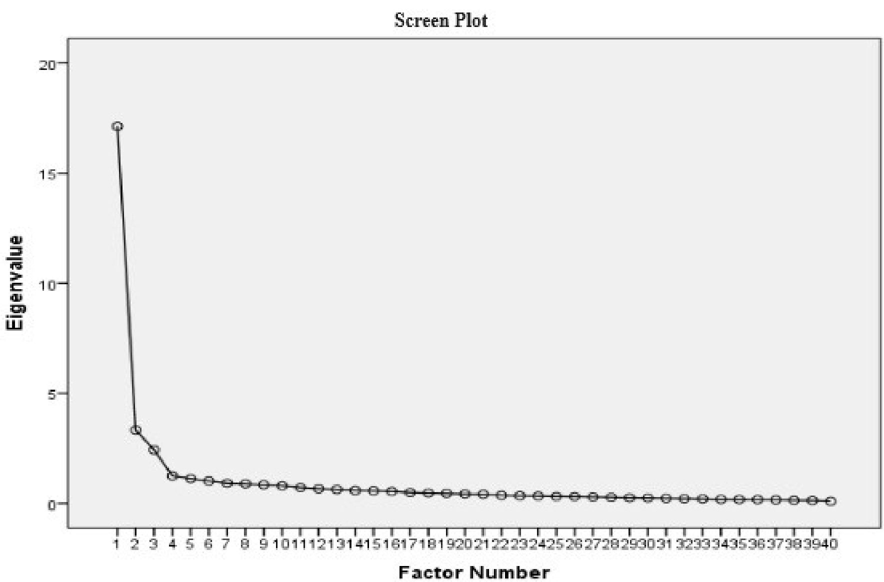

Figure 1: Screen Plot

The screen plot confirmed four factors, as indicated in Figure 1, and applying EFA with four factors, the results are shown below. The factor loadings were identified in Table 3.

Table 3: Factor Loadings

Rotated Factor Matrix					
	Factor				
	1	**2**	**3**	**4**	**Extraction**
Q29	.804	.311			.785
Q22	.740				.637
Q17	.737	.412			.725
Q38	.724				.627
Q32	.686				.533
Q40	.656	.355			.614
Q27	.650	.311			.546
Q23	.622	.319			.534
Q16	.617	.495			.646
Q31	.614	.313			.538
Q26	.605				.513
Q18	.592				.409
Q11	.356	.769			.738
Q14		.767			.629
Q13		.750			.605
Q15		.739			.617
Q7		.712			.586
Q6		.675			.551
Q10		.669			.500
Q21		.591			.454
Q25		.548			.389
Q28	.344	.531			.415
Q36			.698		.533
Q39			.643		.549
Q35	.443		.542		.517
Q8			.468		.336
Q4				.804	.712
Q5			.351	.696	.609

Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 7 iterations.

Results

Table 3 presents the factor loadings of the items, maintaining the number of original items that will facilitate the comparison. The take-off items represent some of the school's characteristics, so some questions did not make sense concerning the population. In the end, 28 items were retained (cf. Lim & Chapman, 2013; Lim & Huang, 2016).

The first factor was classified as enjoyment; they are described with 12 questions that represent the enjoyment/satisfaction with the teacher's mathematics. The second factor comes with ten questions representing the teachers' self-confidence in mathematics. The third factor represents the value of mathematics (4 questions), and the fourth factor indicates the parent/teacher expectations with mathematics (2 questions).

About the internal consistency, the alpha was recalculated for the 28 questions; the new value is .944, which is a good value after taking off the questions. After this, the alpha was calculated for each factor; the results are displayed in Table 4.

Table 4: Internal Alpha for Each Factor

Factor	**Nº of Questions**	**Alpha Cronbach**
I	12	.941
II	10	.917
III	4	.763
IV	2	.787

The values indicated a high internal consistency in each factor, which collaborated with the validation of the application of the questionnaire in teachers. These values were larger than the cut-off point of 0.70 for reliability (Hair, Anderson, Tatham, & Black, 2010) and were comparable to those reported by Tapia and Marsh (2004).

The Pearson Correlation Analysis (PCA) test was applied to confirm whether the factor is independent. According to Matos and Rodrigues (2019), PCA can be used to identify the independence of dimension result of EFA. The results of PCA are described below.

Table 5: PCA to Confirm the Internal Independence of the Factors

		Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	Pearson Correlation	1	.057	.044	.034
	Sig. (2-tailed)		.457	.569	.658
Factor 2	Pearson Correlation		1	.003	-.010
	Sig. (2-tailed)			.968	.894
Factor 3	Pearson Correlation			1	.074
	Sig. (2-tailed)				.332
Factor 4	Pearson Correlation				1
	Sig. (2-tailed)				

According to Cohen et al. (2009), the Pearson Correlation represents correlations between two variables. The value of correlation ranges from $-1 < r < 1$, so when r is closer to -1 or 1, it represents a strong correlation, while value around 0 does not have a correlation. In the case of EFA, the factors need to be independent, so $r = 0$. As we see in Table 5, the Pearson Correlation for each factor is around 0, representing no auto-correlation (Matos & Rodrigues, 2019).

Table 6: Attitude Towards Mathematics

Enjoyment	**Mean**	**Std. Deviation**
Q29_I really like mathematics	2.38	.913
Q22_I learn mathematics easily	2.17	.854
Q17_I have a lot of self-efficacy when it comes to mathematics	2.47	.840
Q38_I am comfortable answering questions in math class	2.40	.870
Q32_I am willing to take more than the required amount of mathematics	2.31	.799
Q40_I believe I am good at solving math problems	2.48	.940
Q27_I would prefer to do an assignment in math than write an essay	2.35	.983
Q23_I am confident that I could learn advanced mathematics	2.47	.901
Q16_Mathematics does not scare me at all	2.41	.903
Q31_Mathematics is a very interesting subject	2.68	.850
Q26_I like to solve new problems in mathematics	2.45	.804
Q18_I am able to solve mathematics problems without too much difficulty	2.26	.828
Self-confidence	**Mean**	**Std. Deviation**
Q11_Mathematics makes me feel uncomfortable	2.55	.880
Q14_My mind goes blank and I am unable to think clearly when working with math	2.50	.927
Q13_Mathematics is one of my most dreaded subjects	2.43	.824
Q15_It makes me nervous to even think about having to do a mathematics problem	2.41	.837
Q7_I am always under a terrible strain in math class	2.40	.849
Q6_When I hear the word "mathematics", I have a feeling of dislike	2.44	.886
Q10_Studying mathematics makes me feel nervous	2.42	.830
Q21_I feel a sense of insecurity when attempting mathematics	2.47	.790
Q25_Mathematics is dull and boring	2.76	.917
Value	**Mean**	**Std. Deviation**
Q28_I would like to avoid using mathematics in college	2.47	.933
Q36_I believe studying math helps me with problem-solving in other areas	2.99	.688
Q39_A strong math background could help me in my professional life	3.06	.770
Q35_I think studying advanced mathematics is useful	2.81	.728
Parent/teacher expectations with math	**Mean**	**Std. Deviation**
Q4_Mathematics helps develop the mind and teaches a person to think	3.38	.728
Q5_Mathematics is important in everyday life	3.46	.634

As shown in Table 6, respondents were asked to indicate on a 4-point Likert scale the extent to which they agree or disagree with the statements about attitude towards mathematics. The mean score of the responses is compared to $2.5(= [1+2+3+4]/4)$. A mean score above 2.5 indicates that students agreed with the statement, whereas scores below 2.5 show that students disagreed.

From Table 6, respondents responded positively to one item under enjoyment: mathematics is an interesting subject ($M = 2.68, SD = .850$). However, respondents reacted negatively to the rest of the statement regarding enjoyment. For example, "I learn mathematics easily" ($M = 2.17, SD = .913$), "I am able to solve mathematics problems without too much difficulty" ($M = 2.26, SD = .828$), and "I am willing to take more than the required amount of mathematics" ($M = 2.31, SD = .799$)

In the same vein, respondents agreed to the items: "mathematics is dull and boring" ($M = 2.76, SD = .790$), "mathematics makes me feel uncomfortable" ($M = 2.55, SD = .880$), and "my mind goes blank, and I am unable to clearly think when working with math" ($M = 2.50, SD = .927$) under self-confidence. On the other hand, respondents disagreed with the statements "I am always under a terrible strain in math class" ($M = 2.40, SD = .849$), "mathematics is one of my most dreaded subjects" ($M = 2.41, SD = .837$), and "studying mathematics makes me feel nervous" ($M = 2.42, SD = .830$) under self-confidence.

Concerning the value factor, three items were responded positively by respondents. These are: "a strong math background could help me in my professional life" ($M = 3.06, SD = .770$), "I believe studying math helps me with problem-solving in other areas" ($M = 2.99, SD = .688$), and "Studying advanced mathematics is useful" ($M = 2.81, SD = .728$). Hence, "I would like to avoid using mathematics in college" ($M = 2.47, SD = .933$) was the negative item under value.

Respondents positively responded to all the statements under parent/teacher expectations with mathematics. For instance, "mathematics is important in everyday life" ($M = 3.46, SD = .634$), and "mathematics helps develop the mind and teaches a person to think" ($M = 3.38, SD = .728$).

Discussion and Conclusion

This study aimed to validate the reliability of the Attitudes Towards Mathematics Inventory (ATMI) among first-year pre-service early-grade teachers from two Colleges of Education in Ghana. The findings revealed that 28 items were retained, with high factor loadings on four factors: enjoyment/satisfaction, self-confidence, value, and parent/teacher expectations. All the factors demonstrated strong reliability (Cronbach's alpha > 0.70), with an overall reliability coefficient of 0.944. These results indicate that pre-service teachers' attitudes toward mathematics were shaped by their enjoyment and satisfaction in learning mathematics, their confidence in studying the subject, their appreciation of its value, and the expectations of parents and teachers.

The study's findings align with Jancarik et al. (2023), who conducted similar research in the Czech Republic. Both studies identified four factors with high-reliability coefficients. However, a key difference lies in the composition of these factors. While the current study in Ghana highlighted parent/teacher expectations, the study in the Czech Republic identified anxiety as a significant factor.

This distinction may be attributed to differences in the educational context and the participant groups. The Ghanaian study focused on first-year pre-service early-grade teachers taking introductory mathematics courses, a context where parental and teacher expectations might play a stronger role. In contrast, the Czech study included first- and second-year undergraduate students in mathematics and computer science, where academic pressures might manifest more prominently as anxiety.

The validated ATMI tool provides a robust foundation for understanding attitudes toward mathematics in diverse contexts. Respondents in this study generally exhibited positive attitudes, particularly in terms of enjoyment and perceived value, as evidenced by strong agreement with statements like "mathematics is an interesting subject" and "a strong math background could help me in my professional life." However, moderate self-confidence levels, reflected in responses to items such as "I learn mathematics easily" and "I am able to solve mathematics problems without too much difficulty," highlight a critical area for intervention.

These findings underscore the need for teacher education programs to address confidence gaps through targeted training and support. By fostering greater self-confidence and reinforcing positive attitudes toward mathematics, educational stakeholders can better prepare pre-service teachers to inspire and engage early-grade learners. The validated ATMI tool also opens avenues for cross-cultural and longitudinal research, enabling comparisons of attitudes toward mathematics across different contexts and examining their evolution over time. Future studies could further explore the link between attitudes and teaching practices to assess their impact on classroom outcomes.

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