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Pre-service Teachers' Perception of the Benefits of Problem-solving and Strategies Used to Solve Mathematical Problems: A Case from some Colleges of Education in Ghana

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Abstract

The quality of pre-service mathematics teacher education depends greatly on their understanding of mathematical problem-solving and its pedagogy. This study investigates pre-service teachers' perceptions of the benefits of problem-solving in mathematics and the strategies they employ to solve problems. A qualitative design was adopted, involving 30 randomly selected participants from three Colleges of Education in Ghana. Data were collected through semi-structured interviews, transcribed, and analyzed thematically. Findings reveal that participants possess substantial knowledge of the benefits of problem-solving, including developing critical thinking and understanding, fostering intellectual challenge, enhancing real-life application skills, achieving set goals, overcoming difficulties, and selecting appropriate strategies. The study also highlights the range of strategies used by pre-service teachers, such as visual representation, logical reasoning, and varied heuristic approaches. These insights underscore the need to strengthen problem-solving pedagogy in teacher preparation programs to enhance both mathematical understanding and teaching practice.

Keywords: Problem-solving, Pre-service teachers, Benefits, Mathematical problems

Abstrak

Kualitas pendidikan calon guru matematika sangat bergantung pada pemahaman mereka tentang pemecahan masalah matematika dan pedagoginya. Penelitian ini mengkaji persepsi calon guru terhadap manfaat pemecahan masalah dalam matematika serta strategi yang mereka gunakan untuk menyelesaikannya. Penelitian ini menggunakan desain kualitatif dengan melibatkan 30 partisipan yang dipilih secara acak dari tiga Perguruan Tinggi Pendidikan di Ghana. Data dikumpulkan melalui wawancara semi-terstruktur, ditranskripsi, dan dianalisis secara tematik. Hasil penelitian menunjukkan bahwa partisipan memiliki pengetahuan yang memadai tentang manfaat pemecahan masalah, termasuk mengembangkan keterampilan berpikir kritis dan pemahaman, mendorong tantangan intelektual, meningkatkan kemampuan penerapan dalam kehidupan nyata, mencapai tujuan yang ditetapkan, mengatasi kesulitan, dan memilih strategi yang tepat. Studi ini juga menyoroti beragam strategi yang digunakan calon guru, seperti representasi visual, penalaran logis, dan pendekatan heuristik yang bervariasi. Temuan ini menegaskan perlunya penguatan pedagogi pemecahan masalah dalam program pendidikan guru untuk meningkatkan pemahaman matematika dan praktik pengajaran.

Kata kunci: Pemecahan masalah, Calon guru, Manfaat, Masalah matematika

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Introduction

Teacher education remains a prominent focus in academic research (Buabeng, Ntow, & Otami, 2020). The substantial impact of teachers on students' learning outcomes, particularly those from disadvantaged and marginalized communities, highlights the critical role of teacher quality (Archibald, 2006; Darling-Hammond & Baratz-Snowden, 2005). As a nation's workforce is shaped by its school system, the quality of education serves as a mirror reflecting the country's future. In Ghana, aspirations to become an industrialized nation are closely tied to the competence of its graduates (Buabeng et al., 2020).

Mathematics is widely recognized as an essential discipline in daily life, yet many learners perceive it as a challenging subject. The motivation for learning and teaching mathematics stems from the belief that it fosters reasoning skills, critical and analytical thinking, and the ability to apply these skills to real-world problems. Research has shown that students' perceptions of mathematics and mathematics learning significantly influence their engagement and achievement (Royster, Harris, & Schoeps, 1999). Traditionally, mathematics instruction has relied heavily on visual aids to represent concepts, principles, and problems. While abstraction enables broader applicability of concepts, it can also present learning difficulties, particularly for students who benefit from hands-on experiences or interactive methods (Chambel & Guimarães, 2005). Visualization plays an important role in making mathematical ideas more concrete, even for abstract or imaginary objects. Poor performance in mathematics globally has been linked more to students' perceptions than to other variables (Royster et al., 1999). These perceptions may be shaped by factors such as myths about success in mathematics, the motivation provided by teachers and parents, teaching styles, learning materials, and self-confidence (Mutodi & Ngirande, 2014).

To improve instructional quality, Darling-Hammond and Baratz-Snowden (2005) identified three intersecting domains of knowledge essential for novice teachers: understanding learners' development within social contexts, mastery of subject matter and curriculum objectives aligned with societal goals, and the ability to teach content effectively using assessment and a supportive learning environment. Within mathematics, problem-solving is considered a central component of instruction, enabling learners to integrate knowledge, connect concepts, and deepen understanding (Gravemeijer et al., 2017; Lester & Cai, 2016). Ernest (1989) categorized teachers' beliefs about mathematics into three perspectives: the instrumentalist view, which regards mathematics as a set of unrelated rules and procedures; the Platonist view, which sees mathematics as a static, unified body of knowledge awaiting discovery; and the problem-solving view, which views mathematics as a dynamic, creative human activity (Cooney & Shealy, 1997). Teachers' theoretical perspectives significantly influence their instructional approaches, and these beliefs are often shaped by their own learning experiences (Jurdak, 1991; Teo, 1997; Perkkila, 2003). Evaluating teaching effectiveness also depends on teachers' self-assessment of their instructional practices, which informs decision-making (Ahmed & Aziz, 2009). Moreover, meaningful curriculum reform requires alignment with teachers' beliefs (Handal & Herrington, 2003).

According to a growing body of research, many pre-service teachers hold more traditional than innovative ideas about the teaching and learning of mathematics. Some view mathematics as a discipline grounded in memorized rules and procedures, with typically one optimal solution to any problem, and answers considered entirely right or wrong (Nisbet & Warren, 2000). Learning mathematics, in this perspective, requires neatness, speed, and procedural accuracy. Building on these insights, this study investigates pre-service teachers' knowledge of mathematical problem-solving and the strategies they employ in teaching and solving mathematical problems. The novelty of this research lies in its dual focus: examining how pre-service teachers conceptualize mathematical problem-solving and identifying the alignment—or gap—between these conceptualizations and the actual strategies they apply in practice. This approach offers a nuanced understanding of teacher preparation that has been largely underexplored in previous studies, particularly within the context of Ghanaian teacher education.

Method

The interpretivist paradigm underpins this study. The interpretivist paradigm attempts to get insights into what participants are thinking to understand. The goal is to understand the participants and their interpretation of the world around them. According to Bogdan and Biklen (1998), the interpretivist paradigm's central tenet is that reality is socially constructed. Based on this paradigm, the study adopted a qualitative design because it will help the researcher understand the behaviour of participants in their environment (Creswell, 2014) and assign meaning to a human problem that can affect either an individual or a group of people. In this study, participants were selected from three Colleges of Education in Ghana. The selection of individuals was done through random sampling because the participants shared common characteristics.

Participants were coded according to the colleges from which they came. Participants who attended MCE college were called MCE1, MCE2, MCE3, up to MCE10. All ten participants were females since MCE is a college for female students. Participants who came from SDC college were termed SDC1, SDC2, SDC3, to SDC10. Five of the participants were females, and the other five were males since SDC college is a mixed-gender college. Participants who came from MTC college were called MTC1, MTC2, MTC3, to MTC10. All ten participants were males since MTC college is a purely male college.

Each college was considered and treated as an individual case. Therefore, a multi-case study was chosen for the study. In a multi-case study, more than one case is studied, and each of the cases should have the same research purpose. Polit and Hungler (1999) referred to data as evidence collected during the study period. Data was collected using interviews from the selected sample. The researcher used a semi-structured interview to get a detailed picture of the participants' perception about the benefits of solving problems in mathematics. The semi-structured approach was chosen because it provided the researcher with more flexibility, as he already had a set of predetermined questions that will help him delve deeply into the topic being studied. After the interview schedule data were transcribed, and a thematic approach was employed for the analysis.

Results and Discussion

For privacy purposes, as stated earlier on, participant names have been replaced with pseudonyms. The themes that emerged from the responses on research question one is covered in the next section.

Problem-solving helps to develop thinking and understanding

Students' ability to think critically and understand mathematical ideas is greatly enhanced by problem-solving activities. As they work through problems, students are forced to use their mathematical skills, apply strategies for solving problems, and gain a deeper understanding of concepts. According to Cahyani, Suarsana and Mahayukti (2021), mathematical tasks are the provision of problems that can assist students in understanding and applying mathematical concepts. So, the problem-solving activities in learning mathematics can provide an opportunity for students to strengthen and expand the construction of their knowledge. Here are some of the responses from participants.

Participant MCE1 said that problem-solving provides an opportunity for students to develop mathematical thinking skills. Participants MCE3 indicated that students can develop reasoning skills through problem-solving. According to participant MCE5, problem-solving is a difficult task that help students understand an idea better. Participant MCE9 also said that problem-solving in mathematics means doing tricky mathematics problems that make you think hard and understand better. Participant MCE10 added that mathematics problem-solving is when you do mathematics tasks that are a bit tough but help you get better at understanding and doing mathematics. Participant SDC3 asserted that solving mathematics problems is when you work on mathematics tasks that can be a bit tricky, but it helps the student to understand mathematics better and get smarter at it. Participant SDC4 acknowledged that mathematics problem-solving is when you work on mathematics stuff that can be difficult, but it helps you get better at mathematics. Participant SDC6 indicated that solving mathematics problems means doing mathematics tasks that make you think hard and understand better.

The assertions made by the participants can be linked to Mudaly's (2021) that iterative visualisation thinking cycle's first stage, where pre-service teachers begin to inculcate critical thinking strategies when teaching mathematics, to heighten students' understanding. Students at this stage try to create mental pictures, which improves upon their mathematical thinking and will eventually help them to develop their understanding of the problem. This stage is known as the doing stage. At this stage, the students' seeing brain works better when the student has a requisite prior knowledge. The seeing brain can be improved through reasoning.

Problem-solving provides intellectual challenges

Participant MCE4 gave the following response when asked about pre-service teachers' knowledge about problem-solving; mathematics problems that can be challenging and help you learn more about mathematics are called problem-solving in mathematics. This statement is referred to as productive struggle. Productive struggle is the process by which students take on challenging tasks or issues that call for perseverance, effort, and critical thinking in order to solve. It requires working through difficult ideas, making errors, and facing obstacles, but in the end, it results in a greater comprehension and learning. Effective learning experiences must include productive struggle because it fosters resilience, metacognitive awareness, and cognitive engagement. As it emphasizes active involvement, inquiry, and reflection in the learning process, this procedure is in line with constructivist learning theory. Through taking on challenges and overcoming setbacks, students build their own knowledge, improve cognitive functions, and gain a sense of urgency and efficacy in their education (Vygotsky & Cole, 1978). Instead of only searching for the right answers in this case, students are given the chance to delve into comprehending mathematical concepts and relationships in order to obtain a deeper understanding (Baker, Jessup, Jacobs, Empson & Case, 2020).

Participant SDC8 indicated that mathematical problem-solving is like a challenge we face when working on mathematics problems or learning a mathematics idea. Participant MTC3 said that mathematics problems that can be a bit challenging but help you learn more about mathematics are called mathematics problem-solving. The participants' claims are supported in literature by Novita, Zulkardi and Hartono (2012) who stated that, mathematical problem-solving refers to mathematical tasks that can provide intellectual challenges for enhancing learners' mathematical understanding and development. Students' mathematical knowledge grows when they encounter intellectual challenges through problem-solving, which also allows them to enhance their problem-solving skills beyond only seeing immediate arithmetic solutions.

As pre-service teachers make an effort to overcome intellectual challenges during problem-solving, they will go through some iterative processes that will help develop their knowledge, based on their prior knowledge. This is the doing stage of Mudaly's (2021) that iterative visualisation thinking cycle. During the doing stage, students make much effort to create mental images to assist in solving the problem. Mental images are created as the problem solver uses manipulative, both physical and technological, as visual mediators to create images based on prior knowledge. In doing so, students will encounter some challenges, but if they are able to overcome these challenges, it gives them the opportunity to solve the problem adequately.

Problem-solving assists in real-life situations

In the real world, problem-solving abilities are extremely valuable because they help people overcome obstacles, make wise choices, and accomplish their goals. Success in social, professional, and personal environments depends on one's capacity to see problems, weigh options and put solutions in place.

According to participant SDC5, solving mathematics problems is about using real-world situations to help students think hard and understand mathematics better. The development of a general ability in problem-solving and the application of mathematics in real-life situations, is one of the primary objectives of learning mathematics. This means that when problems are solved in real-life contexts, it affords students the opportunity to improve upon their mathematical thinking and enhance their understanding. Participants SDC1 said that problem-solving helps students in their real-life situation such as helping them to do simple calculations with money in trading. Participant SDC2 also indicated that problem-solving helps students to know how to solve real-life situations such as how to count money and how to change money. The above responses confirm that problems would be well understood and solvable, when found in real-life situations.

Problem-solving helps to achieve an expected goal

In establishing a systematic method to identifying obstacles, considering possibilities, and putting effective solutions in place, problem-solving plays an essential role in assisting people in reaching their goals. The capacity to overcome challenges and accomplish goals is essential for success in many contexts, including academic, professional, and personal ones. In order to solve problems effectively, one must consider all available options and strategies for overcoming setbacks and achieving the intended result (Simon, 1973).

Participants MCE8 indicated that solving mathematical problems is like following steps and doing tasks to reach a specific goal. MTC1 remarked that mathematics problem-solving is a way of going through different steps and tasks to reach a goal you want. This shows that many activities take place during problem-solving. Some of the factors involved in problem-solving are the right teaching approach, critical thinking, reasoning, and so on. Before a student engages in the process of problem-solving, then a remedy is needed, which leads to an expected goal. When students set their expected goals in the process of problem-solving, it provides a promising direction towards obtaining a solution to the problem. This means that when students define a goal during problem-solving, it motivates them to achieve their goal.

Problem-solving helps in finding a way around a difficulty

The ability to assess problems, come up with answers, and successfully get over obstacles is what makes problem-solving so important for getting around obstacles. Difficulties are bound to arise in life in a variety of contexts, and the ability to solve problems is essential to overcoming them. Creating and assessing feasible solutions to a problem is a necessary component of effective problem-solving (Simon, 1973).

Participant MCE2 said that mathematics problem-solving is like figuring out a way when you are stuck, finding a solution to a mathematics problem that you did not know before. Participant SDC10 remarked that problem-solving in mathematics is like finding the best way to solve a tricky problem or figuring out answers to tough and difficult problems. Participant MTC4 added that mathematics problem-solving is figuring things out step by step to get the right answer. Participant MTC6 said that mathematics problem-solving is not just about getting the right answer; it's about figuring out solutions and understanding how to do it, not just what the answer is.

The submissions indicate that during problem-solving, one seeks to find the best solution to complex or challenging issues. Participant opinions corroborate a previous claim made by Polya (1962) that solving a problem entail figuring out a way through a challenge or around an impediment in order to achieve a goal that was not immediately achievable. Doorman, Drijvers, Dekker, Heuvel-Panhuizer, Lange, and Wijers (2007) corroborated Polya's claim by adding that problem-solving is regarded as an art of handling non-trivial problems that do not yet have a routine solution strategy known to the student but that offer opportunities for the student to develop new strategies. Since there is no routine way of solving the problems, students will go through a lot of iterative processes to make meaning out of the problem. This can be called the "rocess of meaning-making, which occurs at the second stage in Mudaly's (2021) that iterative visualisation thinking cycle. In stage two, the process of meaning-making is intensified through physical and mental manipulation of objects and images. This stage is often iterative because we may work with a few specific examples and then generalise them before understanding occurs. This is the stage where the student will say, I see, which implies I understand what you mean. This stage is critical because the environment must be conducive for both internalization and externalization processes to occur.

Problem-solving assists pre-service teachers to choose appropriate strategies

In order to successfully go through the demands of both teaching and learning, pre-service teachers must possess strong problem-solving abilities. The capacity to select appropriate solutions to effectively address a variety of educational problems is an essential aspect of problem-solving for pre-service teachers. Pre-service teachers who are proficient in problem-solving techniques are better equipped to select instructional strategies based on their pedagogical content knowledge (Shulman, 1986).

According to participant MCE7, mathematics problem-solving is like first understanding the problem, then coming up with ideas on how to solve it, and finally picking a plan to figure things out. Participant MTC8 indicated that mathematics problem-solving is like figuring out what the problem is, thinking of ways to solve it, and then picking the right way to get it done. Participant MCE6 acknowledged that to become good at mathematics problem-solving takes practice. When you are figuring out how to solve a problem, the first step is looking for clues which helps in getting an appropriate strategy, which is an important skill in mathematics problem-solving. As opined by Doorman et al. (2007), problem-solving involves non-routine strategies to come up with a solution, and this provides opportunities for students to develop new solution strategies. This means a problem can have different strategies for developing a solution, but the best strategy should be chosen to make the problem simple to solve. In order to select the best methods for instruction for students, pre-service teachers must examine the needs, traits, and varied backgrounds of their students through problem-solving (Jacobs, Lamb, & Philipp, 2009).

Choosing an appropriate strategy is part of the process of meaning-making, as advocated in Mudaly's (2021) that iterative visualisation thinking cycle, where students try different strategies to come up with a generalisation to improve understanding. During this stage, students use different strategies, both mental and physical, to assist in solving problems. The themes that emerged from the responses on research question two is covered in the next section.

Visual representation and logical reasoning

According to a study on the functions of pictures in problem solving by Elia and Philippou (2004), the relationship between the picture and the problem mainly the function the picture serves in the problem as well as the students' prior knowledge and skills are essential for effective problem solving, which incorporates pictures. According to Tolsberg, Põldre, and Kikas (2022), students' drawings are considered supportive if they accurately represent the structural links and processes mentioned in the text or problem. Twelve out of the thirty participants responded that they make use of visual representation, drawing of diagrams and logical reasoning, as strategies in solving varied mathematical problems. The following are some extracts from the responses provided by the participants:

Participant MCE2 indicated that, when I'm trying to solve a problem, I start by drawing a diagram, imagining it, making guesses, checking and fixing, listing different ways, using logical thinking, finding a pattern, and sometimes working backward. She added that, it makes it easier for solving problems. Participant MCE4 stated that, when I'm faced with a problem, I start by making guesses, drawing pictures or diagrams, making a list, creating a table, trying it out with equipment, thinking it through, and using skills I already know. The reason she provided for using such strategies was that students' ability to use strategies develops their experience and practice. Participant MCE7 was of the view that, when I have a problem, I try to picture it, make guesses and check them, look for a pattern, and sometimes work backward. The reason is that it helps make problem-solving easier and stress free in finding the answer. Participant MCE8 remarked that, when I'm dealing with a problem, I start by drawing it out and trying different formulae to see what works. She added that this approach of solving problems enhances better understanding. Participant MCE10 said that when I have a problem, I try drawing pictures or diagrams, making a list or table, and using skills I already know to help solve the problem. She added that, I use these procedures because it helps in solving problems faster and develops stronger critical thinking skills. Participant SDC3 remarked that when I'm solving problems, I use guess and check, try to spot patterns, and sometimes draw a diagram.

Mathematical learning can be effectively enhanced by combining logical reasoning with visual representation. While logical reasoning abilities allow students to effectively examine, justify, and apply mathematical ideas, visual aids can help learners obtain intuition and understanding into mathematical concepts. Students can get a deeper comprehension of mathematics and improve their problem-solving skills by combining various approaches.

Use of varied strategies

Eighteen participants out of the thirty participants outline various strategies they use in solving mathematical problems. The following are some extracts of the responses provided by the participants:

Participant MCE1 remarked that I have different ways of solving mathematics problems, and one method I often use is BODMAS, which stands for Bracket, Of, Division, Multiplication, Addition, Subtraction. She added that, it makes learning and problem solving easier for her. Participant MCE3 said that when I'm working on mathematics problems, I rely on remembering things and thinking through the steps. She mentioned that these strategies make problems easier to deal with or solve. Memorization helps to remember formulae and use them at the right time during problem-solving. Participant MCE5 remarked that I try to simplify problems because it helps me understand them faster when things are kept simple. Participant MCE6 indicated that I have different ways to solve mathematics problems. One method is CUBES, where I Circle important numbers, Underline the question, Box keywords, Eliminate extra information, and Solve by showing work. Another method is RUNS, where I Read the problem, Underline the question, Name the type of problem, and find a Strategy to solve the problem. Using these strategies, she said, helps students become more proficient in mathematics and gain confidence in their ability to 'do' mathematics. Participant MCE9 stated that using different strategies is important in math because students have different levels of ability when solving math problems. Participant SDC1 added that methods like activity, demonstration, and discussion really help when solving problems. The reason is that it enhances the learners' understanding of the subject matter that is being taught.

The presumption that mathematical problems cannot be solved using just one strategy, is supported in the literature (Kalmykova, 1975). Berenger (2018) added that pre-service teachers use a range of strategies, including a combination of numerical calculations (fractions or percentages), whole number trial and error methods, discrete or region models, generating tables, and algebraic equations to solve problems. These participant-shared thoughts demonstrate that participants are aware that there are a variety of methods for solving mathematical problems; nonetheless, the methods should be easy to use and effective in providing the correct answer. It indicates that teachers must involve students in a variety of strategies to improve their problem-solving skills.

Pre-service teachers' beliefs and attitudes play a crucial role in shaping their approaches to mathematical problem-solving, as beliefs often influence classroom decision-making and instructional effectiveness (Ernest, 1989; Handal & Herrington, 2003). This underscores the importance of examining the perceived benefits they experience during the process. Participants in this study identified multiple benefits, including the development of critical thinking and deeper understanding, the provision of intellectual challenges, the application of mathematics to real-life situations, the achievement of specific goals, the ability to navigate difficulties, and the selection of appropriate strategies. Such perceptions are significant because students' knowledge about problem-solving—and their recognition of its value—strongly influence their attitudes toward mathematics (Mutodi & Ngirande, 2014; Royster, Harris, & Schoeps, 1999). When students are interested in a subject, they are more likely to persevere, work diligently, and set personal goals, which in turn enhances their performance. This aligns with prior literature suggesting that student motivation and commitment are key predictors of learning outcomes, particularly in subjects perceived as demanding (Lester & Cai, 2016).

The distribution of responses reflects a diverse range of emphases among participants. All thirty participants demonstrated an understanding of mathematical problem-solving. Fourteen (46.7%) emphasized its role in developing thinking and understanding, four (13.3%) highlighted its provision of intellectual challenges, and three (10%) noted its usefulness in addressing real-life problems. Additionally, two participants (6.7%) associated problem-solving with achieving specific goals, four (13.3%) identified it as a means to navigate difficulties, and three (10%) emphasized its role in helping pre-service teachers select appropriate strategies. These findings confirm that pre-service teachers value problem-solving not only as an academic skill but also as a life skill that equips students to address complex challenges (Simon, 1973; Novita, Zulkardi, & Hartono, 2012). This resonates with the broader educational aim of mathematics instruction, which is to cultivate critical thinking and reasoning abilities that extend beyond the classroom (Cahyani, Suarsana, & Mahayukti, 2021).

Regarding strategies, twelve participants (40%) reported relying on visual representations and logical reasoning, while eighteen participants (60%) indicated the use of varied strategies. This diversity in approach reflects an awareness that mathematical problems can be tackled through multiple methods, depending on the context and complexity of the task (Kalmykova, 1975; Berenger, 2018). Such adaptability is a desirable attribute for future teachers, as it enables them to address the varied needs and abilities of their students (Jacobs, Lamb, & Philipp, 2009). By combining visual and logical tools with flexible problem-solving techniques, pre-service teachers can foster a more inclusive and effective mathematics learning environment. These insights highlight the need for teacher education programs to explicitly integrate strategy diversity and metacognitive awareness into their curricula, thereby preparing future educators to cultivate both procedural fluency and conceptual understanding in their students (Gravemeijer et al., 2017; Shulman, 1986).

Conclusion

This study shows that most pre-service teachers possess a strong awareness of the meaning and significance of mathematical problem-solving, recognize the importance of using varied strategies, and understand the value of connecting problems to real-life contexts. This is evident in participants' frequent emphasis on problem-solving as a means to develop critical thinking, enhance reasoning skills, and strengthen conceptual understanding, with strategies such as visual representation, logical reasoning, and structured approaches like BODMAS, CUBES, and RUNS. However, variations were found in the depth of understanding: while some participants described problem-solving as an iterative process of reasoning and meaning-making, others focused more on procedural execution without fully articulating the underlying concepts. These findings indicate that while general awareness is high, targeted support is still needed to strengthen conceptual foundations for a subset of pre-service teachers.

Future research could explore targeted interventions, such as structured problem-solving modules that combine procedural fluency with conceptual reasoning, as well as longitudinal studies to track changes in pre-service teachers' problem-solving approaches over time. Based on the findings, it is recommended that teacher education programs incorporate reflective practice sessions for analyzing and refining problem-solving strategies, and design locally relevant problem contexts to connect mathematical concepts with authentic real-world applications. Such efforts would help pre-service teachers not only master problem-solving themselves but also effectively foster these skills in their future students.

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