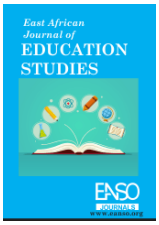

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Original Article

Junior High School Mathematics Teachers' Perceived Knowledge of Problem-Solving and Practices of Teaching Mathematics Through Problem-Solving in the Tamale Metropolis

Issah Alhassan[1], Dennis Offei Kwakye[2], Isaac Brilliant Essuman[3], Alhassan Taah Malik[4], Alhassan Hudu[5] & Abdul Rahaman Iddrisu[6]*

[1] Ghana Education Service, Zogbeli JHS, Tamale, Ghana.
[2] FMS, 402 Iona Street, Fairmont, NC 28340, USA.
[3] Ghana Education Service, Holy Rosary School, Sankpala, Ghana.
[4] Department of Mathematics Education, Tumu College of Education, Tumu, Ghana.
[5] Mathematics Department, Ndewura Jakpa SHTS, P. O. Box UD119, Damongo Ghana.
[6] Ghana Education Service, Tamale, Ghana.
[*] Author for Correspondence ORCID ID: https://orcid.org/0000-0002-6368-7116; Email: denniskkdo@gmail.com

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Mathematical Knowledge, Mathematics Teachers' Perceived Knowledge, Problem-Solving Strategies.

ABSTRACT

This study focused on public JHS mathematics teachers' perceived knowledge about problem-solving and the extent to which mathematics teachers employed problem-solving strategies. The sequential explanatory research design was adopted for this research. The study sample consists of eighty-six JHS mathematics teachers in the Tamale metropolis. Means and standard deviations were used to analyse the quantitative data. The thematic analysis was done on the qualitative data after it was transcribed. The results demonstrated that even though JHS mathematics teachers have good knowledge about problem-solving, they moderately used problem-solving instructional strategies in their lessons and highly used task-based instruction and cooperative learning strategies. Therefore, the researcher recommends a new paradigm of training teachers on problem-solving strategies for public JHS mathematics instruction. The headteachers must ensure that mathematics teachers are supervised and motivated to use problem-solving methods to enhance students' academic performance in mathematics.

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INTRODUCTION

The importance of mathematical knowledge in this technological time is recognised globally, for it is a tool for developing a rational personality (Kavkler et al., 2014). Problem-solving is widely acknowledged as a pivotal skill that nurtures critical thinking, logical reasoning, and the practical application of mathematical principles (Polya, 1945; Schoenfeld, 1985). Without a doubt, the significance of mathematics education cannot be overstated. It is unsurprising that in contemporary society, there is an increasing demand for mathematical abilities and expertise. This is due to the fact that students must acquire advanced skills in order to remain competitive for potential professional paths (Njagi, 2015). The educators' aspiration to witness students achieving mathematical proficiency is highly significant, while this pursuit remains implausible. Based on my extensive experience as an educator in the field of mathematics, it is apparent that the implementation of an effective curriculum delivery system offers a multitude of benefits for students. Enhancing students' reasoning skills, fostering critical thinking abilities, and honing problem-solving competence are among the array of benefits that stem from a comprehensive study of mathematics.

Legner (2013) supports the notion that a foundational grasp of arithmetic, essential for many professions, is generally acquired by the end of primary school. Explicit approach to grasping these arithmetic and integer operations is a necessity (Larbi et al., 2022). Hence underscoring the necessity of prioritising the thorough teaching and learning of its core concepts. Drawing upon this particular viewpoint and the scholarly research conducted by Kavkler et al. (2014), which has systematically demonstrated the benefits of the subject, it is justifiable to argue that providing young pupils with a comprehensive comprehension of mathematics continues to be of utmost importance. This responsibility should be embraced by all educators in the field. Advancing the quality of mathematics education in schools, especially at the pre-tertiary level, has evolved into a worldwide concern over the past three decades. Consequently, multiple countries have undergone substantial revisions to their mathematics curricula. A central principle prevalent in many of these contemporary curricula involves the transition from a teacher-centred approach to a more student-centred pedagogy. For instance, as exemplified by Mosvold (2005), Norway took significant steps to enhance mathematics education by introducing a new mathematics curriculum in 1997. This curriculum places substantial emphasis on student-centred teaching methods, aiming to establish tangible connections between school mathematics and real-life encounters for students.

Correspondingly, Chambers (2008) discloses that England introduced a national mathematics curriculum in the 1980s due to subpar mathematics achievement among students and the pressing need for improved pedagogical methodologies. This initiative involved outlining diverse teaching and learning strategies within these mathematics syllabi to foster students' comprehensive grasp of mathematical concepts. To develop a solution in these kinds of scenarios, the problem solver must employ analysis and prediction. Solving problems is a crucial part of mathematics education. It offers students the opportunity to examine multiple representations and the reasoning behind their solutions while engaging in intelligent discussions about mathematics. Instructional strategies that centre on problem-solving empower students to actively participate in their education and inspire teachers to fully engage in their teaching (Susuoroka et al., 2023). Bay (2000) elaborates on problem-solving instruction as a way for mathematics teachers to offer all-encompassing help in this area.

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Elaborating on this perspective, the author elucidates that teaching through problem-solving entails applying mathematical content via problem-solving strategies and employing suitable tools (Amanyi et al., 2022; Zakari et al., 2021). Through problem-solving activities, students develop, expand, and enhance their comprehension (Hieber & Wearne, 2003). Students who learn through solving problems are prepared for a life filled with skill. Furthermore, it fosters students' eagerness to take on mathematical challenges and helps them feel more confident about their ability to solve problems (Tratton & Midgett, 2001).

Furthermore, Van de Walle (2007) observes that adopting a problem-solving approach to teaching mathematics engages students comprehensively in vital mathematical learning. This signifies that problem-solving underpins all mathematical tasks and functions as a versatile skill. Its pertinence extends to lifelong learning, demanding independent thinking and critical evaluation of matters. Hence, nurturing mathematical problem-solving abilities in students during their foundational education holds significance, indicating their readiness for both professional pursuits and life challenges. The problem of teachers in Ghana not having the necessary skills and knowledge to use efficient problem-solving strategies in maths classes continues (Mereku, 2015). Mereku argues that in Ghanaian basic schools, teachers are not doing enough to support pupils' growth as problem solvers. Teachers must include the essential ideas of teaching through problem-solving into Polya's model in order to improve these methods. This model represents a method that mathematics teachers use to give students deeper teaching in the subject. According to Cai and Lester (2012), teaching through problem-solving develops students' enthusiasm and curiosity in mathematics while also helping them understand concepts, reasoning skills, and mathematical communication.

Polya's paradigm considers problem-solving to be an activity requiring a variety of skills. One view of problem-solving is that it is a practical art that involves both learning and teaching. It focuses on a student's ability to use past information and adapt it to novel circumstances (Polya, 1945). The student's ability to recollect basic mathematics concepts, understand when and how to apply them in novel situations, and carry out such tasks constitute three separate abilities. While a youngster may have all three of the skills necessary to solve problems, mastery of one talent does not always translate into comprehension of the problem. Instead, it can mean that the student's chosen learning style has not been adequately taken into account (Polya, 1954). According to Bley and Thornton (2001), a student's ability to perform isolated operations does not always translate into their ability to apply or analyse the associated figures.

Crafting effective problems involves tailoring them to cater to the varying skill levels, capabilities, and learning preferences of students. Consequently, educators are encouraged to embrace diverse solutions and techniques within the classroom to foster problem-solving abilities.

Furthermore, in light of the global technological and scientific progress, Ghanaian learners must be guided beyond superficial comprehension and rote memorisation of facts and formulas to become future problem solvers. Teachers must therefore possess the necessary tools to foster in their students a sophisticated level of mathematical reasoning. The teacher bears a major responsibility for the growth and depth of students' problem-solving abilities (Acquandoh et al., 2022).

According to Abdul-Razak and colleagues (2022), teachers must make judicious choices, encompassing the selection of engaging learning materials, appropriate teaching methodologies, the creation of conducive learning environments for exploration, prudent decision-making to mitigate risks, and the sharing of both failures and successes from real-world applications.

The traditional role of teachers, serving as mere sources of knowledge and authority, undergoes a substantial transformation in the context of

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developing problem-solving skills in mathematics. Their role evolves into that of guides and facilitators. Proficiency in problem-solving has diverse applications across numerous domains of human endeavour, including commerce, industry, and science. For this reason, it is recommended that students solve problems as a powerful way to learn mathematics (Bornaa et al., 2022; Roberts et al., 2009). Teachers have the ability to provide students with the problem-solving abilities that enable them to tackle real-world issues; nevertheless, this accomplishment is contingent upon the alignment of instructional strategies with the curriculum's objectives related to problem-solving. Although an examination of the Junior High School Mathematics curriculum in Ghana provides enough direction for teachers to integrate problem-solving into their teaching strategy, it is not clear if teachers interpret and apply these directives consistently across the board.

Also, teachers limited knowledge of problem-solving influences how they apply it in the classroom when teaching mathematics.

Problem Statement

Although several concerned scholars, well versed in the subject area, have carried out extensive studies to find some solutions to the current predicament, there are no known studies examining how junior high school mathematics teachers' perceived knowledge of problem-solving aligns with their actual teaching strategies specifically in the Tamale Metropolis. This is, therefore, an issue of concern for improving the teaching and learning of mathematics and producing students who are nationally and internationally competent in problem-solving and decision-making.

Research Questions / Hypothesis

The study was guided by the following questions:

- What are mathematics teachers' perceived knowledge for teaching through problem-solving among public junior high schools in the Tamale Metropolis?
- To what extent do mathematics teachers employ problem-solving strategies in teaching mathematics among public junior high schools in the Tamale Metropolis?

LITERATURE REVIEW

Theoretical Review

The theoretical framework that would assist in investigating into mathematics teacher perceived knowledge, instructional strategies and practices in the classroom was required. Consequently, the constructivism theory was adopted as the underpinning theory of the framework with additional adoption of Pedagogical Content Knowledge (PCK) models. Constructivism is aligned with active learning and encourages comparison of new ideas to prior knowledge (Piaget, 1954). Constructivism, as outlined by Hausfather (2001), guides how teachers approach their work. It is not a specific teaching method but rather a theory concerning knowledge and learning. This theory places importance on the teaching context, students' prior knowledge, and the interaction between students and the subject matter. Tobin and Fraser (1998) suggest that constructivism should serve as the foundation for teachers' thoughts and actions. PCK models, such as those proposed by Rollnick et al. (2008) and Magnusson et al. (1999), were chosen to enable a focus on specific classroom practices, teacher knowledge, and instructional strategies. PCK, as defined by Shulman (1986), encompasses an understanding of what makes the learning of a specific topic easy or difficult, including students' presumptions. Teachers require knowledge of strategies that can reorganise students' understanding to effectively teach and facilitate learning.

PCK is a skill and knowledge that is realised when the teacher accesses what he or she knows in terms of curriculum, student understanding, subject matter, pedagogic principles, and all this is embedded in his/her experiences. So, it is not only about the knowledge of various domains which amalgamate to result in the PCK, but the teacher's craft is the ultimate variable in the classroom

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practice for students' learning. This is also a claim by Lee and Luft (2008), who indicate that PCK is the experiential knowledge and skills acquired through experience in the classroom. Within social constructivist theory, the interactions between the student and the teacher, the students themselves and the social milieu are the fundamental basis for knowledge construction by students (Leach & Scott, 2003).

Empirical Review

Mathematics Teachers' Perceptions of Problem-Solving

As stated by Assan-Donkor et al. (2022) and Ekici (2013), teachers' knowledge levels, perceptions, and viewpoints concerning the process of problem-solving hold significant rank in their ability to effectively teach students problem-solving skills and their application in real-life situations. Chapman (2008) concurred with Ekici's viewpoint, emphasising that teachers should possess a solid foundation in mathematical problem-solving both as solvers themselves and as guides to nurture students' problem-solving abilities. Teachers' proficiency in abstract thinking, comprehension of word problems, and adeptness in progressing through problem-solving stages are pivotal factors influencing their effectiveness in teaching mathematical problem-solving (Yee & Bostic, 2014). A study conducted by Kaino and Yaqiang (2004) revealed that mathematics teachers demonstrated an average level of comprehension in problem-solving, while both teachers and students achieved low scores in mathematics problem-solving. Schukajlow et al. (2012) observed that teachers often misinterpret problem-solving tasks as application problems. In another study by Lee and Kim (2005), the perception of "good problems" among basic schoolteacher candidates was investigated. The majority considered typical routine problems as favourable while displaying resistance towards non-routine problems with unusual characteristics.

Meaning and Processes of Problem-Solving

The consideration of problem-solving is crucial for addressing non-routine mathematical topics. It is imperative to underscore the significance of problem-solving in the context of non-routine challenges. Consequently, it is unsurprising that this field of mathematics education has garnered significant focus over time, leading to more scholars investigating and identifying the procedures involved in instructing pupils to answer problems with greater precision. In essence, problem-solving is centred around a mathematical inquiry that lacks a known solution (Callejo & Vila, 2009).

D'Ambrosio (2003) defines problem-solving as a process that often provides an environment for the student to work independently while discovering precise mathematical paths to answers. Therefore, the path a student takes in solving a problem can be called a problem-solving process. In essence, this implies that the process of problem-solving commences when students are assigned the responsibility of addressing both routine and non-routine situations. It is important to acknowledge that in order for a student to effectively solve problems, they must possess a high level of mental agility. If the student lacks this skill, their ability to work accurately will be significantly impaired (D'Ambrosio, 2003). Additionally, the author claims that problem-solving provides students with the chance to apply their pre-existing knowledge in order to resolve difficulties. The procedure holds significant importance as it enables students to generate novel knowledge and enhance their understanding. Based on his viewpoint, it may be inferred that the process of problem-solving serves as a catalyst for cultivating a more profound comprehension of mathematical concepts and procedures. Hence, when students are confronted with both routine and non-routine tasks, it is crucial to thoroughly peruse the problem in order to comprehend the questions proficiently. This may entail dissecting significant information to enhance comprehension and facilitate the selection of suitable strategies.

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In order to enhance students' proficiency and autonomy in problem-solving, numerous researchers have devised a range of efficacious methodologies that are deemed essential for facilitating the resolution of intricate difficulties. In light of the aforementioned context, Bruder and Collet (2011) suggest that the acquisition of problem-solving skills can be regarded as a protracted pedagogical endeavour encompassing four distinct phases. The strategies encompassed in this approach consist of intuitive familiarization with heuristic methods and techniques, explicit strategy acquisition through the introduction of special heuristics using prominent examples, a brief conscious practice phase to apply the newly acquired heuristics to various task difficulties, and the expansion of the contextual scope of the strategies employed.

According to Foster (2023), teaching through problem-solving will allow students to construct their mathematical concepts and take responsibility for their own learning.

Teachers' Knowledge for Incorporating Problem-Solving in Instruction

Teachers have reported that they lack the knowledge and skills they need to meaningfully incorporate a problem-solving approach into their teaching of mathematics (Buschman, 2004; Cai & Lester, 2010). Little empirical research has been done in Jamaica and the wider Caribbean to help teachers gain greater insight into how they can incorporate problem-solving in their classrooms to advance students' problem-solving competence (Lester & Cai, 2015). However, the research literature has been published elsewhere that largely focuses on the different ways teachers integrate problem-solving in their classrooms and the challenges faced in using a problem-solving approach (Lester, 2013; Lester & Cai, 2015; Polya, 1945).

There are varied ways in which mathematics teachers can guide students' engagement with mathematical problems. The first and perhaps most important relates to selecting a "good" or worthwhile problem (Cai & Lester, 2010; Lester, 2013). Good problems can "inspire the exploration of important mathematical ideas, nurture persistence, and reinforce the need to understand and use various strategies, mathematical properties, and relationships" (National Council of Teachers of Mathematics, 2000). They can also concretise and extend students' prior knowledge, promote understanding of concepts, foster mathematical reasoning, discourse and communication, and capture interests and curiosity.

Both Cai (2003) and Buschman (2004) agree that the use of good problems is vital but posit that the success or failure of teaching using a problem-solving approach is not solely dependent on this. Buschman (2004) explains that everyday classroom activities can provide the basis for excellent problems, but it is imperative that teachers "listen to what children say and do and then help them to become aware of the mathematics embedded in these events". In addition, the teacher should help students to understand the problem, including posing questions that allow learners to extract essential information from the problem, helping learners to determine the goal of the problem, reconstructing the problem if necessary, and identifying suitable mathematical notations for easy reference and manipulation (Fan & Zhu, 2007). Fan and Zhu also argued that after students have understood the problem, the teacher can help them decide on a possible plan of action that may lead to a solution, encourage them to "carry out the plan of action"s, and persist with the plan if it is leading to an appropriate solution; but discard the plan and try a new one if the initial plan is not leading to a solution. Furthermore, a teacher might encourage students to reflect on the plausibility of their solution and make judgments where necessary.

Problem-Solving as a Teaching Strategy

Mathematics educators have widely accepted that the principal objective of mathematics instruction should be developing learners' problem-solving abilities and that problem-solving must play an integral role in the curriculum of mathematics programmes (Lester, 1994). Mills and Kim (2017:

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1) also argued that problem-solving skills do not necessarily develop naturally. They must be taught explicitly so they can be moved across multiple contexts and settings. According to Alsawaie (2003), the NCTM calls for programmes of teaching that will make all learners capable of constructing new knowledge in mathematics through problem-solving, solving mathematical problems that may arise and those appearing in other settings, employing and adapting a lot of suitable techniques in finding solutions to problems and reflecting and monitoring the methods and strategies utilised to work out a mathematics solution to a given problem.

Challenges Related to Teachers

Elementary school mathematics teachers are trained to be generalists and often lack the mathematical knowledge to teach using problem-solving techniques. As educators, they will not have enough information to think about anything other than curriculum goals or instructional boundaries, so it can help them find a problem-solving orientation (Xenofontos, 2007). The situation in Ghana is no different from Xenophontos' views on teacher reform. This phenomenon can lead to teachers not being equipped with the content and pedagogical knowledge to teach mathematics using problem-solving strategies. Mereku (1998), in a research study on the problem of language in solving problems in elementary school calculation, noted that problem-solving is not common in primary schools in Ghana because most teachers do not know how to introduce it in the classroom; they cannot solve problems themselves; nor can they explain why students find it difficult to learn to solve problems. He also pointed out that teaching through problem-solving is difficult for teachers.

McIntosh et al. (2000) argued that teaching mathematics through problem-solving is difficult for teachers because they lack sufficient subject matter knowledge, subject matter knowledge, and personal issues. Another basis for teachers' struggles with implementing problem-solving in their classes may be a lack of the knowledge and skills to incorporate problem-solving meaningfully into the mathematics curriculum (Buschman, 2004; Cai & Lester, 2010). While some teachers acknowledged that enabling student interactions was a critical component of using the problem-solving approach, they were unsure how to foster (or promote) this mathematical knowledge about teaching is essential to effective teaching (Ball & Bass, 2000). Currently, some teachers lack the necessary knowledge, skills, and competencies to teach mathematics through problem-solving (Anderson, 2000). According to Aggrey and Kwakye (2022) and Matlala (2015), mathematics teachers still taught using traditional methods like storytelling and stepping in to demonstrate how to solve mathematical problems to their students because they found it difficult to teach using problem-solving techniques.

METHODOLOGY

The study was carried out using the explanatory sequential design. As per Creswell (2017), an explanatory sequential design entails the investigator conducting quantitative research initially, analysing the outcomes, and subsequently employing qualitative research to extend the conclusions. The two phases (qualitative and quantitative) of the explanatory sequential design make it easy to apply, which is one of its advantages.

The explanatory sequential design procedure first involves the collection and analysis of quantitative data to identify specific quantitative results that need further explanation. This type of design is popular in fields with a strong quantitative orientation (hence, the project begins with quantitative research), but it presents challenges of identifying the quantitative results to further explore and the unequal sample sizes for each phase of the study (Creswell, 2014). All mathematics teachers employed by the Tamale metropolitan district's public junior high schools are the study's targeted demographic. According to estimates from the Tamale Metropolitan Education Office, there are 110 mathematics

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teachers spread among 74 public junior high schools in the city.

A proportion of the 110 mathematics teachers was determined and selected for interviews and data collection. A purposive sampling technique was used to select the participants. 86 junior high school mathematics teachers took part in the study.

Primary data were employed in the investigation. A structured questionnaire was used to get quantitative data, and an interview guide was used to gather qualitative data.

A questionnaire is a list of questions used to collect information from a large number of people on a subject of interest. It serves as a medium through which the researcher and the respondent communicate indirectly (Vaniea, 2019). According to Strange and colleagues (2003), respondents may feel more comfortable conveying their opinions through a questionnaire than in a face-to-face interview. An interview is a flexible tool for the collection of qualitative data, which allows the use of a multi-sensory approach (verbal, non-verbal, spoken, and heard).

The study used descriptive statistics such as mean and standard deviation, frequency and percentages to analyse the quantitative data, while the thematic analytical technique was used to analyse the qualitative data.

RESULTS AND DISCUSSIONS

Perceived Knowledge for Teaching through Problem-Solving

The research question sought to determine JHS mathematics teachers' perceived knowledge and view on problem-solving. In order to respond to this research question, participants were asked to indicate on a four-point Likert scale that went from Strongly disagree to Strongly agree. This resulted in an average/fair score of 2.5 ([1+2+3+4]÷4). Means and standard deviations were used to determine the degree of agreement between mathematics teachers' perceived knowledge of problem-solving techniques. A statistical mean of less than 2.50 indicates low, 2.50 to 3.50 indicates moderate, while 3.50 or above indicates high. Table 1 contains the analysis of Research Question 1.

Table 1: Mathematics teachers' perceived knowledge on problem-solving

Statements on perceived knowledge	Mean	SD	Level of agreement
Mathematics problems should task pupils to reason logically and critically	3.66	0.49	High
Mathematics problems should have a connection with pupils' real-life situation	3.62	0.53	High
Mathematics problems should challenge pupils to apply daily skills in solving it	3.64	0.55	High
Mathematics should guide pupils to self-develop strategies	3.53	0.50	High
Problem-solving involves tasks that challenge pupils' ability	3.37	0.62	Moderate
Mathematics problems should require pupils to conjecture their strategies for solving it	3.21	0.79	Moderate
Overall mean perceived knowledge score	3.51	0.58	High

Table 1 offers a thorough understanding of how mathematics teachers believe that teaching students to solve issues logically and critically (M = 3.66, SD = 0.49) is a better approach to problem-solving than assigning problems that relate to students' real-world experiences (M = 3.62, SD = 0.53). Mathematical puzzles that require the student to use everyday knowledge to solve them (M = 3.64, SD = 0.55). High school mathematics lessons should help students develop their problem-solving strategies (M = 3.53, SD = 0.50), as well as mathematical problems with tasks that test their skills (M = 3.37, SD = 0.62), and mathematical problems that require students to speculatively solve them (M = 3.21, SD = 0.79).

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Overall, the mean and standard deviation of the perceived knowledge of mathematics teachers were 3.51 and 0.58, respectively. This suggests a high degree of agreement and good perceived expertise for problem-solving. Overall, then, it is evident that the Tamale Metropolis' JHS mathematics teachers saw knowledge as the embodiment of problem-solving, which guaranteed that students had a strong understanding of problem-solving techniques aimed at cultivating and producing students who can use these mathematical skills to solve real-world issues.

From *Table 1, the* majority of the teachers ascribed positively to the problem-solving statement, and so it can be argued that having such positive perceptions can be a great asset for the country in our quest for improving mathematics education using problem-solving strategies. Results from five teachers who were interviewed were also used to corroborate some of these facts and were not different from the data gathered from the questionnaires. We asked respondents to define problem-solving in their own words. The purpose of this inquiry was to find out what knowledge the teachers have on problem-solving. Based on the responses, it was evident that nearly every teacher saw themselves as having good problem-solving skills. The following were some of the interview responses:

> *What do you think Problem-Solving is?*

One of the respondents said,

> *Yes, problem-solving is a means of assisting students in formulating their own plans for resolving issues they face on a daily basis...* (Teacher 1, Interview).

Another respondent revealed that,

> *The process of addressing a mathematical problem involves pupils trying to figure out a solution to an issue that they may not have encountered previously. ...* (Teacher 2, Interview).

Another respondent revealed that,

> *To solve an issue is to know how to solve it without having the answer beforehand. This is known as problem-solving..... (Teacher 3, Interview).*

Another respondent also said,

> *In my opinion, word problems are a common way for kids to solve problems since they challenge them to use their talents to think through problems and perhaps collaborate with others to find a solution.....* (Teacher 4, Interview).

One of the respondents said,

> *In order to help children, solve difficulties, arithmetic questions or assignments should challenge them to think critically and reason through solutions; in certain cases, this may require multiple attempts to arrive at the right answer.....* (Teacher 5, Interview).

The subsequent inquiry posed by the researcher was to ascertain the timing and methodology employed by teachers in recognizing problem-solving as an essential focal point in the instruction of mathematics. The teachers' responses revealed that the majority of them were familiar with the Problem-solving concept during their undergraduate studies at various colleges and institutions. Nevertheless, none of them had participated in any problem-solving session in recent years.

Below are some excerpts.

> *When and how does one recognise the need of emphasizing problem-solving strategies in the instruction of mathematics?*

The first respondent said,

> *From the books I have studied, I have gained knowledge regarding the importance of problem-solving in the instruction of Mathematics. During my time at the University of Education, Winneba, I acquired knowledge that problem-solving is a highly effective method for assessing students' utilization of Mathematics. As an educator, I strive to contextualize my lessons with the*

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> *everyday experiences of my pupils.…* (Teacher 1 Interview).

Another participant also said,

> *I have acquired knowledge that problem-solving is a method used to evaluate a child's understanding. I acquired this knowledge during my time at college and university approximately a decade ago, and I occasionally incorporate it into my instructional practices….* (Teacher 2 Interview).

Also, one of the participants said,

> *During my time in college, I observed that problem-solving was a key focus in the instruction of Mathematics. Upon assuming the role of a teacher, I occasionally incorporate problem-solving techniques into my instructional approach.…* (Teacher 3 Interview).

Another participant responded,

> *A session I participated in a few years ago acquainted me with the concept of problem-solving. I have come to understand that problem-solving is a cognitive barrier for children, thus prompting me to employ problem-solving techniques as a means to foster deep thinking in youngsters.…* (Teacher 4 Interview).

One more participant also said,

> *I acquired knowledge about problem-solving from both my college education and a workshop. It provides students with a comprehensive comprehension of both theoretical and practical information.….* (Teacher 5 Interview).

Based on the provided excerpts, the researcher inferred that a majority of the Junior High School Mathematics teachers possess awareness of problem-solving and have a favourable perception of their understanding in this domain. The definitions provided were deemed satisfactory. The participants who were interviewed gave responses demonstrating good perceived knowledge of teaching through problem-solving. The literature's definitions provided insights into the perspectives of teachers regarding the definition of mathematical problem-solving. Several educators had a primary focus on the selection and delivery of "good" or effective issues to students. All five educators who were interviewed expressed a comprehensive understanding of the concept of problem-solving. The definition of problem-solving provided by the instructor included statements such as "posing a question to learners and necessitating their cognitive engagement, without a readily apparent solution," which aligns with the scholarly literature (The National Council of Teachers of Mathematics (NCTM) 2005). The role of problem-solving in mathematics is of utmost importance and should be given significant emphasis in the mathematical education of students.

The findings derived from the survey shown in Table 4.1 indicate that mathematics teachers at Tamale Metropolis Junior High School possess a commendable level of problem-solving expertise ($M = 3.50$, $SD = 0.57$). Prior research conducted by Xenofontos (2007), Mereku (2015), and McIntosh et al. (2000) confirmed that teachers have insufficient expertise in problem-solving, resulting in a lack of problem-solving instruction in mathematics. This finding contradicts the results of the present study. Hence, the results of the investigation indicate that mathematics educators at the junior high school level in the Tamale Metropolis possess the necessary expertise and competencies to effectively instruct mathematics through a problem-solving methodology.

Use of Employ Problem-Solving Strategies in Teaching Mathematics

The second research inquiry focused on the pedagogical approaches employed by mathematics educators when instructing problem-solving skills to intermediate school students in the urban area of Tamale. The extent of problem-solving instructional strategies was determined by calculating mean scores and standard deviation of

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utilization levels. A mean score of 2.50 indicated little usage, a mean score of 3.50 indicated moderate usage, and a mean score of 3.50 indicated high usage. Table 2 displays the outcomes of the teaching tactics employed, as well as the overall level of usage and practice. Data for study question two was collected using items 7 to 15 of the questionnaire. The findings pertaining to the second research topic are presented in *Table 2*.

Table 2 provides a comprehensive examination of how educators adopt and employ problem-solving strategies. The findings presented in Table 2 indicate that mathematics teachers utilized several instructional strategies when teaching problem-solving in mathematics instruction. The results of the study indicate that task-based instruction (M = 3.50, SD = 0.55) and cooperative learning (M = 3.51, SD = 0.67) exhibit higher levels of usage and adoption compared to brainstorming (M = 3.41, SD = 0.81), guided discovery (M = 3.26, SD = 0.94), group work (M = 3.29, SD = 0.9.3), trial and error (M = 3.31, SD = 0.72), look for a pattern (M = 3.15, SD = 0.75), and inquiry learning (M = 3.05, SD = 0.91).

Working backwards (*M* = 2.45, *SD* = 0.93) was low used. The overall level of adoption and usage of the strategies outlined in the study yielded a mean of 3.21 and a standard deviation of 0.80, indicating moderate problem-solving strategies practices. Generally, the study's findings revealed that public JHS mathematics teachers in the Tamale Metropolis moderately used and adopted all the problem-solving instructional strategies outlined in the study. However, the participants highly employed cooperative teaching and learning and task-based instruction.

Table 2: Teachers' level of adoption and practice of problem-solving strategies

Strategies	Mean	SD	Level of usage
Task-based Instruction	3.50	0.55	High
Cooperative Learning	3.51	0.67	High
Brainstorming	3.41	0.81	Moderate
Guided Discovery	3.26	0.94	Moderate
Group Work	3.29	0.93	Moderate
Trial and Error	3.31	0.72	Moderate
Look for a pattern	3.15	0.75	Moderate
Inquiry Learning	3.05	0.91	Moderate
Working backwards	2.45	0.93	Low
The overall level of practice	3.21	0.80	High

The results show an overreliance on only two major strategies, which indicates that the majority of teachers have limited knowledge of the role and benefits of other strategies such as trial and error, brainstorming, guided discovery, looking for a pattern, and inquiry learning in solving problems. Despite the existence of a disparity between theoretical knowledge and practical application, it is evident that mathematics teachers in the Tamale Metropolis possess a commendable understanding of problem-solving techniques. However, the majority of the problem-solving solutions identified in the report have not been widely utilized or accepted.

The implication of the research finding is that the fact that teachers have good perceived knowledge of problem-solving does not necessarily mean that is what they would necessarily practice in their classrooms. It also means that someone knows something that does not necessarily mean that's what the person would do in reality, and this could be a lack of supervision, motivation, and other factors.

The following questions were asked during the interview, which were meant to solicit teachers' views on how they used problem-solving strategies in their teaching:

> *Which instructional strategies do you employ when teaching through problem-solving?*

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One of the teachers indicated that,

> *I thoroughly enjoy assigning pupils group work and tasks, occasionally motivating them to speculate on their solutions before to accomplishing them.*

I thoroughly enjoy assigning pupils group work and tasks, occasionally motivating them to speculate on their solutions before to accomplishing them.… (Teacher 1 Interview).

Another teacher indicated that

> *I employ visual aids such as drawings and diagrams to elucidate the issue with them. Subsequently, I facilitate the process of problem-solving among pupils by employing leading questions. Ultimately, I assist them in reversing their steps to ensure the accuracy of the solution.…* (Teacher 2 Interview).

Also, one of the teachers revealed that,

> *I employ many problem-solving techniques, such as brainstorming and try and error procedures. For instance, I employ conventional exercises in the form of puzzles to enhance students' reasoning abilities and encourage them to write concisely.….* (Teacher 3 Interview).

It was further indicated by one of the participants that,

> *I utilise a variety of methodologies, such as the compilation of a comprehensive list, the construction of a chart or table, the illustration of a diagram, the development of a model, the reduction of the problem, and the application of a backwards approach based on a pattern. Occasionally, I employ a formula or equation, or alternatively, enact the problem scenario through the utilization of conjectures and verifications.…* (Teacher 4 Interview).

Apart from that, one teacher revealed that,

> *By fostering a child-centered approach, teachers acquire knowledge and skills in problem-solving through shared responsibility. Additionally, I make an effort to engage all kids in my courses.…* (Teacher 5 Interview).

The provided excerpts indicate that a majority of the teachers did not consistently utilise problem-solving strategies in their instructional practices, potentially indicating a deficiency in their requisite knowledge, abilities, and competences for effectively teaching mathematics through problem-solving. None of the individuals were able to provide a definitive guiding principle for problem-solving and articulate how they integrate it into their instructional approach. The study results align with Matlala's (2015) findings, which indicate that mathematics teachers encountered challenges when attempting to teach using problem-solving methods. Instead, teachers continued to employ traditional approaches such as storytelling and demonstrating mathematical problem-solving techniques to learners.

Anderson (2000) states that some teachers lack the necessary knowledge, skills, and competencies to teach mathematics through problem-solving. Lack of mathematical knowledge about teaching undermines teachers' confidence in teaching mathematics through problem-solving. Those teachers rely on traditional ways in which students memorise rules that harm the learning of students to build meaningful knowledge about problem-solving. Foong et al. (1996) noted that many teachers voiced their concern that they did not have the teaching skills to solve problems in mathematics. For example, teachers feel inadequate about problem-solving methods, especially with unusual problems. Also, teachers' struggles with implementing problem-solving in their classes may be a lack of the knowledge and skills associated with incorporating problem-solving meaningfully into the mathematics curriculum (Buschman, 2004; Cai & Lester, 2010).

In addition, Buschman (2004) contended that instructing through problem-solving poses a difficulty for numerous educators. One of the issues identified pertained to the inadequacy of

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teacher educators in adequately equipping their students with the necessary skills to effectively teach mathematics through problem-solving. The qualitative data obtained from the interview further demonstrated that mathematics teachers at public junior high schools within the Tamale Metropolis employed problem-solving methodologies to a moderate extent in their instructional practices. The interviewees were unable to articulate their utilization of problem-solving strategies within their pedagogical practices.

Therefore, the findings show that most mathematics teachers reported using a problem-solving approach to teach mathematics daily. This suggests that the teachers appear to use this pedagogical approach regularly, which should have assisted them to become proficient in its use. There is no empirical evidence (as far as the researcher is aware) about the frequency with which teachers across the globe incorporate a problem-solving approach in mathematics instruction. Although the daily use of a problem-solving approach is encouraging, teachers must be careful and mindful to use a variety of teaching strategies as part of instruction (Owusu et al., 2022; Padmore et al., 2023; Strong et al., 2004) since other teaching methods are better at teaching mathematical skills. In other words, teachers need to select the most suitable approach that will enable students to gain the understanding and competencies they seek to advance.

CONCLUSION

It can be concluded that junior high school mathematics teachers in this study generally possess good perceived knowledge about problem-solving. Therefore, junior high school mathematics teachers in the Tamale Metropolis do have the required knowledge and skills to teach mathematics using a problem-solving approach to develop and equip students who can apply mathematical skills for solving real-life problems and decision-making. Such positive perceptions can be a great asset for the country in our quest to improve mathematics education using problem-solving strategies.

The findings of the study indicate that mathematics teachers in the Tamale Metropolis who teach public junior high school students employed a moderate level of problem-solving strategies as indicated in the study. The participants in the study extensively utilized and embraced cooperative learning and task-based instruction, since they perceived these approaches to be effective in enhancing students' comprehension of mathematical ideas and acquisition of skills, ultimately leading to improved performance in mathematics problem-solving.

Recommendation

In order to assure their active participation in ongoing professional development sessions provided by the Ministry of Education, it is advisable for mathematics teachers to undertake supervision. Engaging in this exercise will empower individuals to proficiently employ modern problem-solving techniques. Mathematics educators should undergo training through workshops, seminars, and conferences to acquire the necessary skills to effectively employ problem-solving methodologies and cultivate a strong will to excel.

Implication of the Study

From *Table 1, the* majority of the teachers ascribed positively to the problem-solving statement, and so it can be argued that having such positive perceptions can be a great asset for the country in our quest for improving mathematics education using problem-solving strategies. It is also important to note that despite the fact that the majority of the teachers ascribed moderately to the problem-solving practices, most of them acknowledge the fact that they lack the professional competencies in implementing problem-solving strategies in their respective classrooms, hence their request for more workshops and training sessions on problem-solving

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