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Factors Influencing Preservice Teachers' Attitudes Towards Problem-Solving in Mathematics Education

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ABSTRACT

This study explored the factors that predict preservice teachers' attitudes toward incorporating problem-solving in teaching mathematics. Cognizance of the essential role of problem-solving in teaching and learning mathematics, the study underscored the latent variable that informs teachers' attitudes concerning the incorporation of problem-solving in their mathematics classrooms. Employing a structured questionnaire and Exploratory Factor Analysis (EFA) with 360 preservice teachers in Ghana, the study acknowledged four key factors: Empowerment, Readiness, Commitment, and Perceived Usefulness. These findings open gateways to preservice teacher characteristics that inform their attitude toward problem-solving and recommendations to enhance teachers' positive attitude toward the phenomenon.

INTRODUCTION

Historically, problem-solving has been recognised as a sine quo non of human existence and mathematics education to be precise (Santos-Trigo, 2020). The ability to solve problems has been an essential aspect of human societies since primeval times, as demonstrated by early mathematical literature such as the Rhind Mathematical Papyrus and the Babylonian clay tablets (Posamentier *et al.*, 2019). This emphasis on problem-solving was advanced during the Renaissance, with notables like Galileo Galilei and Leonardo da Vinci using mathematics to unravel everyday problems in various disciplines (Sinitsky & Ilany, 2016). In mathematics, problem-solving is considered a key component of comprehension and is crucial in developing mathematical skills. It also motivates students to acquire new ways of thinking and deeper knowledge (Jayasree & Sigy, 2017).

Problem-solving has advanced in the contemporary era, and mathematical models and disciplines have advanced significantly (Santos-Trigo, 2020). The cornerstone of modern mathematics was established by the seminal contributions of individuals like Isaac Newton, Leonhard Euler, and Carl Friedrich Gauss (Burton, 2011). In the twentieth century, computers enabled sophisticated computations and simulations that revolutionized fields like operations research, computer science, and artificial intelligence by ushering in a new era of problem-solving. Inherently complicated and involving numerous mental processes is problem-solving (Mahapatra, 2020). The process starts with identifying the issue, breaking it down into its parts, and then coming up with possible solutions. The next step is implementing the selected solution and assessing how well it worked (Polya, 1948). In addition to mathematics, this method has many other potential uses in fields as diverse as science, engineering, economics, medicine, and even general decision-making.

Problem-solving is recognized as a fundamental component of mathematics curricula globally due to its numerous benefits. Students are said to have essentially improved their critical thinking abilities as they analyze data and apply mathematical concepts in real-world contexts (Sinaga *et al.*, 2023). This leads to a greater understanding of mathematical principles. As they search for novel solutions to complex challenges, children who solve difficulties also develop critical skills like creativity (Sinaga *et al.*, 2023). Students who regularly complete problem-solving tasks improve their understanding of concepts and problem-solving techniques and become more mathematically proficient.

In light of this backdrop, Ghanaian pre-tertiary school mathematics curricula underscore problem-solving as a core competency for learners across all levels (Ministry of Education, 2018). The educational aims of encouraging pupils to think critically, creatively, and practically are well-aligned with this. Students who learn to solve problems are better able to help their country grow by tackling social and economic issues and making a good impact on the world around them. The incorporation of problem-solving into the curriculum has a multiplicative effect on student achievement and national development in Ghana since it improves academic achievements and prepares students for future jobs (Ministry of Education, 2018).

Similarly, The Ghanaian education system has recognized the importance of integrating problem-solving skills into the teacher training curriculum. To this end, the mathematics teacher training curriculum includes various courses and modules designed to equip pre-service teachers with the necessary skills to teach mathematics effectively (Akyeampong, 2017). Typically, this curriculum encompasses mathematics

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content courses, which cover fundamental mathematical concepts and principles, and pedagogy courses, which focus on teaching methodologies, including problem-solving strategies (Adu-Yeboah *et al.*, 2014). Additionally, it includes practicum and teaching practice, providing hands-on experience in teaching mathematics with an emphasis on applying problem-solving techniques in classroom settings (Akyeampong, 2017). Studies, such as those by Akyeampong (2017) and Adu-Yaboah, Kwaah, Abreh and Amuah (2016) have highlighted this structured approach, which aims to balance theoretical knowledge with practical application.

Despite the numerous benefits of problem-solving for learners and the country at large, its incorporation into mathematics education has encountered significant challenges. Teachers have demonstrated a noticeable reluctance to integrate problem-solving methodologies into their mathematics lessons (Adu-Yaboah *et al.*, 2016). This negative attitude towards problem-solving approaches has been reported to adversely impact students' performance and the educational system as a whole (Adu-Yeboah *et al.*,2014). While numerous studies have explored the phenomenon of teachers' reluctance, few have delved into the specific characteristics of teachers that might account for this hesitation (Akyeampong, 2017). Therefore, there is a pressing need for a study that seeks to unearth the underlying issues contributing to teachers' reluctance to incorporate problem-solving approaches in their mathematics classrooms. This study aims to fill this gap by investigating the potential factors that may explain teachers' reluctance. By contributing to the existing body of knowledge, the study will provide insights that can inform strategies to encourage the adoption of problem-solving methodologies in mathematics education, ultimately enhancing students' learning experiences and outcomes.

Research Questions

What underlying factors influence elementary school teachers' attitudes toward the incorporation of problem-solving approaches in mathematics education?

LITERATURE REVIEW

The importance of mathematics has grown significantly in the 21st century, serving as a key indicator of a country's competitive standing on international platforms (Sitopu *et al.*,2024). Educational systems worldwide continually evolve, with countries like Ghana updating their national curricula to enhance mathematics achievement. The shift towards a constructivist approach has underscored the critical role of problem-solving skills in mathematics education (Hourigan & Leavy, 2023). Mathematical problems are challenges that require innovative strategies for resolution, with a distinction between routine problems, which have single solutions, and non-routine problems, which have multiple solutions. The ability to solve mathematical problems is crucial as it fosters a deeper understanding and flexible thinking. Research has shown that problem-solving skills promote creative thinking and provide insights into students' mathematical understanding (Anggraeni, *et al.*, 2023).

Despite ongoing debates about the most effective methods for teaching mathematics, numerous studies affirm the benefits of focusing on problem-solving (Adu-Yaboah, *et al.*, 2016). Attitudes toward mathematics, encompassing emotions, value perception, and confidence, significantly influence students' engagement and success in the subject. Positive attitudes are essential for fostering interest, reducing anxiety, and ultimately affecting career choices and the daily application of mathematical knowledge (Akyeampong, 2017). The Ghanaian mathematics curriculum aligns with these insights, prioritizing problem-solving, positive attitude development, and the integration of engaging activities to enrich learning experiences and outcomes (Adu-Yeboah*et al.*,2014). This emphasis on problem-solving prepares students to tackle complex mathematical challenges and equips them with essential skills for real-world problem-solving, thus enhancing their overall educational and professional trajectories.

Given this context, extensive research (eg. Csanadi, Kollar, & Fischer, 2021; Khalid, *et al.*, 2020; Santos-Trigo M., 2020; Akyeampong, 2017) has delved into the interplay between teacher characteristics and the adoption of problem-solving methodologies across various subjects, including mathematics. While a substantial body of work underscores the critical role of problem-solving approaches in the teaching and learning of mathematics, there remains a notable emphasis on the broader educational benefits of these methodologies (Anggraeni *et al.*, 2023). Researchers in mathematics education and allied disciplines have also examined how specific teacher characteristics influence the integration of problem-solving strategies in their pedagogy (Anggraeni*et al.*, 2023). However, there appears to be a significant gap in the literature regarding the determinants that shape these teacher characteristics in incorporating problem-solving techniques into mathematics instruction (Mršnik*et al.*, 2023).

The existing literature reveals that many mathematics educators exhibit negative attitudes toward integrating problem-solving approaches. These dispositions are often compounded by low self-efficacy and a limited understanding of problem-solving strategies and their application in the mathematics classroom (Mršnik *et al.*, 2023). This negative disposition toward problem-solving is a critical barrier to its effective incorporation into teaching practices. On the other hand, some studies highlight that a subset of mathematics teachers holds positive views on using problem-solving approaches. These teachers demonstrate favorable attitudes, robust knowledge, and a higher degree of efficacy in implementing problem-solving strategies in their teaching (Mršnik *et al.*, 2023; Ulia & Kusmaryono, 2021). This dichotomy in perspectives suggests a complex landscape where teacher attitudes, knowledge, and self-efficacy significantly influence the adoption of problem-solving methodologies in mathematics education.

While considerable research has illuminated the importance of problem-solving in mathematics education and the varying attitudes of teachers towards its integration, there remains a paucity of studies focusing on the underlying factors that inform these teacher characteristics (Mohd & Mahmood, 2011). Addressing this research gap is crucial for developing targeted interventions that can enhance the adoption of problem-solving approaches in mathematics teaching, ultimately leading to improved educational outcomes (Daniela *et al.*, 2021).

Neuroscientists in education have suggested that both positive and negative classroom behaviors exhibited by teachers are influenced by a variety of confounding factors (Twumasi & Afful, 2022). Similarly, existing literature indicates that students' academic performance is directly linked to teacher characteristics (Siswono *et al.*, 2019). Therefore, to gain a comprehensive understanding and provide deeper insights into teacher attitudes, it is imperative to explore the factors that shape mathematics teachers' attitudes toward incorporating problem-solving strategies in their instruction (Mršnik *et al.*, 2023).

While considerable research has illuminated the importance of problem-solving in mathematics education and the varying attitudes of teachers towards its integration, there remains a paucity of studies focusing on the underlying factors that inform these teacher characteristics (Twumasi & Afful, 2022). Addressing this research gap is crucial for developing targeted interventions that can enhance the adoption of problem-solving approaches in mathematics teaching, ultimately leading to improved educational outcomes (Mršnik *et al.*, 2023).

Furthermore, this exploration is essential for identifying and developing strategies that can enhance teachers' positive attitudes toward the integration of problem-solving methodologies in the teaching of mathematics. By investigating these underlying factors, the study aims to illuminate the complex dynamics that influence teacher behavior and attitudes, offering practical recommendations for fostering a more conducive environment for problem-solving in mathematics education. This, in turn, can lead to more effective teaching practices and improved student outcomes (Mohd & Mahmood, 2011).

METHODOLOGY

Participants

A total of 360 respondents constituting 120 level 300 students each in early childhood, upper primary and junior high school programmes participated in the study. Level 300 students were considered for the study due to proximity and maximum exposure to problem-solving techniques in their programmes. The sampling of respondents for the study was conducted to arrive at a representation of the statistical population. Hence the varied characteristics of the statistical population were taken into consideration. The male and female representation for the study was 45 each while the average age of all respondents was 24 years with a range of 20 to 32 years.

Research Instruments

Questionnaire

This study's data collection instrument was a structured questionnaire designed to evaluate participants' attitudes toward problem-solving in the teaching of mathematics. It included a series of statements specifically aimed at assessing preservice teachers' views on problem-solving in mathematics instruction. Participants rated these statements on a four-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." The questionnaire's development adhered to established guidelines to ensure its content validity and reliability. It contained 27 statements, each with response options coded from 1 (Strongly Disagree) to 4 (Strongly Agree). Reliability was measured using Cronbach's alpha, resulting in a high value of 0.967, indicating excellent internal consistency. Before data collection, the questionnaire was pilot-tested with a small group to confirm the clarity and understanding of the items. Ethical considerations were addressed, and informed consent was obtained from all participants. Overall, the questionnaire proved to be a reliable and valid tool for measuring attitudes toward problem-solving in teaching mathematics, providing valuable data for the study's objectives.

Data Analysis

To robustly address Research Question 1, the study applied the Exploratory Factor Analysis (EFA) statistical method. A substantial cohort of 360 respondents participated, aligning with established guidelines in the literature for determining sample adequacy in EFA. Notably, Hair (2009) proposes benchmarks of 5:1, 10:1, and 20:1, characterizing these ratios as acceptable, moderate, and excellent, respectively. In this study, surpassing the 10:1 ratio underscores its excellence in sample size selection. Central to EFA is the assumption of inter-variable correlations, necessitating a thorough examination thereof. Two key metrics were utilized for this purpose: the Kaiser-Meyer-Olkin Measure of Sampling Adequacy, which ideally approaches 1.0 for optimal suitability, and Bartlett's Test of Sphericity, signifying the presence of adequate inter-variable correlations when statistically significant (Hair, 2009).

IBM SPSS (v29.0) facilitated the analysis, employing the Principal Components method for extraction and the Varimax technique for rotation. Methodologically, the authors refrained from preconceived notions regarding the number of retained factors, yet practical considerations for robust factor structure, especially with 12 variables, suggest retaining between four to six factors, aligning with recommendations for multiple measurements per factor (Hair, 2009). Moreover, decisions on factor retention were substantiated using multiple criteria including Kaiser's criterion, scree plot examination, and variance explained thresholds, ensuring a methodologically rigorous approach to derive meaningful insights from the data.

RESULT

Descriptive Analysis

Table 1 presents a comprehensive summary of the descriptive statistics for the survey data, detailing the mean, standard deviation, skewness, and kurtosis for each variable. The mean values, all comfortably above the midpoint of 2, range from 3.28 to 3.47, indicating a generally favorable response across the sample. The standard deviations, which vary between .719 and .951, suggest a moderate to high level of dispersion in the responses. Skewness values span from -.921 to -.921, indicating a symmetrical distribution around the mean. Kurtosis values, ranging from -.072 to 3.123, fall within acceptable limits, indicating the data's suitability for further statistical analysis. These metrics collectively affirm the robustness and reliability of the survey data, supporting subsequent EFA procedures.

Table 2 provides the results of the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity, both of which affirm the dataset's suitability for Exploratory Factor Analysis (EFA). The KMO value of .912 indicates an exceptionally high level

Table 1: Mean, Standard Deviation, Kewness and Kurtosis of Survey Data

Variable	Mean	Std. Deviation	Skewness	Kurtosis
1. PATPS	3.40	.893	-1.442	1.134
2. PATPS	3.29	.848	-.921	-.108
3. PATPS	3.31	.813	-1.253	1.322
4. PATPS	3.52	.886	-1.904	2.562
5. PATPS	3.53	.719	-1.745	3.123
6. PATPS	3.41	.882	-1.492	1.356
7. PATPS	3.28	.896	-1.230	.787
8. PATPS	3.37	.876	-1.386	1.163
9. PATPS	3.31	.799	-1.015	.460
10. PATPS	3.39	.840	-1.402	1.356
11. PATPS	3.30	.863	-1.038	.191
12. PATPS	3.33	.858	-1.125	.397
13. PATPS	3.30	.863	-1.143	.582
14. PATPS	3.26	.951	-1.078	.072
15. PATPS	3.37	.824	-1.251	.956
16. PATPS	3.32	.906	-1.224	.555
17. PATPS	3.36	.912	-1.295	.656
18. PATPS	3.34	.847	-1.388	1.463
19. PATPS	3.30	.889	-1.296	.996
20. PATPS	3.39	.917	-1.459	1.125
21. PATPS	3.32	.868	-1.291	1.024
22. PATPS	3.32	.868	-1.291	1.024
23. PATPS	3.43	.762	-1.369	1.575
24. PATPS	3.47	.820	-1.658	2.211
25. PATPS	3.40	.787	-1.390	1.671
26. PATPS	3.42	.857	-1.571	1.795
27. PATPS	3.39	.771	-1.235	1.175

Table 2: Kaiser-Meyer-Olkin Measure and Bartlett's Test of Sphericity

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.912
Bartlett's Test of Sphericity	Approx. Chi-Square	9091.523
	df	351
	Sig.	.000

of sampling adequacy, well above the commonly accepted threshold of .50, signifying that the sample size is more than sufficient for reliable factor analysis. Additionally, Bartlett's Test of Sphericity yields a highly significant result, $\chi^2(351) = 9091.523$, $\varrho < 0.000$, demonstrating that the correlations among variables are robust enough to justify the application of EFA. These results collectively underscore the appropriateness of the dataset for uncovering underlying factor structures.

Exploratory Factor Analysis

Table 3 delineates the extracted factors along with their corresponding eigenvalues, the percentage of variance explained by each factor, and the cumulative variance accounted for by the factors. Employing the Kaiser criterion, which retains factors with eigenvalues greater than one, the analysis identified four distinct factors. This finding aligns with the anticipated range of four to six factors and collectively accounts for 68.558% of the total variance observed in the dataset derived from 360 preservice teachers. Although opinions vary on the acceptable threshold for total variance explained, the present findings conform to established recommendations within the social sciences (Aktas & Tabak, 2018; Korkmaz & Unsal, 2016). Specifically, Factor 1 explains a substantial 54.273% of the variance, Factor 2 accounts for 5.598%, Factor 3 contributes 4.844%, and Factor 4 explains 3.842%. This distribution underscores the first factor's dominant influence while highlighting the subsequent factors' meaningful contributions in capturing the data's complexity.

The scree plot in Figure 2 vividly illustrates that retaining four factors is justifiable, as evidenced by the pronounced "elbow" in the plot where the eigenvalues begin to level off. Specifically, the eigenvalue for the fifth factor, assessed against the latent root criterion value of 1.0, falls short at .925, thereby precluding its inclusion (Hair, 2009). Although an eigenvalue close to 1.0 might typically

Table 3: Results of the Component Factor Extraction

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.654	54.273	54.273	14.654	54.273	54.273
2	1.512	5.598	59.872	1.512	5.598	59.872
3	1.308	4.844	64.716	1.308	4.844	64.716
4	1.037	3.842	68.558	1.037	3.842	68.558
5	.925	3.425	71.984			
6	.872	3.230	75.214			
7	.789	2.923	78.137			
8	.739	2.735	80.873			
9	.643	2.381	83.254			
10	.553	2.050	85.303			
11	.534	1.977	87.280			
12	.419	1.551	88.831			
13	.393	1.454	90.285			
14	.383	1.420	91.705			
15	.292	1.081	92.786			
16	.274	1.015	93.801			
17	.262	.970	94.771			
18	.250	.925	95.696			
19	.212	.785	96.481			
20	.171	.632	97.113			
21	.164	.609	97.721			
22	.143	.531	98.253			
23	.124	.459	98.712			
24	.111	.411	99.124			
25	.093	.345	99.469			
26	.080	.295	99.764			
27	.064	.236	100.000			

warrant consideration, this particular value does not meet the threshold. Consequently, all criteria converge to endorse the retention of four factors for subsequent analysis, ensuring a robust and theoretically sound factor structure for further investigation.

Table 4 presents the factor loadings for each variable, with values ranging from .480 to .770. According to Hair (2009), factor loadings of .40 and above are considered significant for sample sizes of 200 or more, thus validating the retention of all items. Additionally, Table 4 demonstrates that each of the four factors is robust, with at least three variables per factor exhibiting loadings above .40. This adherence to established guidelines confirms the reliability and validity of the factor structure, supporting the inclusion of all items in further analyses.

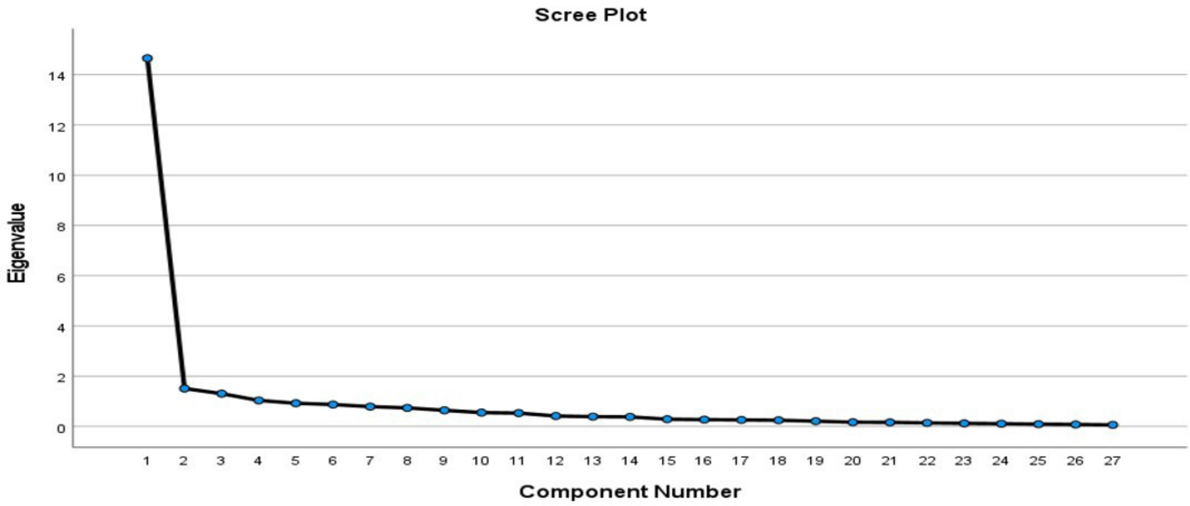

Figure 1: Scree Plot

Table 5 presents the final results of the Exploratory Factor Analysis (EFA), detailing the factor names, Cronbach's alpha values, and factor loadings of each item. The reliability of the scale for each factor is deemed acceptable, meeting the recommended cutoff value of 0.7 as suggested by Hair (2009). Items that loaded heavily on Factor 1 were conceptually linked to gaining

Table 4: Varimax-Rotated Factor Matrix Analysis

Variable	Component			
	1	2	3	4
27. PATPS	.751			
25. PATPS	.741			
3. PATPS	.679			
24. PATPS	.669			
16. PATPS	.625			
5. PATPS	.606			
9. PATPS	.566			
2. PATPS	.537			
6. PATPS	.536			
18. PATPS	.528			
19. PATPS	.485			
26. PATPS		.778		
4. PATPS		.744		
10. PATPS		.672		
14. PATPS		.651		
12. PATPS		.621		
11. PATPS		.568		
20. PATPS		.543		
7. PATPS		.533		

23. PATPS			.770	
22. PATPS			.690	
8. PATPS			.626	
21. PATPS			.593	
13. PATPS			.480	
15. PATPS				.691
1. PATPS				.669
17. PATPS				.602

strength, confidence, and authority over one's actions. Consequently, this factor was named "Empowerment". Similarly, the items that loaded heavily on Factor 2 were primarily associated with readiness and willingness regarding the implementation of problem-solving. Therefore, Factor 2 was christened "Readiness". Factor 3 was designated as "Commitment" because the majority of items in this scale measured respondents' assurance and pledge to implement problem-solving in their mathematics classrooms. Furthermore, all the items in Factor 4 were aimed at measuring respondents' perceived usefulness of problem-solving in mathematics education, leading to its designation as "Perceived Usefulness".

Table 5: Comprehensive Results of the Exploratory Factor Analysis

Variable	Item	Factor loadings
Factor 1. Empowerment (Cronbach's alpha ∝ .934)		
27.	I perceive problem-solving as a means to develop students' problem-solving skills beyond mathematics.	.751
25.	I recognize the role of technology in facilitating problem-solving in mathematics education.	.741
3.	I feel confident in my ability to teach problem-solving strategies effectively.	.679
24.	I see problem-solving as an avenue for promoting mathematical curiosity and exploration.	.669
16.	I believe problem-solving activities can increase students' confidence in their mathematical abilities.	.625
5.	I think problem-solving activities motivate students to engage with mathematics.	.606
9.	I am enthusiastic about introducing innovative problem-solving approaches in my Classroom	.566
2.	I enjoy incorporating problem-solving activities into my teaching practices.	.537
6.	I consider problem-solving as important as procedural skills in mathematics education.	.536
18.	I recognize the importance of assessing students' problem-solving skills in mathematics.	.528
19.	I am interested in learning more about effective strategies for teaching problem-solving.	.485
Factor 2. Readiness (Cronbach's alpha ∝ .925)		
26.	I believe problem-solving activities should be differentiated to meet the needs of all students.	.778
4.	I believe problem-solving enhances students' critical thinking abilities.	.744
10.	I perceive problem-solving as an opportunity for students to apply mathematical knowledge.	.672
14.	I am willing to adapt my teaching methods to facilitate problem-solving in mathematics better.	.651
12.	I am committed to creating a supportive environment for students to engage in problem-solving activities.	.621
11.	I can incorporate real-life problems into mathematics instruction to enhance problem-solving skills.	.568
20.	I believe problem-solving challenges students to think creatively.	.543
7.	I feel well-prepared to teach problem-solving skills to my future students.	.533
Factor 3 Commitment (Cronbach's alpha ∝ .860)		
23.	I am committed to providing scaffolding to support students' problem-solving efforts.	.770
22.	I view mistakes as valuable learning opportunities in problem-solving activities.	.690
8.	I believe problem-solving fosters a deeper understanding of mathematical concepts.	.626
21.	I feel comfortable guiding students through the problem-solving process.	.593
13.	I believe problem-solving promotes perseverance and resilience in students.	.480

Factor 4. Perceived usefulness (Cronbach's alpha ∝ .821)		
15.	I perceive problem-solving as an integral part of the mathematics curriculum.	.691
1.	I believe problem-solving skills are crucial for students' mathematical development.	.669
17.	I think problem-solving allows students to explore multiple solution strategies.	.602

DISCUSSION

The analysis of the survey data reveals generally favorable responses from participants, as indicated by the mean values consistently exceeding the midpoint. This trend is further supported by the standard deviations, which suggest a moderate to high level of variability in the responses, signifying a diverse range of opinions within a positive framework. Additionally, the skewness and kurtosis values fall within acceptable limits, confirming the normal distribution and robustness of the data. These descriptive statistics collectively ensure the survey data is reliable and form a solid foundation for more advanced statistical analyses.

Further validating the dataset's suitability for Exploratory Factor Analysis (EFA) are the results of the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The exceptionally high KMO value of .912 indicates outstanding sampling adequacy, suggesting that the sample size is more than sufficient for reliable factor analysis. Moreover, Bartlett's Test of Sphericity yields a highly significant result ($\chi^2(351) = 9091.523$, $\varrho < 0.000$), demonstrating that the correlations among variables are robust enough to justify the use of EFA. These findings collectively affirm the appropriateness of the dataset for uncovering latent constructs.

The EFA results, as detailed, identify four distinct factors based on the Kaiser criterion, which retains factors with eigenvalues greater than one. These four factors: Empowerment, Readiness, Commitment, and Perceived Usefulness, collectively explain 68.558% of the total variance. The first factor alone accounts for a substantial 54.273% of the variance, underscoring its dominant influence on the dataset. Although contributing smaller portions of the variance, the remaining factors still add meaningful dimensions to the overall analysis. The scree plot further corroborates the decision to retain four factors, with a clear "elbow" indicating where the eigenvalues begin to level off.

The factor loadings are robust and all exceed the .40 threshold, which is significant for large sample sizes. This validation is crucial for confirming the reliability and validity of the factor structure. Each factor comprises multiple variables with high loadings, ensuring that the factors are well-defined and reliable for further analysis. The high internal consistency of each factor, indicated by Cronbach's alpha values greater than .8, reinforces the reliability of the factors.

In terms of interpretation, the factors were named based on the conceptual coherence of the items that loaded heavily on each factor. "Empowerment" encompasses items related to gaining strength, confidence, and authority over one's actions. "Readiness" includes the readiness and willingness to implement problem-solving strategies. "Commitment" measures the assurance and pledge to implement problem-solving in mathematics classrooms. Finally, "Perceived Usefulness" assesses the perceived usefulness of problem-solving in mathematics education. These factors provide valuable insights into the various dimensions of preservice teachers' attitudes and preparedness for problem-solving in mathematics education, offering a robust framework for developing targeted interventions and professional development programs.

CONCLUSION

The comprehensive analysis of the survey data reveals a generally favorable disposition among preservice teachers towards problem-solving in mathematics education. The descriptive statistics confirm the data's reliability and robustness, laying a solid groundwork for exploratory analyses. The high KMO value and significant Bartlett's Test result validate the dataset's suitability for Exploratory Factor Analysis (EFA), which identified four distinct factors: Empowerment, Readiness, Commitment, and Perceived Usefulness. These factors collectively explain a substantial portion of the total variance and demonstrate high internal consistency. The findings provide valuable insights into preservice teachers' attitudes and preparedness, highlighting key areas for targeted interventions and professional development.

Recommendation

Based on the findings, it is recommended that teacher training programs place greater emphasis on enhancing preservice teachers' empowerment, readiness, and commitment towards problem-solving methodologies. This can be achieved through targeted professional development workshops, inclusion of more practical problem-solving modules in the curriculum, and providing ample opportunities for hands-on experience with problem-solving in real classroom settings. Additionally, integrating technology and promoting its role in facilitating problem-solving can further enhance teachers' perceptions of its usefulness, thereby encouraging more widespread adoption of these strategies in mathematics education.

LIMITATION

Despite the robustness of the data and the thoroughness of the analysis, several limitations must be acknowledged. First, the study's sample is limited to preservice teachers, which may not fully represent the broader population of practicing educators. Second, the survey relies on self-reported data, which can be subject to bias. Third, the cross-sectional nature of the study captures attitudes and perceptions at a single point in time, potentially overlooking changes over time or the impact of longitudinal influences. Lastly, the generalizability of the findings may be constrained by cultural or educational system differences not accounted for in the study.

Future Research Needed (FRN)

Future research should focus on longitudinal studies to track changes in preservice teachers' attitudes toward problem-solving as they transition into professional teaching roles. Additionally, exploring the impact of specific interventions, such as professional development programs and mentorship, on enhancing teachers' problem-solving skills and attitudes could provide deeper insights. Further studies should also consider the influence of cultural and contextual factors on the adoption of problem-solving methodologies in diverse educational settings, thereby contributing to a more comprehensive understanding of the factors that facilitate or hinder the integration of problem-solving in mathematics education.

REFERENCES

Adu-Yaboah, C., Kwaah, C. Y., Abreh, M. K., & Amuah, E. (2016). Preparing student teachers for teaching: An exploration of field experience in three colleges of education in Ghana. *Journal of Educational Development and Practice (JED-P), 7*(2), 1-27.

Adu-Yeboah, C., Kwaah, C., Abreh, M., & Amuah, E. (2014). *An investigation of the practical component of the Initial Teacher Education Programme.* Cape Coast: University of Cape Coast Publication.

Aktas, M. C., & Tabak, S. (2018). Turkish adaptation of Math and Me Survey: A validity and reliability study. *European Journal of Educational Research, 7*(3), 707-714. https://doi.org/10.12973/eu-jer.7.3.707

Akyeampong, K. (2017). Teacher Educators' Practice and Vision of Good Teaching in Teacher Education Reform Context in Ghana. *Educational Researcher, 46*(4), 194-203. doi:10.3102/0013189X17711907

Anggraeni, D. M., Prahani, B. K., Suprapto, N., Shofiyah, N., & Jatmiko, B. (2023). Systematic review of problem based learning research in fostering critical thinking skills. *Thinking Skills and Creativity, 49*. https://doi.org/10.1016/j.tsc.2023.101334

Burton, D. M. (2011). *The history of mathematics: An introduction* (Vol. 7). McGraw-Hill.

Csanadi, A., Kollar, I., & Fischer, F. (2021). Pre-service teachers' evidence-based reasoning during pedagogical problem-solving: better together? *A Journal of Education and Development, 36,* 147–168. https://doi.org/10.1007/s10212-020-00467-4

Daniela, O., Lupiáñez, J. L., & Segovia, I. (2021). Roles and characteristics of problem solving in the mathematics curriculum: a review. *International Journal of Mathematical Education in Science and Technology, 52*(7). https://doi.org/1079-1096. 10.1080/0020739X.2020.1738579

Hair, J. F. (2009). *Multivariate data analysis* (7th ed.). Pearson.

Hourigan, M., & Leavy, A. M. (2023). Elementary teachers' experience of engaging with Teaching Through Problem Solving using Lesson Study. *Mathematics Education Research Journal,* 901-927. https://doi.org/10.1007/s13394-022-00418-w

Jayasree, P. G., & Sigy, E. G. (2017). Problem solving ability in mathematics as a correlate of divergent production abilities of higher secondary school students. *PARIPEX - Indian Journal of Research, 6*(5), 320-321. https://www.worldwidejournals.com/paripex/recent_issues_pdf/2017/May/problem-solving-ability-in-mathematics-as-a-correlate-of-divergent-production-abilities-of-higher-secondary-school-students_May_2017_2691471681_6511246.pdf

Khalid, M., Saad, S., Abdul Hamid, S. R., Ridhuan Abdullah, M., Ibrahim, H., & Shahrill, M. (2020). Enhancing Creativity and Problem Solving Skills Through Creative Problem Solving in Teaching Mathematics. *Creativity studies, 13*(2), 270-291. https://doi.org/10.3846/cs.2020.11027

Korkmaz, F., & Unsal, S. (2016). Developing the scale of teacher self-efficacy in teaching process. *European Journal of Educational Research, 5*(3), 73-83. https://doi.org/10.12973/eu-jer.5.2.73

Mahapatra, P. K. (2020, June 18). *Math phobia: Causes and remedies.* Times of India. https://timesofindia.indiatimes.com/readersblog/a-common-man-viewpoint/math-phobia-causes-and-remedies-21792/

Ministry of Education. (2018). *National pre-tertiary education curriculum framework.* National Council for Curriculum and Assessment.

Mohd, N., & Mahmood, T. F. (2011). The Effects of Attitude Towards Problem Solving in Mathematics Achievements. *Australian Journal of Basic and Applied Sciences, 5*(12), 1857-1862.

Mršnik, S., Cotič, M., Felda, D., & Doz, D. (2023). Teachers' Attitudes Towards Mathematics Problem-Solving. *International Journal of Instruction, 16*(2), 823-836. https://doi.org/10.29333/iji.2023.16243a

Polya, G. (1948). *How to solve it: A new aspect of mathematical method.* Princeton University Press.

Posamentier, A. S., Kose, G., Virgadamo, D. S., & Keefe-Cooperman, K. (2019). *The psychology of problem solving: The background to successful mathematics thinking* (Vol. 12). World Scientific. https://doi.org/10.1142/11426

Santos-Trigo, M. (2020). Problem-Solving in Mathematics Education. In S. Lerman (Ed.), *Encyclopedia of Mathematics Education* (pp. 686-693). Springer, Cham. https://doi.org/10.1007/978-3-030-15789-0_129

Santos-Trigo, M. (2020). Problem-Solving in Mathematics Education. In S. Lerman (Ed.), *Encyclopedia of Mathematics Education* (2nd ed., pp. 686–693). Springer. https://doi.org/10.1007/978-3-030-15789-0_129

Sinaga, B., Sitorus, J., & Situmeang, T. (2023). The influence of students' problem-solving understanding and results of students' mathematics learning. *Frontiers in Education, 8,* 1088556. https://doi.org/10.3389/feduc.2023.1088556

Sinitsky, I., & Ilany, B.-S. (2016). *Change and invariance: A textbook on algebraic insight into numbers and shapes*. SensePublishers. https://doi.org/10.1007/978-94-6300-699-6

Siswono, T. Y. E., Kohar, A. W., & Hartono, S. (2019). Beliefs, knowledge, teaching practice: Three factors affecting the quality of teachers' mathematical problem-solving. *Journal of Physics: Conference Series, 1317*(1), 012127. https://doi.org/10.1088/1742-6596/1317/1/012127

Sitopu, J. W., Khairani, M., Roza, M., Judijanto, L., & Aslan, A. (2024). The importance of integrating mathematical literacy in the primary education curriculum: A literature review. *International Journal of Teaching and Learning (INJOTEL), II*(1), 121-134.

Twumasi, E. B., & Afful, J. A. (2022). Junior High School Teachers and Students' Attitude toward Teaching and Learning Mathematics through Problem Solving: A Case Study from Mampong Municipality. *American Journal of Education and Practice, 6*(3), 26-43.

Ulia, N., & Kusmaryono, I. (2021). Mathematical disposition of students', teachers, and parents in distance learning: A survey. *Premiere Educandum: Jurnal Pendidikan Dasar dan Pembelajaran, 11*(1), 147-159. https://doi.org/10.25273/pe.v11i1.8869