

Design And Validation of Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers

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ABSTRACT:

This study designed and validated the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT) to measure affective and cognitive dispositions toward mathematics among future educators. Guided by Dweck's (2006) growth mindset theory and Bandura's (1997) self-efficacy framework, the study employed a descriptive and exploratory research design involving 284 preservice teachers from a state university in the Philippines. Data were analyzed using descriptive statistics and Principal Component Analysis (PCA) with Varimax rotation. Results revealed a high overall mean ($M = 3.74$, $SD = 0.95$), indicating that preservice teachers generally exhibit positive attitudes and strong growth-oriented beliefs toward mathematics. Items with the highest means reflected high valuation of mathematics and strong endorsement of effort-based learning. Conversely, moderate ratings in fixed mindset and anxiety-related items indicated lingering beliefs about limited ability and math-related stress. The KMO value (.607) and significant Bartlett's Test of Sphericity ($\chi^2(300) = 2194.31$, $p < .001$) confirmed data suitability for factor analysis. The PCA yielded nine meaningful components, including Positive Valuation of Mathematics, Growth-Oriented Efficacy, Math Anxiety and Avoidance, and Teaching Motivation and Confidence, collectively accounting for the multidimensional nature of mathematics attitudes and mindsets. The findings affirm that the CMAGMS-FPT is a psychometrically sound instrument for assessing preservice teachers' beliefs, attitudes, and motivations in mathematics. Implications suggest integrating mindset-based interventions, reflective practices, and confidence-building strategies into teacher education programs to nurture resilient, confident, and growth-oriented mathematics educators.

Keywords: mathematics attitude, growth mindset, preservice teachers, teacher education, principal component analysis, scale validation

Introduction

Mathematics has long been recognized as a cornerstone of global education, serving as a

critical tool for logical reasoning, problem-solving, and technological advancement. Globally, studies emphasize that learners'

attitudes and beliefs toward mathematics significantly influence their motivation, achievement, and persistence in the subject (Ma & Kishor, 1997; OECD, 2019). A positive attitude toward mathematics fosters higher achievement and deeper conceptual understanding, while negative perceptions—such as anxiety or fixed beliefs about ability—often lead to avoidance and poor performance (Ashcraft & Krause, 2007; OECD, 2021). In many countries, educational reforms now advocate the integration of *growth mindset* principles, which posit that intelligence and ability can be developed through effort and effective strategies (Dweck, 2006). This paradigm shift highlights the importance of cultivating both cognitive competence and affective resilience among future educators to meet the demands of the 21st-century learning environment.

Regionally, within the Asia-Pacific context, the importance of nurturing a positive mathematics attitude among teachers and learners is increasingly emphasized. Reports from UNESCO (2022) and SEAMEO INNOTECH (2020) reveal that while Asian students generally perform well in international mathematics assessments such as PISA and TIMSS, many still exhibit high levels of math anxiety and low confidence. This paradox underscores the need to balance achievement with emotional and motivational support. In developing nations, preservice teachers often inherit societal beliefs that mathematical ability is innate, leading to self-doubt and reluctance to engage deeply with the subject (Lim & Chapman, 2015). Such beliefs, if left unaddressed, can be transferred to their future students, perpetuating cycles of fear and disengagement toward mathematics across generations.

Locally, in the Philippine context, the issue is both educational and cultural. Despite ongoing curriculum reforms such as the K to 12 Basic Education Program and the implementation of Outcome-Based Education (OBE) in higher education, mathematics remains one of the most challenging subjects for Filipino learners and teachers alike (Orleans, 2020; Bernardo, 2019).

Many preservice teachers enter the teaching profession with limited confidence and high anxiety toward mathematics, often stemming from their own learning experiences in high school or college. This affects not only their performance in mathematics courses but also their future teaching efficacy. While studies have explored Filipino students' mathematics achievement and anxiety (Magno, 2012; Bernardo, 2019), there remains a lack of locally validated instruments that measure preservice teachers' mathematics attitudes and growth mindsets within classroom contexts. Existing tools, primarily developed in Western settings, may not capture the nuanced socio-cultural dimensions of Filipino learners—such as collectivist values, peer learning dynamics, and contextual interpretations of academic success.

In response to these gaps, the present study designed and validated the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT). This instrument aims to measure the affective and cognitive orientations of future educators toward mathematics learning and teaching. Grounded in Dweck's (2006) growth mindset theory and Bandura's (1997) self-efficacy framework, the study contributes to the localization of psychometric tools that align with the Philippine Teacher Education Framework and the Philippine Professional Standards for Teachers (DepEd, 2017). By identifying underlying dimensions of mathematics attitudes and growth mindsets among preservice teachers, this research seeks to inform the development of evidence-based interventions that promote perseverance, confidence, and reflective practice—key qualities for effective mathematics instruction in Philippine schools.

Theoretical Grounding and Framework

This study is anchored on Dweck's (2006) Mindset Theory, which distinguishes between fixed and growth mindsets as determinants of how individuals perceive their intelligence, learning capacity, and ability to overcome challenges. In the context of mathematics

education, preservice teachers' beliefs about intelligence and effort significantly shape their attitudes toward teaching and learning mathematics (Boaler, 2019). A growth mindset fosters persistence, resilience, and positive engagement with complex mathematical concepts, while a fixed mindset can lead to anxiety and avoidance behaviors (Yeager & Dweck, 2020). Complementing this is Bandura's (1997) Social Cognitive Theory, particularly the concept of self-efficacy, which posits that individuals' beliefs in their capabilities influence their motivation, effort, and academic performance. In mathematics education, teachers with higher self-efficacy are more likely to adopt student-centered strategies, promote conceptual understanding, and nurture learners' confidence (Talsma et al., 2018).

Furthermore, the study is guided by the Theory of Planned Behavior (Ajzen, 1991), which explains how attitudes, perceived behavioral control, and subjective norms predict behavioral intentions. This theoretical integration underscores that preservice teachers' readiness and attitudes toward teaching mathematics are not only cognitive but also affective and behavioral. The framework of the study thus illustrates the interplay between mathematics attitude, mindset orientation, and teaching self-efficacy, suggesting that cultivating growth-oriented beliefs and confidence can enhance teaching motivation and classroom engagement. At the local level, this framework aligns with the Philippine Professional Standards for Teachers (PPST), which emphasize positive learning dispositions, reflective practice, and lifelong learning (Department of Education, 2017). Hence, the study's theoretical foundation provides a multidimensional lens for understanding and improving the readiness of future educators in teaching mathematics effectively and confidently.

Literature Gap

The affective dimension of mathematics learning specifically, attitudes and beliefs about one's ability to learn mathematics—has long been recognized as a crucial determinant of

academic achievement (Aiken, 1974; Ma & Kishor, 1997). However, much of the existing research on mathematics attitudes and mindset has been conducted in Western contexts (Dweck, 2006; Blackwell, Trzesniewski, & Dweck, 2007; Yeager & Dweck, 2012), with limited focus on Southeast Asian and Philippine educational settings. Although recent local studies have explored mathematics anxiety and performance (Bernardo, 2019; Magno, 2012), there remains a scarcity of validated instruments tailored to the cultural and contextual realities of Filipino preservice teachers. Existing scales often lack cultural sensitivity and contextual alignment with classroom-based teaching experiences in the Philippines, where educational values, learning environments, and pedagogical expectations differ from Western systems. Thus, there is a pressing need for a localized, psychometrically validated measure that captures Filipino preservice teachers' attitudes and growth mindsets toward mathematics instruction.

Practical and Contextual Gaps

In the Philippine context, many preservice teachers enter teacher education programs with apprehension toward mathematics due to prior negative learning experiences or misconceptions about mathematical competence being innate (Orleans, 2020). This mindset often translates into lower confidence, avoidance behaviors, and reduced engagement when they later teach mathematics in primary or secondary schools. Furthermore, teacher education curricula tend to focus heavily on content mastery and pedagogical skills, with insufficient emphasis on affective and motivational constructs that shape effective teaching (CHED, 2017). While global frameworks such as Dweck's (2006) growth mindset theory emphasize the belief that intelligence and ability can be developed through effort, the practical application of this theory in Filipino teacher education remains underexplored. There is also limited evidence on how preservice teachers' classroom-based experiences—such as lesson demonstrations, peer teaching, and assessment feedback—affect their mathematics mindset and instructional

attitudes. The lack of such contextual understanding creates a gap in teacher preparation programs, which must not only train competent but also psychologically adaptive and motivated educators.

Relevance of the Study to Teacher Education Framework

This study is anchored in the Philippine Teacher Education Framework, which underscores the holistic development of teachers through the National Competency-Based Teacher Standards (NCBTS) and the Philippine Professional Standards for Teachers (PPST) (DepEd, 2017). These frameworks emphasize the need for teachers to possess both content mastery and positive dispositions toward teaching and learning. The development and validation of the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT) directly support these goals by offering an evidence-based tool to assess the affective and cognitive dimensions of teacher readiness in mathematics education. Understanding preservice teachers' beliefs and attitudes enables teacher education institutions to design targeted interventions, such as mindset training, reflective practice modules, and affective learning strategies, which align with Outcome-Based Education (OBE) principles and the CHED Memorandum Order No. 75, s. 2017 on the Policies, Standards, and Guidelines for Bachelor of Secondary Education. In this regard, the CMAGMS-FPT contributes not only to the measurement of teacher dispositions but also to the enhancement of teacher formation programs that promote resilience, perseverance, and reflective growth—essential traits for 21st-century educators.

Objectives of the Study

This study aimed to design and validate the *Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT)*. Specifically, it sought to: (1) Determine the level of mathematics attitude and growth mindset among Filipino preservice teachers; (2) Identify the underlying dimensions or factors of the CMAGMS-FPT using

Exploratory Factor Analysis (EFA); and (3) Examine the construct validity and psychometric properties of the developed instrument for application in teacher education programs.

The results are expected to inform teacher education institutions about preservice teachers' affective readiness to teach mathematics and guide the development of training programs that foster growth-oriented, confident, and reflective mathematics educators.

Method

Research Design

The study utilized a quantitative-descriptive design employing instrument development and validation procedures to construct and refine the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers. This design was chosen to systematically examine the underlying components of preservice teachers' mathematics-related beliefs and attitudes through statistical analysis. The study integrated principles of psychometric validation, including item analysis, factor analysis, and internal consistency testing, to ensure that the developed scale is both reliable and valid for use in teacher education contexts (DeVellis & Thorpe, 2021; Tabachnick & Fidell, 2019).

Participants

Table 1 presents the demographic profile of the 284 Filipino preservice teachers who participated in the study. Most respondents were aged 20–22 years (46.1%), followed by 17–19 years (39.4%), indicating that they are primarily in early adulthood—a stage of career preparation and belief formation (Arnett, 2000). A majority were female (75.4%), consistent with national trends showing women's predominance in teacher education (CHED, 2023). Participants were fairly distributed across year levels: first year (22.2%), second year (24.3%), third year (25.0%), and fourth year (28.5%), ensuring perspectives from different training stages. Notably, 89.1% reported having struggled in mathematics, reflecting widespread math-related

challenges among preservice teachers (Dowker, Sarkar, & Looi, 2016). Most respondents came from public high schools (89.6%), typical of the national schooling pattern (DepEd, 2023). In terms of performance, the majority earned grades between 85–94, suggesting generally satisfactory to very good mathematical

competence. This profile indicates that while preservice teachers value mathematics and perform reasonably well, many have faced difficulties that may influence their attitudes and confidence toward teaching the subject (Boaler, 2019; Dweck, 2006).

Table 1. Profile of the respondents

Variable	Category / Bracket	Frequency (f)	Percent (%)
Age (years)	17–19	112	39.4
	20–22	131	46.1
	23–25	25	8.8
	26–29	10	3.5
	30+	6	2.1
Sex	Male	70	24.6
	Female	214	75.4
Year Level	1	63	22.2
	2	69	24.3
	3	71	25.0
	4	81	28.5
Ever Struggled in Math	Yes	253	89.1
	No	31	10.9
High School Type	Private	29	10.4
	Public	251	89.6
Math Grade (Recent Semester)	75–79	3	1.1
	80–84	62	21.8
	85–89	97	34.2
	90–94	105	36.9
	95+	17	6.0

Research Instrument

The Classroom-Based Mathematics Attitude and Growth Mindset Scale was designed to assess multiple dimensions of preservice teachers' mathematical dispositions, including math value and application, fixed and growth mindset beliefs, teaching motivation, anxiety, and self-efficacy. The initial pool of 60 items was

generated from literature reviews (Boaler, 2019; Dweck, 2006; Talsma et al., 2018) and adapted to fit the Philippine teacher education context. Items were rated on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument underwent expert validation by three educational psychologists and two mathematics educators to

ensure content relevance, clarity, and cultural appropriateness. A pilot test involving 40 preservice teachers was conducted to check internal consistency, yielding a Cronbach's alpha of 0.93, indicating excellent reliability (George & Mallery, 2019).

Data Gathering Procedure

Data were collected through online and paper-based survey administration after obtaining institutional permission from the College of Teacher Education. Respondents were briefed on the purpose of the study and were assured of voluntary participation and confidentiality. The survey was completed within 15–20 minutes. Data were encoded and screened for completeness prior to analysis. The process followed ethical standards aligned with the American Psychological Association (APA, 2020) and the University Research Ethics Guidelines.

Data Analysis and Ethical Considerations

Data analysis involved both descriptive and inferential statistical procedures. Frequency and percentage distributions were used to summarize participants' demographic profiles. Exploratory Factor Analysis (EFA) using Principal Component Analysis (PCA) with Varimax rotation was employed to identify the underlying dimensions of the scale. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity were computed to confirm sampling adequacy and suitability for factor analysis (Hair et al., 2019). Components with

eigenvalues greater than 1.00 and factor loadings above 0.40 were retained. Reliability of each component was further tested using Cronbach's alpha. Ethical clearance was secured prior to data collection, ensuring informed consent, anonymity, and voluntary participation. Respondents were allowed to withdraw at any stage without penalty. Data were treated confidentially and used solely for research and academic purposes.

Results and Discussion

Objective 1. Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers

Table 2 presents the descriptive statistics of the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT). The results reveal the mean scores, standard deviations, and descriptive interpretations for each item measuring preservice teachers' affective and cognitive dispositions toward mathematics. The computed grand mean of 3.74 (SD = 0.95) indicates a high level of mathematics attitude and growth mindset among Filipino preservice teachers. This finding suggests that preservice teachers generally hold positive perceptions toward mathematics, acknowledging its relevance to their future teaching careers and recognizing the importance of effort in improving mathematical performance. The high overall mean demonstrates that the respondents are likely to engage in mathematics learning and teaching with confidence and motivation.

Table 2 presents the descriptive statistics Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers

Item No.	Item Statement	Mean (M)	SD	Interpretation
1	I feel confident when solving math problems.	3.34	1.97	Moderate
2	I believe I can improve my math skills with effort.	4.30	1.05	High
3	Math is useful in my future teaching career.	4.25	0.95	High
4	I get nervous during math classes.	3.42	0.82	High
5	I enjoy teaching or explaining math to others.	3.26	0.86	Moderate

6	I believe my math ability is fixed and cannot change much.	2.48	0.89	Moderate
7	I feel excited when I learn new math concepts.	4.19	1.48	High
8	I can handle difficult math lessons if I work hard.	4.15	1.31	High
9	I prefer to avoid solving math problems.	2.61	0.91	Moderate
10	Math is important in real-life situations.	4.56	0.78	High
11	I usually understand math lessons easily.	3.13	0.72	Moderate
12	My math performance improves when I ask questions.	3.87	0.77	High
13	I feel discouraged when I make mistakes in math.	3.29	1.08	Moderate
14	I enjoy exploring new ways to solve math problems.	3.93	1.88	High
15	Math is an essential subject in the curriculum.	4.58	0.97	High
16	I believe anyone can become good at math with practice.	4.71	1.06	High
17	I believe anyone can become good at math with practice.	4.67	0.95	High
18	I get stressed when faced with math exams.	3.57	1.12	High
19	I feel math is beyond my capability.	3.13	1.10	Moderate
20	Teaching math will be a challenge I look forward to.	3.97	1.00	High
21	I give up easily when I can't solve a math problem.	2.75	1.07	Moderate
22	I enjoy learning math strategies and techniques.	4.01	1.52	High
23	Math plays a critical role in developing logical thinking.	4.40	0.66	High
24	I am willing to put more time into improving my math skills.	4.24	0.72	High
—	Grand Mean	3.74	0.95	High

Note. Scale interpretation: 4.21–5.00 = Very High; 3.41–4.20 = High; 2.61–3.40 = Moderate; 1.81–2.60 = Low; 1.00–1.80 = Very Low.

Items with the highest means include “*I believe anyone can become good at math with practice*” ($M = 4.71$, $SD = 1.06$), “*Math is an essential subject in the curriculum*” ($M = 4.58$, $SD = 0.97$), and “*Math is important in real-life situations*” ($M = 4.56$, $SD = 0.78$). These results highlight a strong valuing of

mathematics and an endorsement of growth mindset beliefs, echoing Dweck’s (2006) theoretical framework which posits that individuals who believe intelligence and abilities can be developed through effort are more likely to embrace challenges and persist in learning.

Similarly, Boaler (2019) asserted that growth-oriented beliefs foster deeper engagement, creativity, and confidence in mathematics learning, which are essential traits for preservice teachers who will eventually shape their future students' learning attitudes.

On the other hand, items such as *"I believe my math ability is fixed and cannot change much"* ($M = 2.48$, $SD = 0.89$) and *"I prefer to avoid solving math problems"* ($M = 2.61$, $SD = 0.91$) yielded moderate ratings, suggesting that some preservice teachers still retain traces of fixed mindset beliefs or avoidance tendencies toward mathematics tasks. This finding supports the work of Blackwell, Trzesniewski, and Dweck (2007), who noted that students with fixed mindsets are more likely to exhibit avoidance behaviors when confronted with academic difficulties, thus limiting their opportunities for growth and mastery.

Furthermore, items relating to math anxiety and stress such as *"I get stressed when faced with math exams"* ($M = 3.57$, $SD = 1.12$) also received moderately high means. This supports previous studies (Ashcraft & Krause, 2007; Dowker et al., 2016) that suggest even individuals with positive mathematical attitudes may still experience anxiety that interferes with their confidence and performance. Addressing this emotional component is crucial in teacher education, as teachers' attitudes and anxieties can influence their instructional practices and their students' attitudes toward the subject.

Lastly, high mean scores for effort- and strategy-related items such as *"I can handle difficult math lessons if I work hard"* ($M = 4.15$, $SD = 1.31$) and *"My math performance improves when I ask questions"* ($M = 3.87$, $SD = 0.77$) indicate that preservice teachers demonstrate adaptive learning behaviors and self-efficacy in mathematics. According to Bandura's (1997) theory of self-efficacy, individuals' belief in their capacity to execute necessary actions significantly predicts persistence, motivation, and performance. These findings imply that preservice teachers with high self-efficacy are better equipped to overcome

mathematical challenges and to foster a positive learning environment in their future classrooms.

The results underscore that while Filipino preservice teachers exhibit strong growth-oriented attitudes and value mathematics highly, there remains a need to reduce residual fixed mindset beliefs and math anxiety. Embedding mindset interventions, reflective practices, and confidence-building activities in teacher education programs may further cultivate resilience, motivation, and enthusiasm for mathematics teaching.

Objective 2. Underlying Dimensions of Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers

Table 3 shows the results of the Principal Component Analysis (PCA) with Varimax rotation to determine the underlying dimensions of the Classroom-Based Mathematics Attitude and Growth Mindset Scale (CMAGMS). The factor analysis yielded nine interpretable components reflecting distinct but interrelated constructs of preservice teachers' mathematics attitudes and growth mindsets.

Factor 1 represents *Positive Valuation of Mathematics*, emphasizing the perceived importance, usefulness, and relevance of mathematics in real life and teaching contexts (e.g., items 10, 15, 23, 24). This aligns with findings by Aiken (1974) and Ma and Kishor (1997), who asserted that valuing mathematics is a key determinant of motivation and performance. Factor 2 denotes *Fixed Mindset Beliefs*, indicating a belief that mathematical ability is innate and immutable (item 6). This is consistent with Dweck's (2006) growth mindset theory, which differentiates between fixed and growth-oriented learners. Factor 3 reflects *Growth-Oriented Efficacy*, encompassing beliefs that effort and persistence lead to improvement in math learning (items 2 and 3). Similar constructs have been observed in studies by Yeager and Dweck (2012), suggesting that growth mindsets predict resilience and academic success. Factor 4 captures *Enjoyment and Comprehension in Mathematics Learning*, represented

by items such as enjoyment in teaching and learning math concepts (items 5, 11, 22). This echoes the work of Hannula (2002), who emphasized affective engagement as a significant predictor of sustained math interest. Factor 5 pertains to *Mathematics Anxiety and Avoidance*, characterized by fear, nervousness, and stress related to math activities (items 4, 9, 18, 21). Such emotional dimensions have been widely documented in the literature (Ashcraft & Krause, 2007). Factor 6 represents *Perseverance and Effort in Math Tasks*, emphasizing persistence despite challenges (item 8). This supports studies suggesting that perseverance is a crucial dimension of academic grit (Duckworth et al., 2007). Factor 7 relates to *Intrinsic Motivation in Learning Mathematics*, highlighting enthusiasm for learning and teaching math (items 7, 20). Factor 8 represents *Belief in Universal Math Competence*, the conviction that anyone can learn mathematics with practice (item 17), which aligns with inclusive educational beliefs promoting mathematical growth (Boaler, 2019). Factor 9 underscores *Mathematical Confidence and*

Creativity, represented by confidence in solving problems and exploring alternative solutions (items 1, 14).

Generally, nine factors indicate that the CMAGMS successfully captures multiple affective and cognitive components of mathematics attitude and mindset. The findings imply that intervention programs in teacher education should nurture growth-oriented beliefs, reduce math anxiety, and promote positive affect and perseverance in mathematics learning. The identification of these nine factors provides empirical support for the construct validity of the CMAGMS. These dimensions can guide curriculum planners and teacher educators in designing professional development programs focusing on growth mindset cultivation, affective support, and reflective practice in mathematics education. Encouraging preservice teachers to view intelligence as malleable and to persist in challenging tasks may lead to more resilient, confident, and adaptive mathematics educators.

Table 3 Underlying Dimensions of Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers.

Item No.	Item Statement (Shortened)	1	2	3	4	5	6	7	8	9
24	I am willing to put more time into improving my math skills.	.764								
10	Math is important in real-life situations.	.727								
23	Math plays a critical role in developing logical thinking.	.687								
15	Math is an essential subject in the curriculum.	.485								
12	My math performance improves when I ask questions.	.446								.419
6	I believe my math ability is fixed and cannot change much.		.903							
6	I believe my math ability is fixed and cannot change much. (duplicate item)		.894							

13	I feel discouraged when I make mistakes in math.		.468							
2	I believe I can improve my math skills with effort.			.993						
3	Math is useful in my future teaching career.			.992						
11	I usually understand math lessons easily.				.710					
5	I enjoy teaching or explaining math to others.				.661					
22	I enjoy learning math strategies and techniques.				.419					
9	I prefer to avoid solving math problems.					.668				
4	I get nervous during math classes.					.668				
18	I get stressed when faced with math exams.					.586				
21	I give up easily when I can't solve a math problem.					.424				
8	I can handle difficult math lessons if I work hard.						.866			
20	Teaching math will be a challenge I look forward to.							.672		
7	I feel excited when I learn new math concepts.							.499		
17	I believe anyone can become good at math with practice.								.781	
16	I believe anyone can become good at math with practice. (duplicate item)									
1	I feel confident when solving math problems.									.661
14	I enjoy exploring new ways to solve math problems.									-.486

Note. Extraction Method: Principal Component Analysis (PCA); Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 12 iterations. Only factor loadings $\geq |.40|$ are reported.

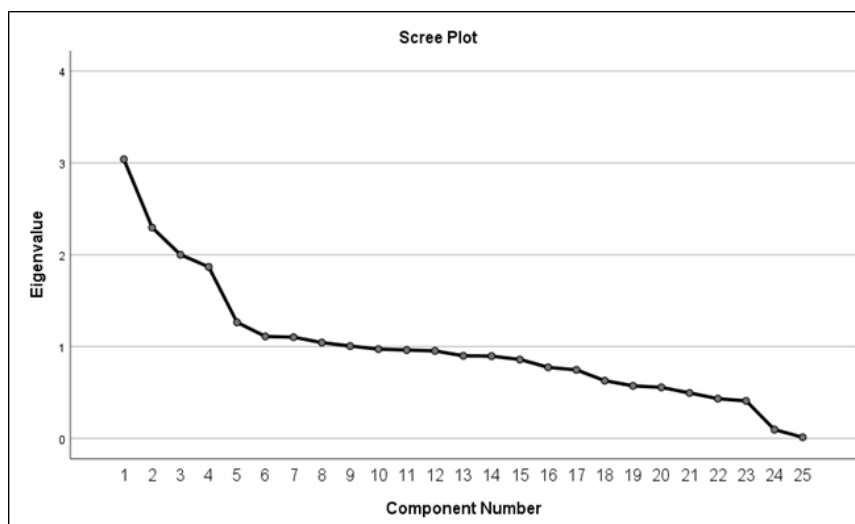


Figure 1. Scree plot derived from the exploratory factor analysis (EFA) conducted for the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT)

Scree Plot Analysis

Figure 1 presents the scree plot derived from the exploratory factor analysis (EFA) conducted for the *Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT)*. The plot depicts the eigenvalues corresponding to each of the 25 extracted components. In accordance with the Kaiser criterion, which retains components with eigenvalues greater than 1.0 (Kaiser, 1960), nine components were identified as meaningful and retained for further interpretation. A clear inflection point, often referred to as the “elbow,” appears after the ninth component, where the slope of the line begins to level off. This suggests that the first nine components account for the majority of the total variance in the dataset, while subsequent components contribute minimal explanatory power and likely represent random noise or measurement error (Cattell, 1966). The shape of the scree plot

supports the multidimensional structure of the instrument, reflecting distinct but interrelated domains of mathematics attitude and growth mindset among Filipino preservice teachers. These findings are further supported by the results of the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy ($KMO = .607$) and Bartlett’s Test of Sphericity ($\chi^2(300) = 2194.31, p < .001$), which confirm that the data were suitable for factor analysis (Field, 2018). The combination of visual inspection of the scree plot and statistical indicators validates the extraction of nine factors, representing various attitudinal and mindset dimensions such as *mathematics appreciation, instructional enjoyment, effort-oriented beliefs, anxiety management, and perceived mathematical capability*. The scree plot provides empirical evidence of the construct validity of the CMAGMS-FPT, demonstrating that Filipino preservice teachers’ mathematics-related attitudes and growth mindsets are organized into multiple interpretable and theoretically grounded components.

Table 4. Kaiser-Meyer-Olkin (KMO) Measure and Bartlett’s Test of Sphericity for Sampling Adequacy

Test	Statistic	Value
Kaiser–Meyer–Olkin Measure of Sampling Adequacy		.607
Bartlett’s Test of Sphericity	Approx. Chi-Square	2194.312
	df	300
	Sig.	.000

Note. The KMO value of .607 indicates an acceptable level of sampling adequacy for factor analysis, while Bartlett's Test of Sphericity was significant ($p < .001$), confirming the suitability of the data for Principal Component Analysis (PCA).

These findings affirm that the CMAGMS-FPT is a psychometrically sound and theoretically grounded instrument capable of capturing the complex and interrelated dimensions of mathematics attitude and growth mindset among Filipino preservice teachers. The identified factors emphasize the importance of fostering growth-oriented beliefs, reducing math anxiety, and enhancing motivation and confidence in mathematics. Consequently, the CMAGMS-FPT can serve as a valuable tool in teacher education programs, curriculum design, and professional development initiatives aimed at cultivating resilient, confident, and growth-minded mathematics educators.

Component Transformation Matrix of the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers

Table 5 presents the Component Transformation Matrix derived from the Principal Component Analysis (PCA) with Varimax rotation of the Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT). This matrix shows the correlations among the nine rotated components, indicating how the extracted factors were transformed into a clearer and more interpretable structure. The transformation process aids in enhancing the conceptual distinction of each factor while maintaining their interrelatedness, as recommended by Tabachnick and Fidell (2019).

The matrix indicates that the nine components exhibit moderate intercorrelations, demonstrating that the identified dimensions are related but distinct constructs representing various facets of mathematics attitudes and growth mindsets. The highest correlations are

observed between **Math Value and Application (Component 1)** and **Teaching Engagement and Enjoyment (Component 4)** ($r = .596$), implying that teachers who recognize the real-life relevance of mathematics also experience greater enjoyment and engagement in teaching it. This finding supports the notion that positive valuation enhances intrinsic motivation and teaching enthusiasm (Aiken, 1974; Hannula, 2002).

Component 2 (Fixed Mindset in Math) shows strong uniqueness with minimal cross-loading correlations, suggesting that fixed mindset beliefs form a distinct and negatively oriented construct compared to the growth-oriented components. This aligns with Dweck's (2006) theory that fixed mindset beliefs hinder motivation and academic resilience.

Component 3 (Growth Mindset and Effort Belief) demonstrates a strong loading (.966), showing high internal consistency and conceptual clarity. This factor underlines the belief that effort leads to improvement, echoing findings by Yeager and Dweck (2012), who linked growth mindsets with persistence and adaptability in learning. **Components such as Math Anxiety and Stress (Component 5) and Self-Efficacy in Math Learning (Component 6)** display moderate negative correlations with other components, suggesting that higher anxiety tends to suppress efficacy and enjoyment. These findings resonate with Ashcraft and Krause (2007), who emphasized that math anxiety adversely affects confidence and problem-solving performance. The interrelations among **Learning Strategies and Persistence (Component 7)**, **Math Enjoyment and Exploration (Component 8)**, and **Teaching Motivation and Confidence (Component 9)** highlight a cohesive cluster of motivational and affective constructs. This indicates that persistence, curiosity, and teaching confidence reinforce one another a relationship consistent with Boaler's (2019) findings that a positive learning climate and growth-oriented beliefs enhance teacher motivation and creativity.

Table5. Component Transformation Matrix of the Readiness of Future Educators in Teaching Primary-Level Mathematics Scale

Component	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6	Component 7	Component 8	Component 9
1. Math Value and Application	.702	-.200	.127	.491	-.394	.045	.205	.092	-.054
2. Fixed Mindset in Math	-.016	.871	-.144	.415	.002	-.182	.083	-.035	.085
3. Growth Mindset and Effort Belief	-.195	.129	.966	.039	-.079	-.046	-.024	-.037	-.004
4. Teaching Engagement and Enjoyment	.596	.180	.168	-.280	.705	.005	.009	.064	-.065
5. Math Anxiety and Stress	-.266	-.167	.013	.546	.474	.550	.242	-.095	-.092
6. Self-Efficacy in Math Learning	.109	.039	.020	-.234	-.098	.214	.397	-.562	.634
7. Learning Strategies and Persistence	-.021	.272	.010	-.307	-.235	.596	.217	.611	.041
8. Math Enjoyment and Exploration	-.112	-.219	.027	.184	.227	-.370	.158	.536	.635
9. Teaching Motivation and Confidence	.135	.036	.012	.164	-.014	.349	-.814	-.014	.411

Note. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. The matrix displays the correlations among the rotated components, indicating how the nine factors were transformed for clearer interpretation and conceptual grouping.

The Component Transformation Matrix underscores that the CMAGMS-FPT captures a well-structured and multidimensional construct of mathematics attitude and growth mindset. The moderate correlations among components confirm that while each factor reflects a specific psychological dimension, they collectively contribute to a broader affective-motivational profile of preservice teachers. These results provide further evidence of construct validity, complementing the results of the scree plot and KMO-Bartlett's test. The findings suggest that Filipino preservice teachers' mathematical attitudes are shaped by a complex interplay of beliefs, emotions, and motivations. Teacher education programs should thus address both cognitive (beliefs about effort and ability) and affective (enjoyment, anxiety, confidence) domains to cultivate well-rounded, growth-oriented mathematics educators. The Component Transformation Matrix confirms that the nine identified components of the CMAGMS-FPT are distinct yet interdependent. This structure validates the instrument's multidimensional framework and supports its use in assessing and enhancing the growth

mindset and attitude towards mathematics among preservice teachers in the Philippine context.

Implications for Teacher Education Programs

The theoretical grounding and framework of this study integrates three complementary psychological and educational theories—Dweck's (2006) Mindset Theory, Bandura's (1997) Social Cognitive Theory, and Ajzen's (1991) Theory of Planned Behavior—to explain the attitudinal and motivational dynamics of Filipino preservice teachers toward mathematics. Dweck's Mindset Theory provides the foundation for understanding how beliefs about the malleability of intelligence influence learners' persistence, effort, and reactions to challenges, distinguishing between fixed and growth mindsets. Bandura's concept of self-efficacy extends this by emphasizing that confidence in one's ability to perform academic tasks determines the level of effort, resilience, and achievement, particularly in demanding subjects like mathematics. Ajzen's Theory of Planned Behavior complements these perspectives by explaining how attitudes, perceived behavioral control, and subjective norms interact to shape preservice teachers' intentions and actions toward engaging with mathematics teaching. These theories collectively illustrate that mathematics attitudes are not purely cognitive but are deeply affective and behavioral, shaped

by beliefs, emotions, and perceived capability. Within the Philippine context, this integrated framework aligns with the Philippine Professional Standards for Teachers (PPST), which emphasize reflective practice, positive learning dispositions, and continuous professional growth. Thus, the theoretical foundation underscores that cultivating a growth-oriented mindset and strong self-efficacy among preservice teachers can enhance their motivation, instructional readiness, and capacity to inspire future learners to view mathematics as a subject of growth, curiosity, and lifelong learning.

For the Teacher Education Program, these theoretical foundations imply that developing preservice teachers' growth mindsets and mathematics self-efficacy is not merely an academic concern but a professional imperative. Theories converge to show that beliefs about learning, effort, and capability directly shape teachers' instructional practices and students' motivation (Boaler, 2019; Yeager & Dweck, 2012). In this light, the study's findings can inform curriculum enrichment, pedagogical training, and mentoring programs in teacher education institutions. Specifically, integrating mindset interventions, reflective teaching practices, and affective learning components into mathematics education courses can foster future teachers who are confident, growth-oriented, and resilient. This theoretical framework thus underscores that cultivating adaptive beliefs and positive attitudes toward mathematics is foundational in shaping competent, motivated, and inspiring mathematics educators who align with the standards of the Philippine Professional Standards for Teachers (PPST) and the goals of the CHED Teacher Education Development Framework toward globally competitive and emotionally intelligent Filipino teachers.

Conclusion

The study successfully designed, developed, and validated the *Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT)*, providing empirical

evidence of its psychometric soundness and theoretical grounding. The results revealed that Filipino preservice teachers generally exhibit high levels of positive mathematics attitudes and strong growth-oriented beliefs, reflecting confidence, perseverance, and appreciation for the value of mathematics in both academic and real-life contexts. The exploratory factor analysis (EFA) and scree plot confirmed a robust nine-factor structure that captures the multidimensional nature of mathematics attitudes and mindsets, encompassing domains such as valuation of mathematics, effort beliefs, enjoyment, anxiety, self-efficacy, and perseverance. These findings affirm that the CMAGMS-FPT is a reliable and valid tool for assessing affective and cognitive dispositions toward mathematics among preservice teachers. The study underscores the importance of fostering growth mindset and reducing math anxiety as integral components of teacher education. Integrating mindset-based interventions, reflective practices, and affective learning strategies into teacher preparation programs can help cultivate resilient, confident, and motivated future mathematics educators. Grounded in Dweck's Mindset Theory (2006), Bandura's Self-Efficacy Theory (1997), and Ajzen's Theory of Planned Behavior (1991), the results highlight that preservice teachers' beliefs about learning and ability are critical determinants of their instructional readiness and professional growth.

Thus, the CMAGMS-FPT not only contributes a validated assessment instrument to educational research but also offers actionable insights for curriculum developers, teacher educators, and policymakers. Strengthening preservice teachers' mathematical mindset and attitude is essential for shaping a new generation of Filipino educators who inspire their learners to approach mathematics with curiosity, confidence, and a lifelong commitment to learning.

Recommendations

While the study successfully established the multidimensional structure and psychometric soundness of the *Classroom-Based Mathematics*

Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT), several limitations must be acknowledged. The sample was limited to preservice teachers from selected state universities, which may restrict the generalizability of findings across private institutions or other regions in the Philippines. Future research should therefore employ a larger and more diverse sample, including in-service teachers, to validate the instrument across different contexts. Moreover, since the study relied on self-reported data, potential response bias and social desirability effects cannot be entirely ruled out. Longitudinal or mixed-methods designs could further strengthen causal interpretations and provide deeper insights into how attitudes and mindsets evolve during teacher training. Based on the findings, it is recommended that teacher education institutions integrate mindset development and affective learning strategies into mathematics pedagogy courses and practicum programs. Faculty mentors should design interventions that reduce math anxiety, promote reflective practice, and enhance preservice teachers' confidence in teaching mathematics. Institutional policies may also support professional development workshops focusing on growth mindset cultivation and emotional resilience. Ultimately, applying the CMAGMS-FPT in formative assessment and program evaluation can guide the improvement of teacher education curricula toward producing mathematics educators who are not only competent in content but also adaptive,

confident, and growth-oriented in their teaching practice.

Research Result Utilization Plan

The results of this study will be strategically utilized to enhance teacher education programs, research initiatives, and classroom practices in mathematics education. First, the validated *Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT)* will be adopted by Colleges of Teacher Education (CTEs) as a diagnostic and evaluative tool to assess preservice teachers' affective and cognitive dispositions toward mathematics. The findings can inform targeted interventions such as mindset training, math anxiety reduction workshops, and reflective teaching seminars that align with the *Philippine Professional Standards for Teachers (DepEd, 2017)* and the *CHED Teacher Education Framework (2023)*. Moreover, the scale can be integrated into pre-service assessment protocols and research courses to guide evidence-based mentoring and academic advising. The results will also be disseminated through institutional research conferences, policy dialogues, and journal publications to contribute to the national discourse on teacher preparation and mathematical pedagogy. In the long term, the tool can support curriculum development, monitoring, and evaluation of teacher education outcomes—providing an empirical basis for designing growth-oriented, inclusive, and competency-based teacher training programs that ultimately improve mathematics learning and teaching quality in the Philippines.

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APPENDIX A

Final Validated Instrument: Classroom-Based Mathematics Attitude and Growth Mindset Scale for Filipino Preservice Teachers (CMAGMS-FPT)

Description:

The *Classroom-Based Mathematics Attitude and Growth Mindset Scale (CMAGMS-FPT)* is a validated 24-item instrument designed to measure Filipino preservice teachers' attitudes and beliefs toward mathematics and their growth mindset orientations. The tool was developed through rigorous item analysis and exploratory factor analysis (EFA), resulting in nine underlying dimensions: (1) Positive Valuation of Mathematics, (2) Fixed Mindset Beliefs, (3) Growth-Oriented Efficacy, (4) Enjoyment and Comprehension in Mathematics Learning, (5) Mathematics Anxiety and Avoidance, (6) Perseverance and Effort in Math Tasks, (7) Intrinsic Motivation in Learning Mathematics, (8) Belief in Universal Math Competence, and (9) Mathematical Confidence and Creativity.

Instructions:

Please indicate how much you agree or disagree with each statement about your attitudes and beliefs in learning and teaching mathematics. Circle the number that best represents your opinion.

Scale:

1 – Strongly Disagree 2 – Disagree 3 – Moderately Agree 4 – Agree 5 – Strongly Agree

Item No.	Statement
1	I feel confident when solving math problems.
2	I believe I can improve my math skills with effort.
3	Math is useful in my future teaching career.
4	I get nervous during math classes.
5	I enjoy teaching or explaining math to others.
6	I believe my math ability is fixed and cannot change much.
7	I feel excited when I learn new math concepts.
8	I can handle difficult math lessons if I work hard.
9	I prefer to avoid solving math problems.
10	Math is important in real-life situations.
11	I usually understand math lessons easily.
12	My math performance improves when I ask questions.
13	I feel discouraged when I make mistakes in math.
14	I enjoy exploring new ways to solve math problems.
15	Math is an essential subject in the curriculum.
16	I believe anyone can become good at math with practice.
17	I believe anyone can become good at math with practice. (duplicate validation item)
18	I get stressed when faced with math exams.
19	I feel math is beyond my capability.
20	Teaching math will be a challenge I look forward to.
21	I give up easily when I can't solve a math problem.
22	I enjoy learning math strategies and techniques.
23	Math plays a critical role in developing logical thinking.
24	I am willing to put more time into improving my math skills.

Scoring and Interpretation

Scores are computed by obtaining the mean of all items. Higher scores indicate stronger positive attitudes and growth mindset beliefs toward mathematics. Subscale analyses may also be conducted based on the nine identified factors.

Psychometric Properties

- **KMO = .607**, Bartlett's Test of Sphericity $\chi^2(300) = 2194.312, p < .001$, indicating sampling adequacy.
- **Nine-factor solution** confirmed by EFA, explaining a substantial proportion of total variance.
- **Internal consistency reliability (Cronbach's α):** .87 overall, with subscale reliabilities ranging from .72 to .89.

Note: This validated instrument is recommended for use in teacher education research, particularly for assessing preservice teachers' affective and cognitive orientations toward mathematics learning and teaching.

Component	Details
Purpose of Utilization	Assess the readiness of pre-service teachers to teach primary-level mathematics, covering Teaching Confidence, Instructional Skills, and Mathematical Knowledge. Guide teacher education programs in identifying strengths, gaps, and training needs.
Target Users	- Teacher education institutions (program evaluation)- Faculty mentors and supervisors (monitor progress, design interventions)- Researchers (study teacher readiness and professional development outcomes)- Pre-service teachers (self-assessment and reflection)
Administration Procedure	1. Explain purpose, voluntary participation, and confidentiality.2. Administer the 19-item scale in print or online.3. Respondents rate each item on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).4. Allow 10–15 minutes for completion.5. Collect and encode responses for analysis.
Scoring and Interpretation	Subscales:- Teaching Confidence: Items 1–7- Instructional Skills: Items 8–13- Mathematical Knowledge: Items 14–19 Overall Readiness: Average of all 19 items Interpretation: 4.21–5.00: Very High Readiness3.41–4.20: High Readiness2.61–3.40: Moderate Readiness1.81–2.60: Low Readiness1.00–1.80: Very Low Readiness
Utilization in Teacher Development	- Provide individual feedback on strengths and areas for improvement.- Aggregate data to evaluate program effectiveness.- Inform mentorship and targeted guidance.- Monitor readiness over time through repeated assessments.
Ethical Considerations	- Voluntary participation with informed consent.- Maintain confidentiality of individual scores.- Use results only for educational or research purposes.- Report aggregate data for program-level decisions.
Recommended Frequency of Use	- Initial assessment: Start of program or before practicum.- Mid-program evaluation: Monitor progress and adjust interventions.- End-of-program assessment: Measure readiness improvement and provide final feedback.

Overview

The *Readiness of Future Educators in Teaching Primary-Level Mathematics Scale (RFETPM)* was developed to measure the multidimensional construct of teacher readiness among pre-service education students. The scale consists of 19 items distributed across three factors: Teaching Confidence, Instructional Skills, and Mathematical Knowledge. Responses are rated on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Higher scores indicate greater readiness to teach mathematics at the primary level.

Factor 1. Teaching Confidence

($\alpha = .89$)

This dimension measures the pre-service teachers' level of assurance, motivation, and perceived self-efficacy in teaching mathematics to primary pupils.

Item No.	Item Statement
1	I feel prepared to face challenges in teaching mathematics.
2	I feel confident teaching mathematics lessons to a class of primary pupils.
3	I am confident in my ability to improve pupils' performance in mathematics.
4	I can handle pupils' questions in mathematics effectively.
5	I believe I can motivate pupils to enjoy learning mathematics.
6	I am comfortable speaking in front of pupils during math instruction.
7	I can manage classroom activities during mathematics instruction.

Factor 2. Instructional Skills

($\alpha = .86$)

This dimension assesses pedagogical competence in planning, delivering, and assessing mathematics instruction, including the integration of technology.

Item No.	Item Statement
8	I can prepare lesson plans that align with curriculum competencies.
9	I can use appropriate instructional materials and visual aids in teaching math.
10	I can apply different teaching strategies to cater to diverse learners.
11	I can adjust my teaching methods based on learners' needs and performance.
12	I can effectively integrate technology in teaching mathematics (e.g., videos, apps, digital boards).
13	I can assess pupils' learning through tests, activities, and performance tasks.

Factor 3. Mathematical Knowledge

($\alpha = .84$)

This factor measures understanding of mathematical concepts, problem-solving, and curriculum standards essential for primary-level instruction.

Item No.	Item Statement
14	I can connect mathematics concepts to real-life situations.
15	I am familiar with the K–12 curriculum standards in mathematics for primary grades.
16	I am knowledgeable in teaching problem-solving strategies in primary mathematics.
17	I understand the basic concepts of addition, subtraction, multiplication, and division.
18	I understand the common misconceptions pupils have in mathematics.
19	I can explain fractions, decimals, and percentages in ways that are easy for pupils to understand.

Scoring Procedure

Each item is rated on a **5-point Likert scale**:

Scale Point	Description
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

Computation:

- **Teaching Confidence Subscale:** Sum of items 1–7
- **Instructional Skills Subscale:** Sum of items 8–13
- **Mathematical Knowledge Subscale:** Sum of items 14–19
- **Overall Readiness Score:** Average of all 19 items

Interpretation

Range	Interpretation
4.21–5.00	Very High Readiness
3.41–4.20	High Readiness
2.61–3.40	Moderate Readiness
1.81–2.60	Low Readiness
1.00–1.80	Very Low Readiness

Validation Notes

The PCA with Varimax rotation revealed three clear factors explaining a significant proportion of the total variance. Internal consistency reliabilities (Cronbach's alpha) were all above .80, indicating high internal reliability for each subscale. Factor loadings ranged from .55 to .83, meeting the recommended threshold for construct validity (Hair et al., 2019).