African Journal of Mathematics and Statistics Studies

ISSN: 2689-5323

Volume 9, Issue 2, 2026 (pp. 41-65)

www.abjournals.org

PRESERVICE MATHEMATICS TEACHERS' PERCEPTION ON COMPUTATIONAL THINKING AS PROBLEM-SOLVING STRATEGY IN TEACHING AND LEARNING

Ernest Kwaku Ofosu[1], Samuel Kwesi Asiedu-Addo[2], Sylvester Frimpong[2], Dennis Offei Kwakye[3*], Sulemana Karim[4], Daniel Kudjo Adiku[5], Gabina Susuoroka[6], Yahaya Mohammed Sherif-Deen[4], Thomas Mensah-Wonkyi[2], and Alex Boadu[7].

[1]Mathematics and ICT Department, SDA College of Education, Asokore-Koforidua, Ghana.

[2]Department of Mathematics Education, University of Education, Winneba, Ghana.

[3]Department of Mathematics and ICT Education, University of Technology and Applied Sciences, Navrongo, Ghana.

[4]Department of Mathematics and ICT Education, University for Development Studies, Tamale, Ghana.

[5]Department of Mathematics, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

[6]Business Studies Department, University of Business and Integrated Development Studies, Wa, Ghana.

[7]Sadie T. Tills Elementary School, Duval County Public Schools, FL 32244, USA.

[*]Corresponding Author's Email: dokwakye@utas.edu.gh

Cite this article:

E. K., Ofosu, S. K., Asiedu-Addo, S., Frimpong, D. O., Kwakye, S., Karim, D. K., Adiku, G., Susuoroka, Y. M., Sherif-Deen, T., Mensah-Wonkyi, A., Boadu (2026), Preservice Mathematics Teachers' Perception on Computational Thinking as Problem-Solving Strategy in Teaching and Learning. African Journal of Mathematics and Statistics Studies 9(2), 41-65. DOI: 10.52589/AJMSS-HXLK5Z8J

Manuscript History

Received: 4 Apr 2026

Accepted: 6 May 2026

Published: 1 Jun 2026

ABSTRACT: *Problem solving is a central goal of mathematics education and a key competency emphasized in Ghana's basic school mathematics curriculum. However, many stakeholders are of the view that classroom practices often prioritize routine procedures rather than strategies that promote critical and analytical thinking. Computational thinking (CT), which involves cognitive processes such as decomposition, pattern recognition, abstraction, and algorithmic thinking, has increasingly been recognized as a powerful framework for structured problem-solving that can enhance mathematical reasoning and learning. Despite its potential pedagogical value, the integration of CT, particularly in unplugged forms that do not require digital technologies, seems limited in mathematics teacher education programs, and little is known about preservice mathematics teachers' perceptions of its role in mathematical problem-solving.*

KEYWORDS: Computational thinking unplugged, pedagogical tool, non-routine problem-solving.

Article DOI: 10.52589/AJMSS-HXLK5Z8J

DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

INTRODUCTION

Traditional approaches to mathematics instruction have often emphasized rote memorization, procedural fluency, and repetitive practice of algorithms rather than deep conceptual understanding and reasoning (Watson, 2013). While such approaches may support procedural accuracy, they have been criticized for failing to adequately prepare students to engage in critical thinking and solve complex real-world problems. With the rapid advancement of digital technologies and artificial intelligence tools capable of performing routine mathematical procedures, the relevance of purely procedural mathematical learning is increasingly being questioned (Watson, 2002; Wolfram, 2020).

Consequently, contemporary mathematics education emphasizes problem-solving as a core objective of learning mathematics. Problem solving enables learners to apply mathematical knowledge in unfamiliar contexts, develop reasoning abilities, and construct meaningful understanding (Baker et al., 2009; Monaghan et al., 2008). According to Johnston et al. (2018), mathematics education must respond to societal expectations by equipping learners with skills that enable them to analyze and solve complex problems in dynamic environments. This shift requires instructional strategies that support creative reasoning, analytical thinking, and structured problem-solving.

In Ghana, educational reforms have emphasized the development of critical thinking and problem-solving competencies within the mathematics curriculum. For example, the Bachelor of Education curriculum for Colleges of Education highlights digital literacy and problem-solving as essential competencies for preservice teachers. The course manual *Learning, Teaching and Applying Numbers and Algebra* encourages preservice mathematics teachers to solve mathematical problems using technology-related strategies and innovative approaches. Such reforms reflect national efforts to align mathematics instruction with global educational trends that emphasize analytical thinking and problem-solving (Donaldson, 2011; Ministry of Education, 2018).

Despite the above policy intentions, several studies suggest that problem-solving approaches are rarely implemented effectively in Ghanaian mathematics classrooms (Agyeman & Mereku, 2015; Ampadu, 2019; Asuma et al., 2022; Donaldson, 2011). In many cases, teachers focus primarily on routine exercises rather than non-routine problems that require deeper reasoning. This situation may partly originate from teacher preparation programs, where preservice teachers may have limited exposure to instructional strategies that promote authentic mathematical problem-solving.

One emerging approach that has the potential to strengthen problem-solving instruction in mathematics is computational thinking (CT). Computational thinking refers to a systematic way of solving problems that involves breaking complex problems into smaller components, identifying patterns, abstracting key features, and developing step-by-step solution procedures (Wing, 2006; Barr & Stephenson, 2011). Although CT originated in computer science, researchers increasingly argue that its core practices closely resemble mathematical reasoning processes and can therefore be integrated into mathematics education (Gadanidis et al., 2017; Yadav et al., 2017).

Importantly, computational thinking does not necessarily require the use of computers. Unplugged computational thinking activities allow learners to explore CT concepts using physical materials, collaborative tasks, and mathematical reasoning without digital

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

technologies (Bell et al., 2009). This makes CT particularly relevant for resource-constrained educational contexts, such as many classrooms in developing countries.

From a pedagogical perspective, CT can function as a structured strategy for mathematical problem-solving. For instance, decomposition helps students break complex mathematical problems into smaller manageable parts. Pattern recognition enables learners to identify relationships and similarities among mathematical structures. Abstraction allows students to focus on essential mathematical properties while ignoring irrelevant details. Algorithmic thinking guides learners in constructing logical sequences of steps for solving problems. The integration of computational thinking into mathematics education can be understood through the conceptual alignment between CT processes and mathematical problem-solving practices. Mathematical problem-solving typically involves analyzing a problem, identifying relevant relationships, selecting strategies, and constructing logical solution procedures (Polya, 1962; Schoenfeld, 1982). Similarly, CT emphasizes systematic approaches to problem-solving through decomposition, abstraction, pattern recognition, and algorithmic thinking (Barr & Stephenson, 2011; Wing, 2006). These processes correspond closely with established mathematical problem-solving frameworks such as Polya's four-step model, which involves understanding the problem, devising a plan, carrying out the plan, and evaluating the solution (Polya, 1962). Thus, computational thinking can be viewed as a cognitive framework that strengthens mathematical problem-solving practices.

Although there seems to be increasing emphasis on CT in global education policies, it is very important to examine preservice mathematics teachers' perceptions and understanding of computational thinking, particularly in developing countries such as Ghana. Studies suggest that teachers often associate CT primarily with programming or computer use rather than recognizing its broader relevance for problem-solving and reasoning (Haseski & İlic, 2019; Kotsopoulos et al., 2021; Shute et al., 2017).

Understanding preservice teachers' perceptions is crucial because their beliefs and conceptual understanding influence their future classroom practices (Cabrera, 2019; Rich et al., 2019). If preservice teachers in Ghana view CT narrowly as computer programming rather than as a problem-solving strategy, they may be less likely to integrate it effectively into mathematics instruction. Therefore, this study investigates preservice mathematics teachers' perceptions of computational thinking and its role as a problem-solving strategy in mathematics teaching and learning.

Purpose of the Study

The purpose of this study was to identify the perceptions of preservice mathematics teachers regarding computational thinking as a problem-solving strategy.

Significance of the study

The study would serve as a promising step for successfully identifying ways of integrating CT into education to help future teachers develop an understanding of CT and its connection to their curricular context. This is because the knowledge gained from this study could help in forming professional development and educational programs that can help align school curricula with computational thinking. In addition, the perceptions of the preservice mathematics teachers of CT identified by the study could help make the necessary adjustments

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

for the positive influence of new learning and practices of CT skills. The findings could also open up several areas that researchers would be interested in studying for future developments.

Objectives of the Study

The following were the objectives that guided the study:

1. To assess preservice mathematics teachers' conceptualization of problem-solving in the teaching and learning of mathematics
2. To ascertain how the preservice mathematics teachers perceive the role of computational thinking as a problem-solving strategy in mathematics instruction

Research Questions

1. How do preservice mathematics teachers conceptualize problem-solving in the teaching and learning of mathematics?
2. How do preservice mathematics teachers perceive the role of computational thinking as a problem-solving strategy in mathematics instruction?

LITERATURE REVIEW

Theoretical framework

Dewey's (1933) thinking theory guided this study. Dewey's argument in problem-solving concludes that it involves identifying a problem, generating possible solutions, evaluating those solutions, and selecting the best solution. Reflecting on Dewey's argument, the following logical stages can be applied. In the process of identifying a problem, one needs to understand the nature of the problem. The next step involves selecting a strategy that can guide the generation of possible solutions and then selecting the best solution.

The concept of problem-solving in mathematics

Based on Dewey's thinking theory, a problem is defined as anything that causes confusion, presents a difficult situation, or casts doubt on one's ideas (Dewey, 1933). Polya (1962) described problem-solving as "finding a way out of difficulty, a way around an obstacle, and attaining an aim that was not immediately attainable" (p. v). He specified a broad conception of problems and problem-solving in terms of mathematics as he stated that: "Our knowledge about any subject consists of information and know-how. What is knowledge in mathematics? The ability to solve problems, not merely routine problems but problems requiring some degree of independence, judgment, originality, and creativity' (p. vii–viii).

Schoenfeld (1982) distinguished between mathematical tasks that are *problems* and *exercises*. He claimed that both are important but that students in many high school mathematics classrooms engage primarily in completing exercises and rarely, if ever, are challenged to solve problems. In this sense, a problem is a task for which the method of solution is not immediately obvious, and it is likely to take more than just a minute or two. NCTM (2000) offered a definition of problem-solving similar to those above but applied it specifically to mathematics. In the *Standards*, NCTM defined problem-solving using different phrasing at different points,

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

but the following is representative: Problem-solving means engaging in a task for which the solution method is not known in advance (Acquandoh et al., 2022; Donaldson, 2011).

To find a solution, students must draw on their knowledge, and through this process, they will often develop new mathematical understanding. When learners face routine problems, they can guess the process of understanding the problem until they find the solution directly. Therefore, it only gives students repetition in problem-solving activities. Students do not have more ideas to solve such problems. Non-routine problems can be considered problems that cannot be predicted in advance (Saygılı, 2017). In other words, we cannot directly solve this problem. We cannot solve these problems using either a known method or formula. According to Hiebert and Wearne (1993), a problem should be difficult, but not too difficult: "Allowing mathematics to be problematic does not mean making mathematics unnecessarily difficult, but it does mean allowing students to wrestle with what is mathematically challenging" (p. 6).

The Concept of Computational Thinking

Computational Thinking (CT) became popular after Wing's paper in 2008, and has gained the attention of researchers in several areas, including outside computing. Wing (2008) defined CT as the thought process involved in formulating problems such that their solutions can be expressed as computational steps or algorithms to be carried out by a machine or human agent. One key thing worthy of note is that solving problems computationally is not a digital skill but rather a mental skill (Yadav et al., 2018). Bell et al. (2009) assert that computational thinking is more about humans than computers. It can be inferred that CT is a problem-solving strategy that employs computer science concepts in the problem-solving process without using a computer (Donaldson, 2011; Mouza et al., 2017).

Computational thinking is defined as a process of solving complex problems and breaking them down into smaller parts that are easier to solve. The process of solving complex problems into smaller ones is called problem decomposition. Yadav et al. (2014) also recognized computational thinking as a mental activity that helps abstract problems and formulate automated solutions. Although there is no universally agreed definition of CT, there are some widely and universally recognized concepts, including problem decomposition, pattern recognition, algorithmic thinking, abstraction, data collection, automation, parallelization, and simulation (Barr & Stephenson, 2011; Hambrusch et al., 2009; Yang et al., 2018). These CT concepts are referred to as components of computational thinking skills (Hunsaker, 2020; Lee et al., 2019). Shute et al. (2017) state that CT is "a way of thinking and acting, with or without the assistance of computers" (p. 143).

Computational Thinking as a problem-solving strategy

In computational thinking, the students demonstrate the ability to identify a problem, break it down into manageable steps, work out the important details or patterns, shape possible solutions and present these solutions in a way that a computer, a human, or both can understand. Computational thinking can also involve structuring and manipulating data sets to support the solution process (IEA, 2016, p. 1). In recent years, computational thinking has often been discussed in problem-solving contexts (Donaldson, 2011; González & Muñoz-Repiso, 2017; Pala & Mihci, 2021).

CT has developed strong theoretical advancements in recent years. Many authors have stated the importance of promoting its development from a very early age. This is because it could

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

significantly improve students' abilities to face and solve different kinds of problems. These problems could be academic, personal, and social (Wing, 2012). Therefore, CT is based on solving problems using basic concepts of computers (Wing, 2008), in other words, not the computer itself. When applying CT in a problem-solving process, the following steps come into play:

1. The problem is broken down into smaller sub-problems, which is called the decomposition process. It consists of splitting a complex problem (situation or task) into smaller and more manageable sub-problems, whose combined solutions provide a solution to the general problem.

2. Attention is focused on the most important characteristics of the abstraction process. The aim is to capture the essence of the problem by filtering the non-fundamental characteristics and preserving the most relevant features to create a simplified representation or model.

3. The knowledge of similar problems solved previously is used, called the "Recognition of Pattern" process. It involves looking for similarities between different problems and within the same problem. It is about finding patterns of a complex problem (or sub-problem) with an analogous one already analyzed and solved effectively. The more patterns are recognized, the easier and faster the general task of solving problems becomes.

4. The action plan to be executed is called an algorithm. It consists of a set of clear and precise instructions, which are identified and planned in a certain order for the resolution of a problem. Since computer teaching has been defined as strategic for the educational system from a very early age, it is considered relevant to train new generations of teachers in the development of CT.

The four steps above, Decomposition, Abstraction, Pattern recognition, and algorithm, are popularly known as PRADA, an acronym used by Dong et al.(2020). In their study, they adopted these four CT concepts as practical ways of introducing the core ideas of CT to non-computing teachers. These CT concepts are also referred to as components of computational thinking skills (Hunsaker, 2020; Lee et al., 2019).

Preservice Mathematics Teachers' Perceptions of Computational Thinking

It has been established that teachers should be adequately prepared to include CT as part of their classroom practice (Barr & Stephenson, 2011; Lye et al., 2014) and the teacher preparation should begin at the preservice level. Notwithstanding, it has been asserted that misconceptions about CT still exist for both preservice mathematics teachers and in-service mathematics teachers (Avcı & Deniz, 2022; Uzumcu, 2023). This is because many scholars regard CT as a problem-solving approach in various contexts. For instance, Rosen et al. (2013) perceive CT as the way computer scientists think to solve problems. Additionally, by Syslo and Kwiatkowska (2006), CT is regarded as a computational principle. Barr and Stephenson (2011) regarded CT as a problem that must be formulated in such a way that computers and other tools must be used to solve it. Again, by Bell et al. (2009), it was concluded that CT is more about human thinking than computers. All of these interpretations give different perceptions of CT to preservice mathematics teachers. According to Boateng et al. (2025) and Powers et al. (2020), preservice mathematics teachers do not yet have an adequate

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

understanding of the concept of CT. Most perceived CT as logical thinking or reasoning. Others perceive CT as using ICT or computer science in problem-solving.

While Shute et al. (2017) define CT as "a way of thinking and acting, with or without the assistance of computers" (p. 143), preservice mathematics teachers continue to view CT as coding or programming as employed by computer scientists. According to Alhassan et al. (2024) and Cabrera (2019), preservice mathematics teachers' perceptions of CT are important because they may impact their new learning and practices in CT skills. Furthermore, according to Cabrera (2019), preservice mathematics teachers' misconceptions about computational thinking (CT) can hinder their capacity to advance their knowledge and abilities in CT and how they can successfully integrate it into their teaching practices. More significantly, Fang (1996) has also confirmed that preservice mathematics teachers have preconceptions about CT. Even after participating in a CT training program, preservice mathematics teachers continue to hold misunderstandings, according to Ung et al. (2022).

METHODOLOGY

This study adopted an explanatory sequential mixed-methods design to investigate preservice mathematics teachers' perceptions of computational thinking (CT) as a problem-solving strategy in the teaching and learning of mathematics. An explanatory sequential design involves collecting and analyzing quantitative data first, followed by qualitative data to explain, elaborate, or provide deeper insights into the quantitative results (Creswell & Plano Clark, 2018).

The explanatory sequential design was considered appropriate for this study because the research aimed first to identify general patterns in preservice teachers' perceptions of problem-solving and computational thinking, and subsequently to explain the reasons underlying those perceptions and clarify possible misconceptions. According to Creswell and Creswell (2018), explanatory sequential designs are particularly useful when researchers need to move beyond statistical patterns to understand participants' reasoning, interpretations, and experiences.

In the first phase of the study, quantitative data were collected through a structured questionnaire administered to preservice mathematics teachers. This phase provided measurable information about their perceptions of the use of problem-solving in mathematics teaching, their understanding of the nature of mathematical problems, and their views on computational thinking as a problem-solving strategy.

In the second phase, qualitative data were collected through semi-structured interviews with selected participants. The purpose of thinking and phase was to explain and expand upon the findings obtained from the questionnaire by exploring participants' interpretations and conceptual understanding of computational thinking and mathematical problem-solving in greater depth.

The integration of the two phases enabled the researchers to develop a comprehensive understanding of preservice teachers' perceptions, thereby strengthening the explanatory power of the study.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

PRESENTATION AND ANALYSIS OF DATA

The questionnaires were scored on a 5-point Likert scale (Strongly Disagree = 1, disagree = 2, neutral = 3, agree = 4, Strongly Agree = 5). The internal reliability of the questionnaires for each of the four categories by Cronbach's alpha were > 0.73), which indicates that the instruments were reliable. The mean obtained by each item and its perceived level of knowledge were interpreted as follows: Strongly Disagree (SD) on a range of scales 1.00-1.80 (Very low), Disagree (D) 1.81-2.60 (Low), Neutral (N) 2.61-3.40 (Not sure), Agree (A) 3.41-4.20 (High), and Strongly Agree (SA) 4.21-5.00 (Very high) (Nyutu et al., 2020). The scores of each category were examined in detail by examining the response patterns of the individual items and the mean scores and standard deviations for individual items. This helped identify preservice teachers' perceptions of areas of concern.

To further clarify students' perceptions of CT as a problem-solving strategy, five students were conveniently selected to be interviewed. Pseudonyms (R1, R2, R3, R4, R5) were used for the names of the interviewed students (participants). The students were also assured of confidentiality (i.e., no real names were mentioned during the write-up of the study). This was strictly adhered to. To analyze the qualitative data, Braun and Clarke's (2006) six-step thematic analysis framework was followed.

The first step was familiarization with the data. The interview transcripts were read and re-read to take note of the initial ideas and patterns that emerged. Second, the researchers systematically went through the data, highlighted meaningful features, and manually assigned codes to segments of the data related to the research questions. Third, related codes were grouped together to form potential themes. This was done by looking for broader patterns or meanings that captured important elements of the data and then gathering all relevant data extracts for each theme. Fourth, themes were refined by checking whether they worked in relation to the coded extracts and entire dataset. The researchers then removed, combined, or split the themes as needed. This was performed to ensure that the themes were coherent and distinct. Fifth, the researchers clearly defined what each theme meant and what aspects of the data they captured. The researchers then wrote theme descriptions and decided on clear and concise names. Sixth, a compelling narrative explaining each theme was written using data extracts. The analysis was then connected to the research questions and the relevant literature.

Research Question One

How do preservice mathematics teachers conceptualize problem-solving in the teaching and learning of mathematics?

This research question aimed to determine preservice mathematics teachers' conceptualization of problem-solving and the nature of problem-solving questions in mathematics. Table 1 indicates the responses about preservice mathematics teachers' concepts about the use of problem-solving in the teaching and learning of mathematics.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Table 1*:* **The preservice mathematics teachers' conceptions of the use of problem-solving in the teaching and learning of mathematics**

No.	Item	SD	D	N	A	SA	Mean	SD
1	It is important for the teaching and learning of mathematics to be done through problem-solving.	0	0	0	29	94	4.77	.422
2	In teaching mathematics, it is always better to engage learners in problem-solving activities.	0	0	0	28	95	4.76	.421
3	I believe problem-solving may challenge learners to think deeply in the mathematics classroom.	0	0	0	62	81	4.50	.501
4	I believe that problem-solving leads students to relational learning of mathematical concepts.	0	0	0	81	62	4.50	.501
5	I think problem-solving strategies may require much preparation on the part of the teacher.	0	0	0	69	54	4.48	.502
6	I believe problem-solving instructional strategy may be difficult to use by mathematics teachers.	0	0	0	77	46	4.37	.486
7	One must be more concerned with the final answer in a problem-solving situation than the process.	10	11	45	37	20	3.35	1.152
8	I believe students can improve performance in mathematics if they are taught through problem-solving.	0	0	0	28	95	4.77	.421
9	Problem-solving exercises may give students the chance to apply the mathematical principles they learn in the classroom to real-world scenarios.	0	0	0	62	81	4.50	.501
10	I think that mathematics teachers must make problem-solving an integral part of mathematics teaching and learning.	0	0	0	28	95	4.77	.421

Adapted from (Twumasi & Afful, 2022)

From Table 1, it can be seen that the preservice mathematics teachers strongly agreed with almost all the items. They strongly agreed that it is important for the teaching and learning of mathematics to be done through problem-solving (M=4.77, SD=.421). They strongly agreed that in teaching mathematics, it is always better to engage learners in problem-solving activities (M=4.77, SD=.421). They also believed that problem-solving may challenge learners to think deeply in mathematics classrooms (M=4.50, SD=.501). They strongly agreed that problem-solving leads students to the relational learning of mathematical concepts (M=4.50, SD=.501). They strongly agreed that a problem-solving strategy may require much preparation on the part of the teacher (M=4.48, SD=.502).

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Again, they strongly agreed that problem-solving instructional strategies may be difficult to use by mathematics teachers (M=4.37, (SD=.486). However, preservice mathematics teachers were neutral about being more concerned with the final answer in a problem-solving situation than the process (M=3.35, SD=1.152). They strongly agreed that students can improve their performance in mathematics if they are taught through problem-solving (M=4.77, SD=.421). The preservice mathematics teachers strongly agreed that problem-solving exercises may give students the chance to apply the mathematical principles they learn in the classroom to real-world scenarios (M=4.50, SD = .501).

Finally, they strongly agreed that mathematics teachers must make problem-solving an integral part of mathematics teaching and learning (M=4.77, SD=.421).

Looking in detail at the preservice mathematics teachers' responses to all the ten items, nine of them followed the same pattern, with the most common response being 'strongly agree' (95.77%) followed by 'agree' 28(22.76%) as the second most common response. There were no responses of neutral, "disagree" or "strongly disagree". This response pattern explains the high mean scores on these items.

However, item 7 deviated from this pattern in such a way that the most common response was 'neutral' 45(36.59%). The second most common response was 'agree' 37(30.08%), the third most common response was 'strongly agree' 20(16.26%), this was followed by 'disagree' 11(5.94%) as the fourth most common response and then finally, 'strongly disagree' 10(8.13%) as the fifth most common response. This response pattern explains the neutral mean score for that item. From the responses, the mean of means was calculated to be 4.48, which can be interpreted as meaning that preservice mathematics teachers have a 'very high' conception about the use of problem-solving in the teaching and learning of mathematics.

The qualitative data analysis

Five preservice mathematics teachers participated in semi-structured interviews that allowed for a thorough examination of the participants' comprehension in order to gather a variety of viewpoints and identify underlying conceptual trends. The qualitative data revealed the following:

How do pre-service mathematics teachers conceptualize the use of problem-solving in the teaching and learning of mathematics?

The responses from the above question are stated below. The first respondent stated that problem-solving underpinned deeper understanding rather than just memorization of procedures.

"I see problem-solving as the core of mathematics teaching. It is not just a method but the goal of learning mathematics itself. When learners engage in problem-solving, they develop deeper understanding rather than memorizing procedures." (R1)

The second respondent also made very important remarks. That problem-solving is learner centered and helps the learner to think critically as they find their own strategies to get their answers.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

"To me, problem-solving is a learner-centered approach that encourages critical thinking and creativity. It allows students to explore different strategies and arrive at solutions on their own, which makes learning more meaningful and long-lasting." (R2)

The third respondent also focused on the role of the teacher in using problem-solving. The teacher guides the learner to think independently.

"I conceptualize problem-solving as a tool for developing independent thinking in learners. It shifts the role of the teacher from giving answers to guiding students through thinking processes, which improves their confidence in mathematics." (R3)

The respondent four justified that problem-solving helps to make mathematics real in the learner's life.

"Problem-solving is essential in connecting mathematics to real-life situations. I believe it helps students see the relevance of what they learn in class and motivates them to participate actively in lessons." (R4)

The respondent five views problem-solving as a strategy that supports collaboration among learners and heightens their understanding.

"I view problem-solving as an interactive and engaging teaching strategy that promotes collaboration among students. Through group discussions and shared reasoning, learners gain multiple perspectives and strengthen their understanding." (R5)

The qualitative responses strongly corroborate the quantitative results, revealing that preservice mathematics teachers hold a highly positive and robust conceptualization of problem-solving in mathematics education. Across all responses, problem-solving is consistently viewed not merely as an instructional strategy, but as the central goal and foundation of mathematics teaching and learning. The findings indicate that preservice teachers perceive problem-solving as a learner-centered approach that promotes active engagement, critical thinking, and creativity. They emphasize its role in shifting instruction from teacher-dominated methods to facilitative guidance, where learners construct their own understanding. Additionally, the respondents highlight that problem-solving fosters independent thinking, confidence, and collaboration among learners. It is also seen as a vital tool for connecting mathematical concepts to real-life contexts, thereby enhancing relevance and motivation in the classroom.

Overall, the qualitative data suggest a strong alignment with constructivist-oriented beliefs, demonstrating that pre-service teachers value problem-solving as an effective means of achieving deep, meaningful, and applicable mathematical understanding.

Preservice Mathematics Teachers' Conceptions about Problem-solving Questions in Mathematics

This questionnaire helped to determine preservice mathematics teachers' conceptions about the nature of problem-solving questions in mathematics. Table 2 gives the results of the number of responses for each item in the level of agreement, together with the mean and standard deviation of the preservice mathematics teachers' conception of problem-solving questions in mathematics.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Table 2*:* Preservice Mathematics Teachers' Conceptions of Problem-solving Questions in Mathematics

Item	What do you understand about the nature of problem-solving questions in Mathematics?	SD	D	N	A	SA	Mean	SD
1.	Problem-solving questions can create confusion for students	81	34	5	3	0	2.21	.732
2.	Problem-solving questions can create some sort of worrying for students	57	48	17	1	0	1.69	.737
3.	Learners can easily figure out the answer to a problem-solving question	10	6	31	40	36	3.69	1.017
4.	Problem-solving questions can be very procedural in nature	11	2	23	45	42	3.60	.945
5.	One can quote rules and formulas to solve it	11	1	32	39	40	3.86	1.003

Source, *Field, 2024*

From Table 3, it can be seen that the preservice mathematics teachers disagree with item 1, that problem-solving questions create confusion for students (M=2.12, (SD=.753). They strongly disagree that, 'problem-solving questions create some sort of worrying for students' (M=1.69, SD = .737). They agreed that learners could easily determine their answer to a problem-solving question (M=3.69, SD=1.017). Again, they agree that, 'problem-solving questions are very procedural in nature' (M=3.62, SD = .945), they also agree that, 'one needs to remember rules and formulas in order to solve it' (M=3.86, SD=1.003).

Looking in detail at the preservice mathematics teachers' responses to all the items, three out of five items followed a similar pattern (items 3, 4, and 5) and two also followed another pattern (items 1 and 2). For instance, in item 3, the most common response was 'agree' (40.3%), the second most common response was 'strongly agree' (29.3%); the third most common response was neutral, that is 'neither agree nor disagree' 31 (4%); fourth most common response was 10 (8.13%), 'strongly disagree,' and lastly, 6 (4.88%) 'disagree.' This pattern explains the high mean scores of these items.

However, items 1 and 2 deviated from this pattern. In item 1, the most common response was 'strongly disagree' (81, 65.9%); the second most common response was 'disagree' (34, 27.6%); the third most common response was 'neutral' (5, 4.06%); the fourth most common response was 'agree' (3, 2.44%); and no one responded to 'strongly agree.' ' Item 2 also followed a similar pattern. This response pattern explains the low mean scores for these items. From the responses, the mean of means was calculated to be 3.01, which was an indication that the preservice mathematics teachers 'are not sure'; in other words, they are not certain of the nature of problem-solving questions in mathematics.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

The Analysis of the Qualitative Data

In order to gather a variety of viewpoints and identify underlying conceptual trends, this study examined a number of participants. The deductive thematic analysis method was used. The themes were developed from the nature of problem-solving questions embedded in the definitions by Dewey, Polya and Schoenfeld as captured in the literature. The analysis was done by firstly reading and rereading the interview transcripts carefully and then looking for recurrent themes and patterns in the participants' responses in relation to these viewpoints.

Based on the literature pertaining to the research questions, two themes were created. The first theme is "interpretation of problem-solving in context," and the code is "a question that requires thinking beyond routine steps, a question that creates confusion, a perplexing question." "Mathematical and cognitive demand" is the second theme. The codes include using well-known principles in novel ways, need logical and sequential reasoning, have no simple answers, and pose a very difficult question. The analysis of the interview questions was led by these processes.

What is the nature of mathematics questions you regard as problem-solving questions?

As the participants tried to answer the above question, the following themes and patterns emerged. The first respondent believes that the mathematics problems given to learners during lessons are problem-solving questions.

"Problem-solving questions are the mathematics problems the teacher gives to the students to solve during lessons." (R1).

In a similar view, (R5) also was of the view that the exercises given to learners at the end of the lesson in mathematics textbooks are problem-solving questions.

"At the end of every mathematics lesson in a textbook, you'll observe that they've given a lot of problems for the learners to do. Those questions are the problem-solving questions" (R5).

Again, both (R2 and R3) believe that problem-solving questions are the ones that demand complex procedures to solve.

"They are the questions that take very complicated formulas to solve them" (R2)

"As the name suggests, they are the type of questions that demand complicated procedures to the extent that they create a lot of problems for the learners" (R3)

Another respondent also believed that problem-solving questions involve many activities.

"They are the questions that involve a lot of activities in order to solve" (R4).

The patterns identified from the above responses deviated from the established themes. It is very clear from the above responses that preservice mathematics teachers have some degree of misconception about the nature of a "problem-solving question" in mathematics. It could be concluded from the patterns of responses in the interviews that the preservice mathematics teacher understands a problem-solving question to be 'the normal routine and procedural exercises in the mathematics classroom.'

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Research Question 2

How do preservice mathematics teachers perceive the role of computational thinking as a problem-solving strategy in mathematics instruction?

The research question two helped to identify the preservice mathematics teachers' perception of the role of computational thinking as a problem-solving strategy in mathematics instruction. To be able to do this, it was necessary to examine the preservice mathematics teachers' perceptions of the concept of computational thinking and then, secondly, identify how they perceive computational thinking as a problem-solving strategy.

Table 3 examined the preservice mathematics teachers' perceptions of the concept of computational thinking (CT). It shows the results of the number of responses for each item in the level of agreement, together with the mean and standard deviation of the preservice teachers' perception of computational thinking. Table 4 also examined preservice mathematics teachers' perceptions of computational thinking as a problem-solving strategy. Afterwards, the same five participants were interviewed on these areas to have a broader view of the problem.

Table 3: Preservice Mathematics Teachers' Perceptions of Computational Thinking

Item	What is your understanding of computational thinking (CT)?	SD	D	N	A	SA	Mean	SD
1.	It is an approach to problem-solving in mathematics	48	66	9	0	0	1.52	.631
2.	It is about computer programming	11	2	42	45	23	3.62	.945
3.	It is only about how computers process information for solution	13	3	31	48	28	3.69	1.017
4.	It's about how someone approaches a problem in a manner similar to the way a computer would process information	33	8	80	2	0	2.68	.634
5.	It's about how someone can use computer science concepts to solve a problem without necessarily using the computer	50	64	9	0	0	1.52	.831

Source: *Fieldwork, 2024.*

From Table 3, it can be seen that the preservice mathematics teacher 'strongly disagrees' with item 1, that computational thinking is an approach to problem-solving in mathematics (M=1.54. SD=.631). They also 'strongly disagree' with item 5 that CT is about how someone can use computer science concepts to solve a problem without necessarily using the computer (M=1.52, SD=.831). However, the preservice teacher 'agree' to item 2 that CT is about computer programming (M=3.62, SD = .945) and also 'agree' to item 3 that CT is only about how computers process information for solution (M=3.69, SD=1.017). The preservice mathematics teacher was, however, neutral to item 4 of CT being about how someone approaches a problem in a manner similar to the way a computer would process information (M=2.68, SD=.634).

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Three distinct patterns were found when the preservice mathematics teachers' answers to every question were examined. The pattern is the same for items 1 and 5. The most frequent response to item 1 was "disagree" (66, or 54.7%), followed by "strongly disagree" (48, or 39%), and "neutral" (9, or 7%). There were no "strongly agree" or "agree" answers. The low mean scores of these items were explained by this. A similar pattern was generated by items 2 and 3.

In item 2, "agree" was the most often given response (45, or 36.59%), with "neutral" coming in second. 42 (34.15%), "strongly agree" (23, 18.69%), "strongly disagree" (11, 8.94%), and "disagree" (2, 1.63%) were the next most common responses. The high mean scores on these two items were explained by these answers. The initial most common response to item 4 was "neutral," at 80 (65%), followed by "strongly disagree," at 33 (26.83%), "disagree," at 8 (6.5%), "agree," at 2 (1.63%), and "strongly agree," at which point there was no response. The mean of means of the response was found to be 2.60; this shows that the preservice mathematics teachers had a 'low' perception about what computational thinking really is.

Table 4*:* Results of Preservice Mathematics Teachers' Perceptions of Computational Thinking as a Problem-solving Strategy

Item	How do you perceive computational thinking as a problem-solving strategy?	SD	D	N	A	SA	Mean	SD
1.	It can improve learners' thinking skills in their problem-solving situations.	48	66	9	0	0	1.52	.831
2.	It can improve learners' problem-solving skills even though computers are not involved.	48	66	9	0	0	1.52	.831
3.	It can guide learners to use computer science concepts in their problem-solving situations without using computers.	33	8	80	1	1	2.68	.634
4.	It can prepare learners for future tasks in technology.	33	8	80	2	0	2.68	.634
5.	It's a problem-solving skill for every learner in this 21st century.	33	57	17	1	0	1.69	.634

Source: *Fieldwork,2024.*

From Table 4, the preservice mathematics teachers strongly disagree with item 1, that computational thinking can improve learners' thinking skills in their problem-solving situation (M=1.52, SD = .831). They strongly disagree with item 2, that it can improve learners' problem-solving skills even though computers are not involved (M=1.52, SD=.831) In addition, they strongly disagree with item 5, that CT is a problem-solving skill for every learner in this 21st century (M=1.69, SD=.631). However, preservice mathematics teachers had a neutral perception of item 3, that computational thinking can guide learners to use computer science concepts in problem-solving situations without using computers (M=2.68, SD = .634). The preservice mathematics teachers were neutral about item 4, that computational thinking can prepare learners for future tasks in technology (M=2.68, SD = .634).

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Furthermore, a thorough examination of the answers reveals the following trends. The same pattern was seen in items 1, 2, and 5. For example, in item 1, the most popular response was “disagree,” with 66 respondents (53.7%), followed by “strongly disagree,” with 48 respondents (39%), and “neutral.” There were no answers for “strongly agree” or “agree” in 9 (7.3%). The low mean score was explained by the respondents’ strong disagreement with these three items. The response pattern for items 3 and 4 was identical.

For example, 48 (39%) of the responses to question 3 were “agree.” “Neutral” was the second most popular response. 31 (25%) responded “strongly agree,” 38 (30.8%) responded “strongly disagree,” 13 (10.6%) responded “strongly disagree,” and 3 (2.4%) responded “disagree” to the item. The high mean scores of these items were corroborated by these answers. With a mean score of 2.02, these answers show that preservice mathematics teachers have a “low” opinion of computational thinking as a problem-solving technique.

The qualitative data about how preservice mathematics teachers perceive computational thinking revealed the following:

The answers of respondents 1, 2, 3, and 5 reflect a tool-based misunderstanding, where CT is seen as dependent on digital devices rather than a cognitive process.

"I think computational thinking is mainly about using computers or calculators to solve mathematical problems faster, especially when the calculations are too long." (R1)

"To me, computational thinking means teaching students how to code so they can use programming to solve math problems." (R2)

"Computational thinking is helpful mostly in advanced topics like algorithms or computer science, but not really necessary for basic mathematics instruction." (R3)

Response 4 acknowledges step-by-step problem-solving, but still ties it to technology use.

"It is about breaking problems into steps, but I feel it is only useful when technology is involved, like using software or apps in class." (R4)

Response 5 highlights uncertainty and ambiguity, particularly in distinguishing CT from general logical reasoning.

"Computational thinking seems similar to logical reasoning, but I am not sure how it is different or how to apply it directly when teaching mathematics topics like algebra." (R5)

The qualitative data indicate that preservice mathematics teachers hold significant misconceptions about computational thinking. Specifically, they conflate CT with technology and programming, rather than understanding it as a cognitive problem-solving framework. They demonstrate limited awareness of its applicability across different areas of mathematics. Their understanding is often partial, unclear, or fragmented, lacking connection to classroom practice. Overall, these misconceptions suggest a need for explicit instruction and training in teacher education programs to clarify the conceptual foundations of computational thinking and demonstrate its role as a generalizable and powerful strategy for mathematical problem-solving, independent of technology.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Furthermore, the following responses and their analysis revealed preservice teachers' personal opinions on computational thinking as a problem-solving strategy in the mathematics classroom. The qualitative analysis reveals that preservice mathematics teachers generally hold an underdeveloped perception of computational thinking as a problem-solving strategy. For almost all the five respondents, there is a technological dependency misconception, where CT is believed to be impossible without digital infrastructure.

"Computational thinking is basically about using computers to solve mathematical problems. So unless there are computers in the classroom, I don't think it can really be applied in teaching mathematics." (R1)

"I think computational thinking means writing computer programs or coding. Since mathematics teaching at my level does not involve coding, I don't see how it is relevant." (R2)

"From what I understand, computational thinking is more for ICT students. In mathematics, we already have formulas and methods, so I don't think we need computational thinking." (R3)

"Computational thinking sounds like something technical that requires advanced computer knowledge. I feel it would be difficult to use in a normal mathematics classroom without special training or equipment." (R4)

"I have heard of computational thinking, but I thought it was just about using software or calculators to solve problems faster. I didn't know it could be used as a teaching strategy in mathematics." (R5)

From the responses above, the analysis reveals that preservice mathematics teachers hold significant misconceptions about computational thinking, primarily interpreting it as computer usage, programming, or ICT-related activity. This narrow understanding leads to the belief that CT is irrelevant to mathematics teaching, especially in non-digital classrooms.

Problem-solving strategies preservice mathematics teachers observed during mathematics lessons in STS programme

A problem-solving question requires a problem-solving strategy. The study sought to determine whether preservice mathematics teachers came across any problem-solving strategy in their observation of mathematics lessons during their STS program. The following are the two main themes and their codes: The first theme was 'problem-solving exposure', with the following codes: focusing on problem-solving and modeled problem-solving behavior. The second theme was 'structured problem-solving strategy,' having the following codes, use of step-by-step explanation and breaking down complex into parts. These two themes guided the data analysis.

What problem-solving strategies did you observe during the Mathematics lessons in your STS programme?

The following are the responses the preservice mathematics teachers gave as they tried to answer the above question. One respondent observed that the teacher used concrete materials and created a market scene to emphasize the concept of addition and subtraction in primary two.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

"I was in primary 2 and I observed that the teacher used bundles of sticks during problem-solving questions involving addition and subtraction. At other times too, the teacher created a scene to teach a concept. For example, he used to demonstrate how buying and selling take place in a market to teach the concept of addition and subtraction." (R4).

The next respondent observed that the teacher worked with examples for the students to observe and then gave them some examples to practice.

"I had the opportunity to do my observation during my STS at primary 4. The teacher normally introduces the topic, takes one example, and works for the learners to observe. She would ensure they've understood by asking them 'do you understand?' and they would respond 'yes madam'. She works a second example, which is a little more complex than the first example. At this stage, she would pause and give the learners examples for them to solve as she goes round to observe." (R1).

The same approach was observed by another respondent; according to this respondent's report, the teacher puts the learners into groups and creates some kind of competition among the groups to ensure speed and accuracy.

"I had my observation at basic 6 and what I noticed was that the teacher works examples of the mathematics questions on the board for students to observe. He takes his time to do that step-by-step in order to make sure that the learners are following what he was teaching. When he finishes, he puts the learners into groups and assigned them tasks in their textbooks. He creates some kind of competition among the learners in order to ensure speed and accuracy and it makes the lesson very interesting". (R2).

The only difference in the teaching methods observed by (R1 and R2) from (R3) was that this teacher revised the previous lessons with the learners before proceeding to the day's lesson.

"At basic 5, the teacher normally begins by reviewing the previous lessons. He would ask them to find out if they have any problems or not before he begins the day's lesson. He works several examples and gives them some of the examples to do and he supervises that." (R3).

In basic one, according to the respondent, the approach seemed different; many songs and rhymes intermittently took place. Concrete materials were used for addition. The teacher asked the students to count and add them.

"My observation took place at a basic level. There were a lot of rhymes and songs within the lesson. The teacher brings in songs at a very short interval. She also tells a story alongside the lesson and tries to make the lesson very practical. She used teaching materials like bottle tops, bundling sticks, pebbles and pictures to help the learners understand. In one of the lessons, she taught addition, where she writes the number on the board and asks them to count it aside using their bundling sticks or bottle tops. Then she writes the second number and asks them to count it. Then she asked them to put the two together and say the answer. Most of the pupils followed these instructions very well and were able to get the answers right." (R5).

Observing the methods discussed above, it can be seen that most of the questions in classrooms are not problem-solving questions. From the teachers' approach, it seems they wanted the learners to follow certain procedures, as most of them worked examples and asked the learners to follow the same procedures to arrive at an answer. In conclusion, it could be stated that there

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

African Journal of Mathematics and Statistics Studies
ISSN: 2689-5323
Volume 9, Issue 2, 2026 (pp. 41-65)

were no problem-solving questions and, as such, there was no problem-solving strategy in the mathematics classroom.

RESULTS AND FINDINGS

The study investigated preservice teachers' perceptions of computational thinking as a problem-solving strategy in the teaching and learning of mathematics, using an explanatory sequential mixed-methods design. Closed-ended questionnaires and semi-structured interviews were used to identify the preservice mathematics teachers' conceptualization of problem-solving in the teaching and learning of mathematics and how preservice mathematics teachers perceive the role of computational thinking as a problem-solving strategy in mathematics instruction. Five preservice mathematics teachers were interviewed, and their responses were analyzed using thematic deductive analysis.

The findings revealed that preservice mathematics teachers possess a very high and positive conceptualization of problem-solving in the teaching and learning of mathematics. Respondents strongly agreed that problem-solving is essential in mathematics teaching. It promotes deep thinking and relational understanding as well as enhances students' performance in real-world applications of knowledge. These views are consistent with the conclusion drawn by Hiebert andWearne (2003) that students develop, extend, and enrich their understanding by solving problems. However, they also acknowledged that problem-solving requires significant teacher preparation, and it can be difficult to implement in classrooms. This view also supports the assertion made by Donaldson (2011) and Michelson et al. (2022) that describing the problem is extremely difficult in order to prepare for problem-solving for the classroom.

Notably, they were uncertain about whether the *process* or *final answer* in a problem-solving situation is more important; this suggests partial conceptual gaps. The interviews reinforced these results, showing that preservice teachers view problem-solving as the core goal of mathematics learning, emphasizing learner-centered approaches, critical thinking, and creativity. They emphasized that problem-solving recognizes the teacher's role as a facilitator rather than a transmitter of knowledge. They also associated problem-solving with real-life applications, collaboration, and deeper understanding. These findings are supported by Dewey (1933) and Schoenfeld (2007), who firmly believe that problem-solving should be an essential component of mathematics instruction.

However, despite these strong beliefs, findings from Table 2 and interviews revealed misconceptions about the nature of problem-solving questions. Many participants viewed problem-solving questions as routine textbook exercises, procedural and formula-based questions requiring complicated steps rather than non-routine thinking. These findings are contrary to literature; Dewey (1933) defined a problem as anything that confuses people, puts them in a challenging situation, or makes them question their beliefs. According to Schoenfeld (1982), a mathematical task is only considered a problem if one is unable to solve it. Furthermore, it was agreed upon by Hiebert and Weane (1993) and Polya (1962) that problem-solving questions must have a significant degree of complexity that causes students to get confused and perplexed. According to other research, problem-solving questions do not always follow a set process (Donaldson, 2011; Saygih, 2017), and the answers are not always clear (Schoenfeld, 1982). It was defined as a challenge where the solution strategy is unknown

 Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

beforehand in another study (NTCM, 2000). From the literature, it can be said that preservice teachers had some conceptual gaps with regards to mathematics problem-solving questions.

In conclusion, it can be said that, while the preservice teachers value problem-solving highly, their understanding of what qualifies as a genuine mathematical problem remains limited and inconsistent.

The second research question, the quantitative results, showed that preservice mathematics teachers have a low and underdeveloped perception of computational thinking. Most respondents disagreed that CT is a problem-solving approach. They agreed that CT is about programming and computer operations. Most failed to recognize CT as a cognitive process independent of technology. In addition to that, with respect to CT as a problem-solving strategy, the quantitative findings indicated a low perception. Most respondents did not believe that CT improves thinking or problem-solving skills. They did not see CT as relevant without computers. They were unsure of its role in mathematics instruction. The interviews also revealed deep-rooted misconceptions. They perceived CT as computer use, programming, or coding, a tool limited to ICT or advanced topics and irrelevant to basic mathematics teaching. Participants showed a technological dependency misconception that CT requires computers. They also demonstrated conceptual confusion by equating CT with logical reasoning and lack of pedagogical connection to mathematics instruction.

These views are inconsistent with the literature. Hansuker (2020) came to the conclusion that CT is a method for solving problems. According to a different study, CT is the process of resolving a complicated problem (Mouza et al., 2017). Researchers have shown that CT enhances pupils' critical thinking and problem-solving abilities (Yadav, 2017). Furthermore, CT improves the ability to solve problems (Guler, 2021). According to other researchers like Bell et al. (2009) and Wing (2012), CT is a necessary problem-solving ability in the twenty-first century and is more akin to human thought than computers. Once more, CT teaches students how computer scientists solve problems (Krauss & Prottsman, 2017).

In summary, preservice teachers misinterpret computational thinking, failing to recognize it as a general problem-solving framework involving decomposition, abstraction, pattern recognition, and algorithmic thinking (PRADA).

Furthermore, findings from teaching practice (STS observations) revealed that Classroom instruction is dominated by teacher-led demonstrations, step-by-step procedural teaching, and routine exercises rather than non-routine problems. Strategies observed include worked examples, practice exercises, and use of concrete materials (especially in lower grades). However, there was little or no evidence of genuine problem-solving activities. No structured use of computational thinking strategies was observed. It is clear from this that there were no problem-solving exercises in the basic school mathematics classrooms. This result corroborates that of Agyeman andMereku 2015), Ampadu (2019), and Asuma (2022), who found that Ghanaian basic school teachers did not employ problem-solving techniques in the teaching and learning of mathematics.

From the discussion, it can be concluded that there is a disconnect between preservice teachers' beliefs and actual classroom practices, with teaching largely focused on procedural learning rather than authentic problem-solving.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

CONCLUSION

The study concludes that preservice mathematics teachers hold strong positive beliefs about problem-solving, recognizing its importance in promoting meaningful learning, critical thinking, and real-world application. Despite these positive beliefs, they lack a clear and accurate understanding of the nature of problem-solving tasks, often confusing them with routine and procedural exercises.

Preservice teachers demonstrate significant misconceptions about computational thinking, largely viewing it as synonymous with computers, programming, or ICT, rather than a cognitive problem-solving strategy. Their low perception of CT limits its integration into mathematics instruction, as they do not recognize its relevance or applicability without technological tools. Classroom observations reveal a predominance of traditional, procedural teaching approaches, with minimal exposure to authentic problem-solving or computational thinking practices.

Overall, the study highlights a critical gap between theoretical understanding, conceptual clarity, and instructional practice, particularly in relation to computational thinking and problem-solving in mathematics education.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. Teacher education programs should be intentional about distinguishing clearly between routine exercises and non-routine problems in mathematics. The program should provide practical examples of authentic problem-solving tasks in the teaching and learning of mathematics.
2. Incorporate the Concept of Computational thinking in the College of Education mathematics curriculum. Providing workshops, simulations, and micro-teaching sessions focusing on CT and problem-solving. This will help to create the opportunity for preservice teachers to design and implement CT-based lessons emphasizing it as a cognitive and pedagogical tool, not just a technological skill.
3. Bridge Theory and Practice. Revise STS (School-Based Teaching Practice) programs to encourage problem-solving-oriented teaching approaches. Include mentorship and supervision focused on innovative strategies that emphasize CT.

Acknowledgment

We acknowledge the precious time and cooperation given by all participants in this study.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Author’s declaration

The authors declare no conflict of interest.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Funding

No funding was received for this study.

Data Availability

Data will be made available on reasonable request.

REFERENCES

Acquandoh, E., Zunurain, Z., Kwakye, D. O., & Adornyo, S. A. (2022). Effects of teaching students through problem-solving on students' academic performance in problem-solving. *Jurnal Gantang,* 7(2), 121-127. https://doi.org/10.31629/jg.v7i2.5314

Agyemang, M., & Mereku, D. K. (2015). Technology use among Ghanaian Senior High School mathematics teachers and the factors that influence it. *African Journal of Educational Studies in Mathematics and Sciences*, 11, 31–42. https://www.ajol.info/index.php/ajesms/article/download/168997/158461

Alhassan, I., Kwakye, D. O., Essuman, I. B., Malik, A. T., Hudu, A., & Iddrisu, A. R. (2024). Junior High School Mathematics Teachers' Perceived Knowledge of Problem-Solving and Practices of Teaching Mathematics Through Problem-Solving in the Tamale Metropolis. *East African Journal of Education Studies*, 7(1), 500-515. https://doi.org/10.37284/eajes.7.1.1835

Ampadu, E. (2019). Mathematics Teachers' Perceptions about Problem-Solving: The case of Ghana. *The Oguaa Teacher*, 3(22), 1–18. https://doi.org/10.47963/toe.v13i.22.

Asuma, C., Ali, C. A., Adzifome, N. S., & Eric, A. (2022). Mathematics Teachers' Problem-Solving Knowledge, Practices and Engagement among Public Junior High Schools in Berekum West, Ghana. *East African Journal of Education and Social Sciences* 3(1), 29-37. https://doi.org/10.46606/eajess2022v0 3i01.0143.

Avcı, C., & Deniz, M. N. (2022). Computational thinking: Early childhood teachers' and prospective teachers' preconceptions and self-efficacy. *Education and Information Technologies*, *27*(8), 11689–11713. https://doi.org/10.1007/s10639-022-11078-5.

Baker, E. D., Hope, L., & Karandjeff, K. (2009). Contextualized Teaching & Learning: A Faculty Primer. A Review of Literature and Faculty Practices with Implications for California Community College Practitioners. *Academic Senate for California Community Colleges*, 76.

Barr, V., & Stephenson, C. (2011). Bringing computational thinking to K-12: What is involved and what is the role of the computer science education community? *ACM Inroads*, *2*(1), 48–54. https://doi.org/10.1145/1929887.1929905.

Bell, T., Alexander, J., Freeman, I., & Grimley, M. (2009). Computer science unplugged: school students doing real computing without computers. *New Zealand Journal of Applied Computing and Information Technology*, *13*(1), 20-29. http://hdl.handle.net/1959.3/229004.

Boateng, F. O., Appiagyei, E., Adiku, D. K., & Kwakye, D. O. (2025). Investigating Perceived Student Engagement and Mathematics Achievement in Contextualized Lessons in TVET Schools: Moderating Effects, Motivation and Interest. *European Journal of Contemporary Education and E-Learning*, 3(4), 46-65. https://doi.org/10.59324/ejceel.2025.3(4).04.

Bocconi, S., Chioccariello, A., Dettori, G., Ferrari, A., & Engelhardt, K. (2016). *Developing computational thinking in compulsory education – Implications for policy and practice* (*EUR* 28295 EN). https://doi.org/10.2791/792158.

Butler, D., & Leahy, M. (2021). Developing preservice teachers' understanding of computational thinking: A constructionist approach. *British Journal of Educational Technology*, *52*(3), 1060–1077. https://doi.org/10.1111/bjet.13090.

Cabrera, L. (2019). Teacher Preconceptions of Computational Thinking: A Systematic Literature Review. *Journal of Technology and Teacher Education, 27*(3), 305-333. https://doi.org/10.70725/676916nohbuf.

Denning, P. J., & Tedre, M. (2021). Computational Thinking: A Disciplinary Perspective. *Informatics in Education,* 20(1), 361–390. https://doi.org/10.15388/infedu.2021.21.

Dewey, J. (1933). *How we think*. D. C. Heath & Co.

Donaldson, S. E. (2011). *Teaching through problem-solving: Practices of four high school mathematics teachers* (Doctoral dissertation, University of Georgia).

Dong, Y., Bai, Y., Wang, W., Luo, R., Liu, C., & Zhang, L. (2020). Does gender matter for the intergenerational transmission of education? Evidence from rural China. *International Journal of Educational Development*, 77, 102220. https://doi.org/10.1016/j.ijedudev.2020.102220.

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research*, 38(1), 47-65. https://doi.org/10.1080/0013188960380104.

Gadanidis, G., Cendros, R., Floyd, L., & Namukasa, I. (2017). Computational thinking in mathematics teacher education. *Contemporary Issues in Technology and Teacher Education,* 17(4), 458-477. https://eric.ed.gov/?id=EJ1162567.

González, Y. A. C., & Muñoz-Repiso, A. G. V. (2017). Development of computational thinking and collaborative learning in kindergarten using programmable educational robots: A teacher training experience. *ACM International Conference Proceeding Series*, *Part F1322* (October). https://doi.org/10.1145/3144826.3145353.

Gretter, S., & Yadav, A. (2016). Computational Thinking and Media & Information Literacy: An Integrated Approach to Teaching Twenty-First Century Skills. *Tech Trends*, 60, 510-516. https://doi.org/10.1007/s11528-016-0098-4.

Güler, Ç. (2021). Algorithmic thinking skills without computers for prospective computer science teachers. *Journal of Theoretical Educational Science*, 14(4), 570-585. https://doi.org/10.30831/akukeg.892869.

Hambrusch, S., Hoffmann, C., Korb, J. T., Haugan, M., & Hosking, A. L. (2009). A multidisciplinary approach towards computational thinking for science majors. *ACM SIGCSE Bulletin*, 41(1), 183–187. https://doi.org/10.1145/1539024.1508931.

Hiebert, J., & Wearne, D. (1993). Instructional Tasks, Classroom Discourse, and Students' Learning in Second-Grade Arithmetic. *American Educational Research Journal Summer* 30(2), 393-425. https://doi.org/10.3102/00028312030002393.

Hunsaker, E. (2020). Computational Thinking. In the *K-12 Educational Technology Handbook*. https://edtechbooks.org/-vY.

IEA (2016). General Assembly Meeting 57, 10–13 October, Oslo, Norway.

Ilic, U., Haseski, H. İ., & Tugtekin, U. (2018). Publication trends over 10 years of computational thinking research. *Contemporary Educational Technology*, *9*(2), 131-153. https://doi.org/10.30935/cet.414798

Kanaki, K., & Kalogiannakis, M. (2022). Assessing Algorithmic Thinking Skills in Relations to Gender in Early Childhood Educational Process. *Education Sciences,* 11(2), 44-59.

Korkmaz, Ö., Saltali, N. D., Özmutlu, E. B., Ergan, S. N., & Özsoy, G. (2023). An Evaluation of the Effect of Activity-Based Computational Thinking Education on Teachers: A Case Study. *Participatory Educational Research*, *10*(2), 1–25. https://doi.org/10.17275/per.23.26.10.

Kotsopoulos, D., Floyd, L., Khan, S., Namukasa, I. K., Somanath, S., Weber, J., & Yiu, C. (2017). A Pedagogical Framework for Computational Thinking. *Digital Experiences in Mathematics Education*, *3*(2), 154–171. https://doi.org/10.1007/s40751-017-0031-2.

Lee, I., Grover, S., Martin, F., Pillai, S., & Malyn-Smith, J. (2019). Computational Thinking from a Disciplinary Perspective: Integrating Computational Thinking in K-12 Science, Technology, Engineering, and Mathematics Education. *Journal of Science Education and Technology*, *29*(1), 1–8. https://doi.org/10.1007/s10956-019-09803-w.

Monaghan, J., Pool, P., Roper, T., & Threlfall, J. (2008). Open-start mathematics problems: an approach to assessing problem-solving. *Teaching Mathematics and Its Applications an International Journal of the IMA*, *28*(1), 21–31. https://doi.org/10.1093/teamat/hrn023.

Mouza, C., Yang, H., Pan, Y. C., Yilmaz O. S., & Pollock, L. (2017). Resetting educational technology coursework for preservice teachers: A computational thinking approach to the development of technological pedagogical content knowledge (TPACK). *Australasian Journal of Educational Technology*, *33*(3), 61–76. https://doi.org/10.14742/ajet.3521.

National Council of Teachers of Mathematics, (2000). *Principles and Standards for School Mathematics*. *National Council of Teachers of Mathematics*. https://www.nctm.org/uploadedFiles/Standards_and_Positions/Position_Statements/EMS%20Joint%20Position%20Statement.pdf.

Nyutu, E. N., Cobern, W. W., & Pleasants, B. A-S. (2020). Development of an instrument to assess students‘perceptions of their undergraduate laboratory environment. *The Journal for Research and Practice in College Teaching,* 5(1), 1-18.

Pala, F. K., & Mıhcı, T. P. (2021). Improvement of preservice teachers' computational thinking skills through an educational technology course. *Journal of Instructional Development and Education*, 10(3), 245–266. https://doi.org/10.47156/jide.1027431.

Pólya, G. (1962). *How to solve it*. Princeton University Press.

Powers, J., Musgrove, A., Brown, V., & Azhar, M. (2020). Exploring the Development of Preservice Teachers/ Knowledge and Attitudes towards Integrating Computational Thinking and Robotics into the Classroom. *FDLA Journal*, 6(1).

Rich, K. M., & Yadav, A. (2019). Infusing computational thinking instruction into elementary mathematics and science: Patterns of teacher implementation. *Proceedings of the Society for Information Technology & Teacher Education International Conference 2019*.

Rosen, L. D., Whaling, K., Carrier, L. M., Cheever, N. A., & Rokkum, J. (2013). The media and technology usage and attitudes scale: An empirical investigation. *Computers in Human Behavior,* 29, 2501-2511. https://doi.org/10.1016/j.chb.2013.06.006.

Saygılı, S. (2017). Examining The Problem Solving Skills and The Strategies Used by High School Students in Solving Non-Routine Problems. *E-International Journal of Educational Research*, 8(2), 91-114.

Sands, P., Yadav, A., & Good, J. (2018). Computational thinking in K-12: In-service teacher perceptions of computational thinking. In Computational Thinking in the STEM Disciplines: Foundations and Research Highlights (pp. 151–164). *Springer International Publishing*. https://doi.org/10.1007/978-3-319-93566-9_8.

Schoenfeld, A. H. (2007). Problem solving in the United States, 1970–2008: research and theory, practice and politics. *ZDM*, *39*(5–6). https://doi.org/10.1007/s11858-007-0038-z.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J

Schoenfeld, A. H., & Herrmann, D. J. (1982). Problem perception and knowledge structure in expert and novice mathematical problem solvers. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8*(5), 484–494. https://doi.org/10.1037/0278-7393.8.5.484.

Shute, V. J., Ventura, M., Bauer, M., & Zapata-Rivera, J. D. (2017). Formative and summative assessment. *Handbook of Research on Learning and Instruction*, (2nd ed.). Routledge.

Syslo, M. M., & Kwiatkowska, A. B. (2006). Contribution of informatics education to mathematics education in schools. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *4226 LNCS*, 209–219. https://doi.org/10.1007/11915355_20.

T-TEL (nd). Learning, Teaching and Applying Number and Algebra, Course Manual Y1-S1, Ministry of Education, Ghana.

Ung, L. L., Labadin, J., & Mohamad, F. S. (2022). Computational thinking for teachers: Development of a localized E-learning system. *Computers & Education*, 177, 104379. https://doi.org/10.1016/j.compedu.2021.104379.

Üzümcü, Ö. (2023). Computational thinking scale: the predictive role of metacognition in the context of higher order thinking skills. *Journal for the Education of Gifted Young Scientists*, *11*(3), 423–437. https://doi.org/10.17478/jegys.1355722.

Watson, A. (2013). *Key ideas in teaching mathematics: Research-based guidance for ages 9–19* (K. Jones & D. Pratt, Eds.). Oxford University Press.

Watson, A. (2002). Working with students as researchers: Ethical issues and policy implications. *British Educational Research Journal, 28(3),* 403–418. https://doi.org/10.1080/0141192022013749.

Wing, J. M. (2008). Computational thinking and thinking about computing. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *366*(1881), 3717–3725. https://doi.org/10.1098/rsta.2008.0118.

Wolfram, C. (2020). The Math(s) Fix: An education blueprint for the AI age. Wolfram Media.

Yadav, A., Krist, C., Good, J., & Caeli, E. N. (2018). Computational thinking in elementary classrooms: measuring teacher understanding of computational ideas for teaching science. *Computer Science Education*, *00*(00), 1–30. https://doi.org/10.1080/08993408.2018.1560550.

Yadav, A., Mayfield, C., Zhou, N., Hambrusch, S., & Korb, J. T. (2014). Computational thinking in elementary and secondary teacher education. *ACM Trans. Comput. Educ.*,14(1). http://dx.doi.org/10.1145/2576872.

Yadav, A., Stephenson, C., & Hong, H. (2017). Computational thinking for teacher education. *Communications of the ACM*, *60*(4), 55–62. https://doi.org/10.1145/2994591.

Yang, H., Mouza, C., & Pan, Y. C. (2018). Examining preservice teacher knowledge trajectories of computational thinking through a redesigned educational technology course. *Proceedings of International Conference of the Learning Sciences, ICLS*, *1*(2018-June), 368–375.

Article DOI: 10.52589/AJMSS-HXLK5Z8J
DOI URL: https://doi.org/10.52589/AJMSS-HXLK5Z8J