University of Cape Coast https://ir.ucc.edu.gh/xmlui

UNIVERSITY OF CAPE COAST

SENIOR HIGH SCHOOL MATHEMATICS TEACHERS' PERCEPTION AND KNOWLEDGE OF THE USE OF PROBLEM-SOLVING STRATEGY AS AN INSTRUCTIONAL APPROACH

IBRAHIM KWAME ADJEI

2022

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

©2022

Ibrahim Kwame Adjei

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

UNIVERSITY OF CAPE COAST

SENIOR HIGH SCHOOL MATHEMATICS TEACHERS' PERCEPTION AND KNOWLEDGE OF THE USE OF PROBLEM-SOLVING STRATEGY AS AN INSTRUCTIONAL APPROACH

BY

IBRAHIM KWAME ADJEI

Thesis submitted to the Department of Mathematics and ICT Education of the Faculty of Science and Technology Education, College of Education Studies, University of Cape Coast, in partial fulfilment of the requirement for the award of Master of Philosophy degree in Mathematics Education

JULY, 2022

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my original research and that no part of it has been presented for another degree at this University or elsewhere.

Candidate's Signature: ……………………. Date: …………………..

Name: Ibrahim Kwame Adjei

Supervisors' Declaration

We hereby declare that the preparation and the presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature: ……………………… Date: …………..…

Name: Prof. Ernest K. Davis

Digitized by Sam Jonah Library

ABSTRACT

The research investigated the knowledge base and how mathematics teachers at the senior high schools in the Central Region perceive the use of the problem-solving instructional strategy. This used the sequential exploratory mixed-method design. for this research,136 mathematics teachers from 21 senior high schools responded to the survey questions for purposes data collection after which a sample of 7 out of the 136 mathematics teachers were interviewed followed by an observation of their lessons. The sampling technique adopted for this study was multi-stage in nature. This method was adopted in order to gather the various samples for the research. Both inferential and descriptive statistics were used in analyzing quantitatively the data obtained. Analysis of the qualitative data from the open-ended items was done using the thematic coding technique. This study revealed that mathematics teachers have positive perceptions about the problem-solving instructional approach. It was also found that about 91% of the senior high school mathematics teachers professed knowledge of use in teaching about problem solving and teaching for problem solving rather than teaching through problem solving. Teachers reported practices they could not demonstrate in their actual lesson. Their observed practices in their classroom had a lower score than what they reported. The study recommends that in-service senior high school mathematics teachers should be given professional development training on problem solving instructional approach and how it is used in the classroom.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

KEY WORDS

Problem solving instructional approach

Perception

Knowledge

Mathematics instruction

Senior high school

Mathematics teachers

Use

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

ACKNOWLEDGEMENTS

I sincerely appreciate my supervisor, Prof. Ernest Kofi Davis, for his perseverance, love, and meticulous direction in making this project a success. May God almighty increase your wisdom and bless you abundantly sir. I would like to extend my most sincere thanks to the leadership and administration of all the schools that permitted data collecting in their institution. I appreciate their contribution and support very much. Last but not least I value the support and encouragement received from Mr. Farouq Mensah, my course mates and my entire family.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

DEDICATION

To my entire family, I wish to dedicate this project

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

TABLE OF CONTENT

Content **Page**

Digitized by Sam Jonah Library

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

LIST OF TABLES

Table **Page**

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

LIST OF FIGURES

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

CHAPTER ONE

INTRODUCTION

Background of the Study

The study of mathematics and the knowledge of mathematics has been an indispensable tool for the development of every country due to its importance. The impact that mathematics has had on every sector of every economy in the world has been enormous. As a result, mathematics has been made a required subject throughout the levels of education in every country.

In Ghana, mathematics is studied as a core subject and also as an elective subject at the senior high school level. After the West Africa Secondary School Certificate Examination (WASSCE), the discussion and the analysis of students' results most of the time center on students' performance in mathematics. According to Atteh, Appoh, Obeng-Denteh, Okpoti and Amoako, (2014), students' mathematics performance in the past few years has not been encouraging. Many educationists attribute students' poor performance to many other reasons. One of those reasons was the inadequate preparation of teachers (Butakor, Ampadu & Cole, 2017). Other educators also attribute the poor performance of students in mathematics to the teachers' method of instruction. Adeyemi and Adu (2012) have stated that the pedagogical content knowledge of a teacher is one thing which has a strong relationship with students' performance. That is, what the teachers teach and how they teach is a matter of great concern. As teachers are an integral part of students' mathematical achievement due to the important role they play in students' mathematical knowledge and skills attainment (Osiakwan, Wilmot & Sokpe 2014; UNESCO, 2010; Wilmot, 2009), how the teacher delivers the

Digitized by Sam Jonah Library

curriculum contents is as important as the knowledge itself. Since students' mathematical achievements and teachers' approach to mathematical instruction is of great importance, countries such as Singapore, England, Finland, and Turkey also adopted a national curriculum that places much emphasis on problem-solving. Due to the performance of these countries in international tests like the TIMSS and PISA (Kuzle, 2018), many mathematics educators in Ghana advocated for the development of the problem-solving approach in our national curriculum.

Base on the nature of the content and the aims of mathematical education, the revised Ghanaian senior high school mathematics curriculum emphasizes the teaching of mathematics through problem-solving (Nabie, Akayuure & Sofo, 2013). The NCTM (2000) stated that "the goal for school mathematics should be for all students to become increasingly able and willing to engage with and solve problems". The general aims of the mathematics curriculum include "the appreciation of the use of mathematics as a tool for analysis and critical and effective thinking". The curriculum further has "discover order, patterns and relations, develop mathematical abilities useful in commerce, trade and public service, make competent use of ICT in problem-solving and investigation of real-life situations, and develop the ability to translate word problems (story problems) into mathematical language and solve them with related mathematical knowledge, Organize, interpret and present information accurately in written, graphical and diagrammatic forms, develop precise, logical and abstract thinking, Organize and use spatial relationships in two or three dimensions, particularly in solving problems, respond orally to questions about mathematics, Carry out practical

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

and investigational works and undertake extended pieces of work" as some of it general aims (CRDD, 2010).

Since problem-solving is the center of mathematics instruction, one can only agree that these aims can only be achieved when mathematics is taught using the problem-solving instructional approach. As a result, problem-solving and applications were not made a topic but a means through which the aims and objectives of the curriculum will be achieved (CRDD, 2010).

The inclusion of practical mathematical problems that will make use of mathematical processes to help students to discover mathematical knowledge lessons is something required from teachers of mathematics (Nabie, Akayuure & Sofo, 2013). Various literature indicates that the basic aim of mathematics education has been to develop problem-solving abilities in students (Monaghan, Pool, Roper, & Threlfall, 2009; Rittle-Johnson, Mathews, Taylor, & McEldoon, 2010; Nelson, 2011). Problem-solving abilities in students can be achieved when teachers are themselves problem solvers and can instruct students using the problem-solving approach because students' attitude toward mathematics is influenced by teachers' ability to solve problems (Wilmot, Davis & Ampofo, 2015). Sadly, most students desire that mathematics is not part of their school subjects though it is mathematics through which further education can be built (Atteh, Appoh, Obeng-Denteh, Okpoti & Amoako, 2014). However, most Ghanaian teachers have not taken the issue about mathematics instruction via problem solving and problem solving in seriously.

Digitized by Sam Jonah Library

Fletcher (2010) indicated that students are not able to link their classroom mathematics with the mathematical situations that happen in our daily lives. He further explained that the inability of students to create a connection between the mathematics learned in the classroom and that of outside classroom might as a result of the quality of instruction students were given on problem-solving. As noted by Siswono, Kohar, Kurniasari, and Astuti, (2016) teachers' instructional practices influence the achievement of students likewise the instructional practices of the teacher are influenced by the teacher's knowledge of the instructional strategy.

Wilmot, Davis and Ampofo (2015) explained that for students to derive understanding from mathematics, we must realize that understanding is not directly taught but is obtained from solving problems. The problem-solving instructional knowledge and practice help teachers to formulate good problems for classroom instruction. An assertion by Akhter, Akhtar and Abaidullah (2015) was that to develop proficiency in mathematics problem solving, mathematics teachers can teach from the viewpoint of problem-solving or using various know-how. They further explained that this will develop students' thinking. In real-life situations, students tend to relax when thinking about a solution to problems and they become good problem solvers when they are involved in dealing with none routine and everyday practical problems (Wilmot, Davis & Ampofo, 2015).

This method of instruction however, seems not to gain prominence with mathematics teachers. Akhtar, Akhter and Abaidullah (2015) explained that in comparison with the traditional approach, in the 21st century the ways of instruction in mathematics, in relation to instructional approaches pose a

Digitized by Sam Jonah Library

challenge. One challenge raised by Osmanoglu and Dincer (2018) concerning the ways of instruction identified with teachers about their instructional approaches is their inability of adapting to their instruction of the curriculum. They explained that due to mathematics teachers' view of the fact that mathematics can be varied, the process of adapting is different for teachers. Teachers must thoroughly examine the curriculum to determine how much adaptation is necessary due to the multifaceted nature of mathematics. (Eryaman & Bruce 2015; Osmanoglu & Dincer, 2018).

The chief examiner for mathematics reported that one of students' main weaknesses in the mathematics examinations is the inability of students' to translate word problems into mathematical statements (WAEC, 2017). One major factor that might have contributed to students' inability to deal with real-life practical problems is what Davis and Chaiklin (2015) described as, students' out-of-school and school mathematics. They explained that students' out-of-school and school mathematics have been dealt with as two unrelated knowledge, which they believe have resulted in the non-achievement of the objectives of the Ghanaian mathematics curriculum. Adopting the radical-local approach to teaching is one way they considered appropriate to help in realizing the goals of the mathematics curriculum. The radical-local is a form of envisaging mathematics teaching as instruction through problem-solving (Davis & Chaiklin, 2015). Teachers' ability to recognize and use this approach to instruction depends on the teachers' knowledge, exposure, capacity and readiness to use such an approach to instruction.

Digitized by Sam Jonah Library

In Ghana, senior high school teachers are categorized as professional and non-professional. Professional mathematics teachers are those who offer teacher education programs from either the University of Cape Coast or the University of Education Winmeba during their degree programmes. Non-professional mathematics teachers on the other hand do not offer any educational program for the purposes of teaching. Both categories of teachers teach mathematics in our senior high schools.

Tatto, Lerman, & Novotna, (2010) noted the differences in the pedagogical practices of teachers who went through professional programs and those who did not. He explained that the latter is glued to the traditional instruction approach which they might have experienced as students and thus inform their instruction. The previous are informed about the subject matter and pedagogy. However, Davis and Chaiklin, (2015) pointed out that, one critique of teacher training programs in Ghana is how trainees acquire only the skill of presenting mathematical knowledge in a fixed sequential manner and neglect other important parts like students' empirical background.

Teacher training programmes in Ghana do not allow pre-service teachers to view mathematics instruction through the lens of problem-solving (Akyeampong, Lussier, Pryor, & Westbrook, 2013; Davis & Chaiklin, 2015) though teacher education programs in the universities which offer teacher education programs have instruction for problem-solving and instruction through problem-solving as part of their curriculum. One important role of universities in teachers' preparation is equipping pre-service teachers with instructional competence (Choy, Wong, Lim & Chong, 2013). But some educationists have expressed that educational faculties run mathematics

Digitized by Sam Jonah Library

programs that only equip pre-service teachers with theoretical knowledge, which teachers are not able to translate into practice (Bransford, Brown & Cocking 2000; Baki & Arslan, 2012). Choy, Wong, Lim and Chong, (2013) expressed that beginning teachers' knowledge of how students learn and teachers' content knowledge is very important and further explained how this knowledge must be linked to the realization of the curriculum goals.

Given the various emphases on using the problem-solving approach for mathematics instruction and the importance attached to teachers' knowledge for teaching mathematics, the perception, knowledge, and practices of mathematics instruction through problem solving in achieving the mathematical goals of senior high school mathematics teachers were explored.

Statement of the Problem

This study aims to examine senior high school mathematics teachers' perception and knowledge of the use of problem-solving as an instructional approach. This is because; the Ghanaian high school mathematics curriculum emphasizes mathematics instruction through problem-solving approach. The Ghanaian senior high school mathematics syllabus has a rationale which is "focused on attaining one crucial goal, thus: to enable all Ghanaian young people to acquire the mathematical skills, insights, attitudes and values that they will need to be successful in their chosen careers and daily lives" (CRDD, 2010). The success of producing competent entrants to science and technology is influenced by the quality of education mathematics teachers provide to secondary school students who are more expected to be students of Science, Technology, Engineering and Mathematics (STEM) in the near future.

Digitized by Sam Jonah Library

Due to the prominence STEM education is gaining in Ghana, teaching mathematics with the appropriate methodology which coincides with the objective of the mathematics curriculum is believed to be pertinent. Various mathematics researchers and educators agree that the problem-solving approach to instruction be the focus of mathematics instruction because that holds the promise of fostering students' mathematical learning (Cai, 2003; O'Shea & Leavy, 2013; Matlala, 2015). Due to the importance attached to problem-solving and instruction through problem-solving, there have been various researchers who have researched and have done extensive studies on this topic of problem-solving in recent years. Most of these studies focused primarily on: pre-service teachers' knowledge of problem-solving (Wilmot, Davis & Ampofo, 2015), and how problem-solving enhances students' achievements (Atteh, Appoh, Obeng-Denteh, Okpoti &Amoako, 2014), the assessment techniques in employed teachers in problem-solving (Nabie, Akayuure & Sofo, 2013), the importance and effectiveness of the problem-solving approach to instruction (Brhane, 2012; Alkhater, Alkhatar & Abaidullah 2015; Lester, 2013).

The various literatures on problem-solving in Ghana looked at variables such as teachers' assessment practices during problem-solving instruction, students' achievement, students' errors when solving problems, and teachers' knowledge of teaching problem-solving. Those studies that are about instruction through problem-solving used either primary school teachers or pre-service teachers. None of these studies looked at the issue of teachers' knowledge and perception of use of problem-solving as an instructional strategy. Nabie, Akayuure and Sofo (2013) concluded that 79.9% of teachers

Digitized by Sam Jonah Library

employ the problem-solving approach and investigative processes in their mathematics lessons. Suggests that students in our secondary school level are exposed to the methods and the process of instruction through problem-solving, however, their research emphasized that teachers were not observed in the classroom during the instructional times to see the problem-solving strategies used during their instruction. There has not been any study that focused on finding out about teachers' knowledge of use, perception and how teachers apply the problem-solving approach to instruction in Ghana in the senior high schools. It is as a result of this background, the existing gaps in the literature and the quest to contribute to the literature on teaching through problem-solving that this study investigates senior high school mathematics teachers' perception and knowledge of use of the problem-solving instructional strategy in the central region, Ghana. The Ghana education sector analysis indicates that the performance students' from central region in the WASSCE mathematics has been less promising since 2016 as compared to their counterpart in the Ashanti, Eastern, Brong Ahafo and the Western region (MoE, 2019). Central region was referred to by Gyesi and Addo (2014) as the cradle of education in Ghana. It is on this back drop that the region was chosen for the study.

Purpose of the Study

The purpose of this study was to investigate teachers' knowledge of use of the problem-solving approach to instruction and how this knowledge of teaching through problem-solving influences their mathematics instruction. It also seeks to investigate teachers' perceptions of use of problem-solving as an instructional approach and how their perception affects their mathematics

Digitized by Sam Jonah Library

instruction. Finally, the study looks at issues that affect mathematics teachers' use or not use of the problem-solving instructional approach

Research Questions

1. What are the perceptions of senior high school mathematics teachers about the use of problem solving as an instructional strategy?
2. What is mathematics teachers' knowledge on the Problem Solving Instructional Approach?
3. What factors influence mathematics teachers' use or not use of the Problem Solving Instructional Approach?
4. What practice do Senior High School teachers employ in their teaching of mathematics through Problem Solving?
5. What relationship exists between teachers' perceptions and their observed practices?

Significance of the Study

The study is an attempt to contribute to literature and knowledge on mathematics teachers' use of problem-solving instructional approach. The study will also bring to the attention of teachers and educationist the extent to which mathematics teachers understand and use the problem-solving approach to instruction in their classroom. National Council for Curriculum and Assessment (NaCCA) will be inform about how problem-solving as means of mathematical instruction is being implemented by teachers and how some of the aims of the mathematics curriculum are being achieved

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Delimitation

This study is limited only to Central Region public senior high schools mathematics teachers. This is because mathematics teachers in our senior high schools went through a more detailed programme and had been exposed to problem-solving and instruction through problem-solving during their training in the universities in Ghana than their counterparts at the basic schools. Therefore, are expected to possess an in-depth understanding of the problem-solving instruction approach.

Also, since government policies and curricula for mathematics education are mainly directed at public schools rather than private schools, the study concentrated on public senior high schools. Again, this research was limited in relation to the variables. It looked at mathematics teachers' perceptions and knowledge. In the researchers' view, perception and knowledge influence practice.

Limitations

The schools within the various district selected for the study were widely spread across the Central Region. As a result, commuting between these schools to administer and collect the questionnaire and data for the study was a bit challenging. Because data collection took place within the COVID-19 period, some targeted schools were not reached. Also, schools reached could not produce the number of teachers needed for the study. Some of the teachers who agreed to participate in the study too could not submit the questionnaire for data analysis. This affected the size of the sample needed for the study. The sample size affected some aspects of data analysis which also

Digitized by Sam Jonah Library

affected the generalization of the findings to the mathematics teachers' population in Ghana.

Finally, there have been very few studies about this topic in Ghana regards to hence literature used had limited local content to describe fully the Ghanaian context of the problem.

Organization of the Study

The various research works that relates to mathematics teachers' perception and knowledge of problem-solving instructional approaches were reviewed in chapter two of this research work. It looks at the theoretical framework of van de walle's theory of instruction through problem-solving. It also looked at, an empirical review of studies that employed the problem-solving approach to instruction, the perception of teachers' about the use of problem-solving instructional strategy, teachers' knowledge of using the problem-solving approach to instruction and the concept of mathematics instruction through problem-solving.

The third chapter explains the research methods that enabled the gathering of data for this study. The chapter also discusses the research questions that guided the research. Among the many topics covered are the research design, population, sample and sampling techniques, data collection instruments, and data collection procedures. Additionally, it offers the numerous techniques and procedures the researcher employed to analyse the data gathered.

The fourth chapter includes the findings, data analysis, and discussions of the findings or results.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

A summary of the study, its findings, conclusions made from them, and recommendations and suggestions are provided in the last chapter, Chapter Five.

Digitized by Sam Jonah Library

CHAPTER TWO

LITERATURE REVIEW

This section of the study examines the literature on the use of problem-solving as a teaching strategy. The chapter looks at the theoretical framework: theories about instruction through problem-solving. It then captures issues concerning teacher perception, knowledge, and the concept of mathematics instruction via problem-solving approach.

Theoretical Framework

Van de Walle (2004) in dealing with instruction through problem-solving developed a three-step model which serves as a guide for teachers using the problem-solving instructional strategy. According to Van De Walle, mathematics lessons consist of three parts, namely: before, during and after stages. Lappan, Phillips, Fey, and Friel (2014) also corroborating Van De Walle's model through the Connected Mathematics Project, brought the Launch/Explore/Summarize stages for teaching through problem-solving. These phases were looked at as a sequential process and any teacher adopting the problem-solving approach to instruction should look at it as such.

Presented below are the expected behaviour of the teacher and teaching activities in each of the phases of problem solving approach to mathematics instruction.

The Before Phase

The before phase is the first stage of the problem-solving approach to instruction. It spells out to teachers the activities and the preparation that should be done before the actual problem-solving activity. The before phase set the tone for the lesson. Van De Walle (2004) & SAIDE (2008) explained

Digitized by Sam Jonah Library

that, in the before phase of the lessons, the teacher's agenda must be to study and examine the problem that students will work on. This will help the teacher to anticipate the approach students are likely to use and also clarify their expectations. This is important because at this stage students are mentally prepared for the task ahead of them. He noted that it is important for students to know the meaning of the problem before devising a plan to solve it. Therefore, at the before stage students' understanding of the problem must be clear. In addition, vary the happenings at this stage of the lesson with the task. Students must be engaged in a series of activities related to the problem. The presentation of the problem to be solved may occur at the beginning or the end of the 'before phase'.

Van De Walle summarized the before phase of the lesson in terms of teachers' actions:

Activate prior knowledge: start with a simplified version of the project; relate to students' experiences; discuss potential methods or resolutions; determine or foresee whether single-computation tasks are intended to establish a computational process. The teacher must take into account the mathematical concept they want the students to learn when choosing the problem (Van de Walle, 2003 in Selmer & Kale, 2013).

Be sure the problem is understood: Have children explain what the problem is asking. Go over vocabulary that may be troubling. Note: This does not mean that you are explaining how to do the problem- just that students should understand what the problem is about.

Digitized by Sam Jonah Library

Establish clear expectations: tell students whether they will work individually, in pairs, or small groups or if they will have a choice. Tell them how they will share their solutions and reasoning.

Other teacher actions suggested by SAIDE (2008) include;

- Start with a simplified version of the task; break it down into more basic words.
- Brainstorm: When a task is not simple, have the students offer alternatives and techniques, which will result in diverse answers.
- Estimate or use mental computation - To develop the computational technique, have the students mentally perform the computation or estimate the result on their own.
- Confirm that the task is understood; failure to do so is not an option. Always check that students comprehend the issue before assigning them a task. Keep in mind that their viewpoint is distinct from your own. Request that they explain the issues in their own terms to have them reflect about it.
- Specify your expectations. This step is crucial. It is important to communicate expectations to learners. For instance, justify (in writing) why you believe your response is accurate.
- One written explanation from the group should be used when students are working in groups. Discuss your thoughts with a teammate before deciding which strategy to present
- Describe how you would approach the small version of the assignment to resolve the problem.

Digitized by Sam Jonah Library

- Put this problem as a test for your students. Be mindful of the sophistication of their thinking, building, and manipulations.
- What background information would students be needed to comprehend? Explain.

The During Phase

The important part of the model is the middle phase (during, explore) where students without having been directed by the teacher on how to solve the problem work on a problem or task at hand. Here is where the teacher must "let go" and "allow the students to make mistakes and develop their ideas". A good lesson must have this time for students to develop ideas while attempting to solve a problem – the during phase (Van de Walle, 2004).

Further, students are made to tackle the problem either alone, in pairs or small groups. At this time students are not to be told how to handle the problem at hand or how their solution is evaluated rather teachers can find out about the different approaches and illustrations students adopt in their solution, the solutions that are interesting and concepts that are misrepresented to handle them in the after phase. It is very important also at this stage that teachers allow the question to be problematic for the students. This is because a teacher seeing students struggle may be asking leading questions that can help students with the solution (Selmer & Kale, 2013) the students must be allowed to struggle to find a solution (Selmer & Kale, 2013) to enable teachers, identify what the students know, how they think and how they are approaching the task given them (Van de Walle, 2004 & SAIDE, 2008).

Van de Walle summarized the teacher's agenda in "the during phase" in four subthemes:

Digitized by Sam Jonah Library

Let go: despite the need to jump in and assist, resist the urge and take time to observe and absorb what the pupils are doing instead.

Notice students' mathematical thinking: base your question on the students' work and their responses to you. Use questions like "tell me what you are doing" and "Can you tell me more about your……" i.e. inquire more about students' procedures. Ask questions that might help understand their thinking.

Provide appropriate support: Instead than instructing pupils on how to solve a problem, try to find ways to encourage their thinking. Make sure the students comprehend the issue, and ask them about any solutions they have already tried. Tell the pupils that they could try a different tactic.

Provide a worthwhile extension: Early finishers should be given a challenge relating to the issue they just resolved. Ask possible questions like; "I see you found one way to do this, are there any other solutions? Are any of the solutions different or more interesting than others" ask good questions to extend students thinking. E.g. "Would the same idea work for...?"

Once a teacher is satisfied that students are ready to work on the task, teachers now assume the facilitating role (SAIDE, 2008) by:

- Demonstrating confidence and respect for the learners' abilities.
- The students get into the habit of working in groups – to indulge in cooperative group work.
- Listening actively – find out what your learners know, how they think, and how they are approaching the task.
- Providing hints and suggestions – when the group is searching for a place to begin when they stumble. Suggest that they use a particular manipulative or draw a picture if that seems appropriate. The teacher

Digitized by Sam Jonah Library

must be an active facilitator, helping students select the result to share as a group. Also ask mathematically stimulating questions that still keep the task in its problematic form (Selmer & Kale, 2013).

- Encouraging the testing of concepts Stay away from endorsing their findings or concepts. Remind the students that answers without testing and justification cannot be accepted.
- Suggesting broadenings or generalization. Many of the good puzzles appear to be easy on the surface. The extensions are what really stand out. (SAIDE, 2008).

It is not so difficult to guide students through their solutions, however, teachers who frequently step in to help students face a lot of difficulties (Selmer & Kale, 2013).

The After Phase

Van De Walle (2006) opined that; good lessons must have this time for students to develop ideas while attempting to solve a problem. However, if some time is not reserved to culminate it with a rich discussion of students' solutions, then the approach will fail. He also explained that teachers need the skill to develop a classroom environment where students talk to each other, truly discuss ideas and look at others' responses. Hiebert (2003) was of the view that classroom discourse can arise when students' procedures and solution methods used in solving the problem are shared. As students explain the thinking behind their solutions, they also think through the solutions shared by colleagues. Much of the learning then occurs as students individually and collectively contemplate on ideas they have explored. Van de Walle (2004) summarized the main agenda of the after phase as:

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Promoting a community of learners: Students need to learn what you anticipate from them during this period as well as how to treat others with respect. Role-play suitable ways to respond to each other. The section on orchestrating classroom discourse offers suggestions and methods for facilitating discussions that foster a community of learners.

Listening actively without evaluation: Here, the objective is to draw attention to students' mathematical reasoning and make it apparent to other students. To encourage students to offer their views more freely, refrain from evaluating whether or not a response is correct. Simply asking what other people think about the students' comments can help kids think without evaluating their ideas.

Summarizing the main idea and identifying future problems: Formalize the lesson's central idea while highlighting the relationships between other mathematical concepts or procedures. Additionally, this is the perfect moment to reiterate the proper terminology, meanings, and symbols. Additionally, you might wish to build the groundwork for next projects and activities.

An Empirical Review of the use of the Problem-Solving Instructional Approach

A study by Davis and Chaiklin (2015) emphasized the importance of the radical-local approach and how it will be relevant in our Ghanaian basic schools. This was exemplified with the concept of measurement in primary four pupils by considering the following questions in measurement:

1. What we measure?
2. Why we measure? and
3. What is measured from things we measure?

Digitized by Sam Jonah Library

Davis and Chaiklin used the problem-solving approach to instruction to illustrate how the radical-local approach can be useful in our classrooms. According to them, the radical-local approach is a way of bridging the gap between students out of school and in-school mathematic knowledge. In other words, the radical local approach helps the teacher to duel on students' societal and cultural practices to teach mathematics in a meaningful way to the student in the classroom.

The researchers randomly selected from the Cape Coast Metropolis a rural school. Using the problem-solving instructional method four introductory lessons on measurement were presented to the pupils'.

Their study found that in using the problem-solving approach to instruction, teachers can use the social and cultural traditions of their pupils in a way that encourages them to participate actively in the lesson and to truly understand the various ideas.

They noted that the demands and the success of using such an instructional approach depend greatly on the capability of the Ghanaian schoolteacher. Their research also revealed that the teaching strategy gave students the chance to independently use known cultural objects to highlight various traits rather than just being told by the teacher. The pupils felt like their opinions mattered, which increased their confidence.

They concluded that to improve pupil performance and interest school mathematics such approaches are practicable ways of doing so. The research backs up the claim that a radical-local strategy may be used to mathematics instruction more generally. Although this study only focused on one topic and one school, it has demonstrated that it is possible to use students' societal and

Digitized by Sam Jonah Library

cultural practices in Ghana and other nations with characteristics similar to that of Ghana to teach mathematical concepts in a relevant way in elementary schools.

This study by Davis and Chaiklin brings to light two major aspects of using the problem-solving method. That is the teachers' capacity and preparedness in using the problem-solving approach and the teachers' knowledge base in terms of the content of the topic to be treated, and the approach to be used. They stated that the only way students on our side of the world can learn meaningful mathematics is to adopt the method we have mistrusted for a very long time. They also emphasize that this kind of strategy can be applied at any level looking at the setting the level where the method of instruction was exemplified.

Another study is that of Donaldson (2011). She conducted a qualitative study which employed interviews and classroom observation for data collection in Athens, Georgia. Her research studied the practices and beliefs of high school mathematics teachers who used problem-solving methods of instruction. According to Donaldson, for a long time, academics in mathematics education have provided numerous recommendations for problem-solving instruction. They now want to know how these recommendations are actually being implemented. She opined that knowledge of what instruction through problem-solving approach is about by teachers, who wish to use the approach, can help them implement practices that support the instructional approach.

Four senior high school mathematics teachers who were well-known for their skillful instruction and who are teachers recognized as problem-

Digitized by Sam Jonah Library

solvers were used for the project. According to the research, the instructors' fundamental pedagogical philosophies were comparable, but they had different approaches to assisting students in becoming better problem solvers. According to the study, there are numerous approaches to support students' development of their problem-solving skills. They described their instruction through problem solving practices to give mathematics teachers an excellent knowledge of what instruction through problem-solving should look like. Along with giving out good problems, they collectively put into practice the following teaching strategies: Problems that conflict with the recommendation to teach through problem-solving contained in the literature on mathematics education. The study concluded that although each teacher was unique in their practices, some were more prevalent than others. However, these teachers as a group regularly engaged in the following: (a) "teaching problem-solving strategies", (b) "modelling problem solving", (c) "limiting teacher input—for example, having students work in groups", (d) "promoting metacognition, and (e) highlighting multiple solutions".

Teachers' Knowledge for Teaching through Problem Solving

Teachers' resource otherwise referred to as mathematical knowledge is the basis for any mathematical problem-solving instruction. Literature suggests that there are 7 forms of knowledge possessed by teachers for instruction. They include: (a) content knowledge (b) general pedagogical knowledge(c) curriculum knowledge (d) pedagogical content knowledge (e) knowledge of learners and their characteristics (f) knowledge of educational contexts (g) knowledge of educational ends (Susanta, 2012). She explained that among these types of knowledge is pedagogical content knowledge which

Digitized by Sam Jonah Library

distinguishes the kinds of knowledge for instruction. Pedagogical content knowledge considers how the subject can be exhibited to the learner to elicit understanding. She explained that this kind of knowledge involves the knowledge and understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and then presented for instruction (Susanta, 2012). In a further explanation to these types of knowledge, the recognition of what makes the learning of specific topics easy or difficult, she indicated that is part of the pedagogical content knowledge: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons.

The significance of teaching approaches in the process of teaching and learning is emphasized by these collections of pedagogical content knowledge. Boz and Boz (2007) write that pedagogical content knowledge has other related aspects like students, curriculum, instruction, and evaluation. Since the main concept of pedagogical knowledge is the delivery of good instruction, teachers should understand that students with misconceptions about topics may not come to the class as blank slates. These teachers need to know the strategies that may be effective in reorganizing the students' understanding. A teacher’s knowledge of instructional strategies according to Boz and Boz (2007) is of two kinds; knowledge of topic-specific strategies which comprise the teachers’ ability to select appropriate instructional strategies for a topic and knowledge of subject-specific strategies.

Arbaugh, Chval, Webb and Jackson (2009) explained the four domain model of teacher knowledge for teaching by Grossman. They emphasized the

Digitized by Sam Jonah Library

teachers' pedagogical content knowledge in four distinct categories: (a) "the conceptions of purposes for teaching subject matter – this involves knowledge and beliefs about the purposes for teaching a subject at different grade levels". They stated that mirrored in the teachers' aims for teaching a subject matter are the primary conceptions of teaching a particular subject. (b) "Knowledge of students' understanding. explaining this concept Arbaugh et al said, to generate appropriate explanation and representations, teachers must have some knowledge about what students already know about a topic and what they are likely to find puzzling". (c) "Curricular Knowledge includes knowledge of curriculum materials available for teaching particular subject matter, as well as knowledge about both the horizontal and vertical curricula for a subject" (d) "knowledge of instructional strategies – Experienced teachers may possess rich repertoires of metaphors, experiments, activities, or explanations that are particularly effective for teaching a particular topic while beginning teachers are still in the process of developing a repertoire of instructional strategies and representations". Teachers' knowledge of instructional strategies is also subject-specific as explained by Grossman in her fourth domain on pedagogical knowledge. Teaching mathematics requires teachers' knowledge of various instructional strategies. Thus, it requires strategies that will enable the students to acquire the necessary skills and attitudes that the national goals of mathematics education emphasize. Martin (2007) opined that the success of a mathematics teacher depends on the knowledge of students learning and teaching. Special mathematical knowledge for teaching is needed for students' proficiency. Zaslavsky and Leikin (2004) are of the view that mathematics teachers develop knowledge in two ways. That is, ''through learning, as

Digitized by Sam Jonah Library

facilitated by a mathematics teacher educator, or through teaching, when they facilitate [mathematics teachers'] learning''

Ball (1988) came out with a research model on pedagogical knowledge for teaching mathematics. She noted that the justification for adopting a mathematical approach to teaching mathematics is from the subject matter, learners, learning and the context but the use of this knowledge about instructional strategies rallies on one's opinion of the goals of teaching mathematics. Munter and Correnti (2017) explained that irrespective of the approach, the quality of a teacher's mathematical instruction has been the link between teachers' pedagogical content knowledge in mathematics and the teachers' mathematical instruction. They further stated that teachers may have the same Pedagogical Content Knowledge (PCK) however, this kind of knowledge may only encourage variations in the instructional strategies.

Teachers value and find the best way an instructional strategy could be used when they know and understand the underlying theories behind those instructional strategies (Liu, Jones & Sadera, 2010). Though teachers can acquire their PCK and the best methods for teaching specific topics in mathematics through experiences with the use of such strategies, the basic source of a teacher's mathematical knowledge on instructional strategies has been their professional development programs. And the inability of their previous teacher education programs to adequately prepare them for teaching using the various instructional strategies, like the problem-solving approach, is one of the difficulties most teachers face (Buschman, 2004; Matlala, 2015) concerning the use of their pedagogical content knowledge. Matala assert that most times teachers tend to teach in the manner they were also taught during

Digitized by Sam Jonah Library

their professional training programs. However, they are expected to teach in a manner they did not experience from their teachers. Elaboration on this aspect of teachers' knowledge for instructional practice Matala stated that teachers possess the theoretical knowledge of the problem-solving instructional approach however, they lack the ability to implement such knowledge in the classroom.

Perception of Teachers about the Use of Problem Solving Instructional Approach

Vagle (2009) in his primacy of perception indicated that everyone perceives. He explained that our perceptions as humans are not based on our intellectual reasoning rather it is a natural phenomenon that occurs as a result of our views, perspectives and experiences on issues over a period. He noted that perception is not synonymous with thinking. Wasike, Ndurumo and Kisilu (2013) explained that perception is the results when there have been connections with materials in our memory. He argued that our psychological and physical state, experiences and knowledge interpret our perceptions.

For teachers, the pre-instructional process, the instructional process and all other things related to instructions are affected by perception. Cheeseman (2019) noted that, to some teachers, their inability to adopt investigative tasks in the classroom is a result of their view of how young children learn mathematics. As teachers' perceptions of effective teaching are influenced by other factors like students' characteristics and teacher experiences likewise the choice of an instructional strategy to use for a lesson is also influenced by teachers' perceptions.

Digitized by Sam Jonah Library

Awinyam (2018) indicated that the sort of improvement and the pedagogical choices of teachers for effective instruction was the result of their perception. Teachers' perceptions and instructional practices are most times subject-specific. Since perception influences human behaviour, it is very essential to look at the perception of mathematics teachers (Awinyam, 2018). The mathematics teachers' perception of mathematics instruction is influenced by the effectiveness of an instructional strategy and students' performance. Liu, Jones and Sadera, (2010) hold the view that a mathematics teachers' possibility of using an instructional strategy like the problem-solving instructional strategy is strongly based on the teacher's perception of the instructional practices. Teachers who do not use this instructional strategy cite factors like knowledge of problem posing and also organizational and managerial factors (Cheeseman, 2019). In support of Cheema's claim, Akhter, Akhtar and Abaidullah (2015,) stated that teachers indicated ample space in the classroom, and good and sufficient materials and environments are needed to implement the problem-solving method. Further on reasons for not using the problem-solving teaching method, Xiuping (2002) also argued that due to time constraints, the number of resources needed and the huge number of students in the class, the problem-solving approach cannot be adopted every time during mathematics instruction. These reasons identified, exemplifies the perception of teachers when it comes to the use of the problem-solving approach

Akhter, Akhtar and Abaidullah (2015) indicated that though teachers have a good perception of the problem-solving methods in terms of their importance, many teachers believe that the use of the problem-solving

Digitized by Sam Jonah Library

instructional approach should be done taking into consideration the students' class size and level. They further expressed that teachers find it difficult to use the problem-solving method due to teachers' low level of understanding of the process involved in using the approach and also teachers' inability to plan, manage and pose questions to the class when using the problem-solving instructional method. This point out that knowledge of a concept also affects one's perception

Some teachers adopt different teaching strategies to help children develop an understanding of mathematical ideas. These teachers hold the perception that children create their knowledge through the learning of mathematics. This is done by using their mental activities and engagement with the environments (Awinyam, 2018; Cathcart, Pothier, Vance, & Bezuk, 2001). For a teacher to adopt an instructional approach the teacher needs to have a positive perception which is based on both theory and experience in the practice of the importance and effectiveness of such an approach.

Mathematical Instruction through Problem Solving

Teaching is the art of interaction between students and teachers to bring about the achievement of the desired learning outcome based on certain content. This process involves writing a specific objective and following through with a defined plan. Based upon the initial evaluation of student skills, teachers assess the level of students' knowledge of a previous lesson to present a preceding instruction (Arafeh, 2008; Swanson, 2001). As a result, there have been many suggested approaches to effective mathematical instructional delivery since individual teachers have their views of effective instruction

Digitized by Sam Jonah Library

taking into consideration the societal needs, teachers' context and student characteristics (Cho, 2014).

Susanta (2012) noted that the development of students' understanding of mathematics is the aim of mathematics instruction. Explaining the concept of understanding in mathematics, she maintained that understanding connotes the ways of knowing the procedures, skills, facts and the sort of thinking needed in mathematics. Using an appropriate approach during mathematics instruction leads to the achievement of the goals of mathematics instruction. One most important of such approaches is the problem-solving approach to teaching.

There are three basic aspects of problem-solving instruction. They include: Instruction for problem-solving, instruction about problem-solving and instruction through problem-solving. Masingila, Olanoff, and Kimani (2017) addressed three issues related to mathematics instruction through problem-solving. They included: teaching about problem-solving in which students are taught problem-solving heuristics Polya (1957), teaching for problem-solving in which the focus is on ''ways in which the mathematics being taught can be applied to both routine and non-routine problems'' and teaching via problem-solving in which ''problems are valued not only as a purpose for learning mathematics but also as a primary means of doing so'.

Brhane (2012) defined the problem-solving approach as a method of teaching mathematics through problem-solving contexts and enquiry-oriented environments characterized by the teacher 'helping students to construct a deep understanding of mathematical ideas and processes by engaging them in doing mathematics: creating, conjecturing, exploring, testing, and verifying. Also, Donaldson (2011) explained mathematics teaching through problem-solving

Digitized by Sam Jonah Library

as a technique of instruction in which teachers use problem-solving as the fundamental way to convey mathematical concepts to students in order to aid in the integration of their mathematical knowledge. This method of instruction has been recommended by most mathematicians and researchers in mathematics education and they have advocated for its use in mathematics classrooms. There has been other research on problem-solving and revisions of curricula by educators and trainers to assist students in using their higher-order thinking and problem-solving abilities (Cai, 2003). It is in this view that the use of a problem-solving instructional approach has now become the focus of mathematical instruction in the curriculum of many countries and national standards. The advocacy for the use of the problem-solving approach to instruction is grounded in the fact that this approach is the current basic method needed by today's learners (Brhane, 2012). He stressed that Problem-solving should be the central focus of the mathematics curriculum. He continued that, mathematics instruction must be such that the subject will be envisaged as problem-solving by students. Brhane, (2012), maintained that: teachers should concentrate on problem-solving approach to instruction due to its numerous benefits to the student. The adoption of a problem-solving approach to instruction is based on the assumption that by solving problems, students can enhance their understanding, and develop and extend their knowledge (Donaldson, 2011).

Thus, the main import of using a problem-solving instructional strategy is not only to make learners problem solvers but ultimately to enable students to gain a deepened understanding of mathematics (Donaldson, 2011). In the concept of mathematics, an indispensable and decisive pedagogy is the

Digitized by Sam Jonah Library

problem-solving approach to instruction (Brhane 2012). In the medium term, the underlining mathematical concept is what instruction through problem-solving directs students' attention (Van de Walle, 2003).

The adoption and use instruction via problem-solving as enshrined in the curriculum is a decision by the teachers. Donaldson (2011), said that teaching through problem-solving is not assured just by handing over to the teacher a problem-based curriculum. Donaldson explained that due to inadequate research, most teachers are unable to ascertain what the method of teaching through problem-solving looks like. The decision not to utilize the problem-solving approach to instruction can be influenced by other reasons such as the impression of teachers to complete the content of the textbook within a specified period, teachers' awareness, and lack of dedication to use the approach (Alemayehu, 2010) and teachers' misinterpretation of the problem solving instructional methodology (Brhane 2012). Akhter, Akhtar and Abaidullah (2015) also noted that those who adopt the problem-solving instructional approach encounter problems with classroom management, planning and questioning. Samuel (2002) in Akhter, Akhtar and Abaidullah (2015) stated that these difficulties arise due to the teachers' lack of expertise and difficulty in using the problem-solving instructional method for the existing mathematics curriculum.

The study by Donaldson (2011) showed that the problem-solving instruction approach looks differently for every teacher so teachers who wish to implement the approach should know what the approach looks like. The problem-solving instructional strategy is implemented differently by different teachers as a result Donaldson advised that beginning teachers should be

Digitized by Sam Jonah Library

cautious so as not to copy how other teachers implement the instructional approach. But how successfully teachers use this instructional method as they modify their method of teaching is characterized by the support and encouragement they get from other teachers and associates (Cai, 2009).

However, there are recommended principles and roles teachers follow when using the problem-solving strategy. In the problem-solving strategy, the lesson starts with posing a good problem for students to solve using various strategies whiles the teacher serves as a guide. Teaching through problem-solving involves selecting a task appropriate for the lesson, allowing the students to work out a solution and organizing a classroom discussion that will unearth the underlining concept of the lesson (Selmer & kale, 2013; Cai, 2009). Donaldson (2011) also stated that the key to letting the mathematics to be problematic for students is for teachers to desist from trying to help students immediately and doing most of the mathematical work faster. This emphasizes the importance of the discussion on teachers' roles and actions when adopting this approach. Literature has it that, implementing the problem-solving strategy to reduce students' difficulty during their problem-solving process, teachers must choose the sort of challenging questions to ask, the part of the work to emphasize and the kind of support to give the students so as not to think for them. Teaching strategies used in problem-solving is another role of the teacher in teaching via problem-solving (NTCM, 2000, Cai 2009). Donaldson (2011) gave 7 guiding principles to help the roles and actions of teachers when using problem-solving teaching strategy. They include; Giving many problems, providing "quality" problems, and imparting either specialised or generic problem-solving techniques (including heuristics),

Digitized by Sam Jonah Library

Promote metacognition by modeling problem solving - by having students work in small groups and fostering reflectiveness and the highlighting of multiple options.

Summary of Literature Review

The various literature reviewed touched on teachers' knowledge of teaching problem-solving and the perception of teachers on problem-solving instruction and instruction through problem-solving. The various writers concentrated on teachers' knowledge of mathematics instruction and knowledge of teaching specific content of mathematics. Research on mathematics instruction through problem-solving has given very little specific information. Literature has not delved into teachers' knowledge about the problem-solving instructional approach.

The literature reviewed failed to bring to light discussions and issues about teachers' knowledge of use of problem-solving instructional strategy, especially at the senior high school.

This study indicates the knowledge base teachers of mathematics at the senior high schools have about applying the problem-solving instructional approach. It helps to make the knowledge for mathematics instruction strategy specific.

VERITAS LUMEN NOBIS

Digitized by Sam Jonah Library

CHAPTER THREE

RESEARCH METHODS

This part of the research explains the procedures and methods adopted in exploring senior high school mathematics teachers' perception and knowledge of problem-solving as an instructional strategy. This includes; research design, the population of the study, sample and sampling procedures, research instrument, data collection procedure and data analysis procedures.

Research Design

This study used the sequential explanatory mixed-methods design. The design employs both the quantitative and qualitative research procedures of data collection to help readers acquaint themselves with the direction of the study.

Sequential explanatory mixed method design is when the collection and analysis of a quantitative data follows the collection and analysis of a qualitative data (Ary, Jacobs & Sorensen, 2006; Creswell, 2012). This was because the nature of this research required the collection of a quantitative data before the collection of a qualitative data.

Questionnaires were administered in the quantitative phase of data collection. In the qualitative data collection phase, participants were required to throw more light on specific responses they gave in the open-ended questionnaires. This was followed by observation. In the broader perspective, the quantitative portion of the research can be identified by readers and the qualitative part which also helps to explain the general view of the study can also be identified (Creswell, 2012).

Digitized by Sam Jonah Library

Population

All mathematics teachers in public second cycle schools in the Central Region made up the population for this study. The Ghana Education Service (GES, 2018) statistics indicate that there exist seventy (70) government senior high schools within the region. These schools are found within twenty-two (22) Districts, Municipal and Metropolitan Assemblies. The population of mathematics teachers within the region is estimated to be 560.

Sample and Sampling Procedure

The sample and the sampling procedures adopted for this research were multi-stage sampling procedures. First, 21 senior high schools within the region were chosen using a simple random sampling procedure.

According to Van Dalen (1979), at least ten (10) to fifteen (15) per cent of the target population is a good sample for a study. Therefore 30 per cent of the 70 schools were used for the study. The school names were recorded on pieces of paper and sequentially picked with replacement (lottery method). The mathematics teachers within those schools chosen were used for tis research. Thus intact class sampling method was also employed to obtain the required number of teachers for the study. In total, 136 mathematics teachers participated. This value was also guided by the Krejcie and Morgan (1970) theory for population and sample.

Data Collection Instruments

Questionnaires, interview guide and observation guide were the instruments which helped in gathering data for the study. The questionnaires and interviews sought to find out about teachers' perceptions, knowledge base and the procedures adopted by teachers when using the problem-solving

Digitized by Sam Jonah Library

approach to instruction. After conduct of the observation in the classroom, teachers were interviewed with the help of an interview guide. The teachers were observed during their mathematical instruction to find out how they use the problem solving instructional approach. An observation checklist was used for the observation. (See Appendices)

Questionnaire

Questionnaires were administered to teachers to obtain the initial data on their perception and knowledge of instruction through problem-solving. The questionnaire of Akhter, Akhtar and Abaidullah (2015) and Awinyam (2018) was adapted for the study.

The questionnaire was divided into four parts. It was structured into both close-ended questions and open ended ones. Part one inquired about the biographical information of respondents. The questionnaire's second part measured mathematics teachers' perceptions of use of the problem-solving instructional approach. The questions were close-ended questions on a five-point Likert scale. Open-ended questions were posed in the third part to assess the knowledge of the mathematics teachers in the utilization of the problem-solving approach to instruction. The last part of the questionnaire elicited information on mathematics teachers' practices and activities when using the problem solving instructional approaches in lessons. The questions in part four had a four-point Likert scale questions which reflected the Van De Walle's steps and activities for instruction through problem solving. (See Appendix A)

Validity and reliability

Though the questionnaire was adapted, it was still crucial for a professional to determine whether the instrument appeared to be measuring

Digitized by Sam Jonah Library

what it was intended to measure (Polit & Beck, 2012). To ensure the instruments for this study were valid, the instruments were given to my supervisor who is a professor and an expert in the field of problem-solving instruction, for inspection and judgment. In order to ascertain validity of content and its face validity, he assessed the quality of the questionnaire. The quality of data emanates from the quality of the instrument used in obtaining the data. According to Mohajan (2017), to ensure the quality of research instruments, it is necessary to conduct a validity test. In order to confirm that the instruments were accurate and dependable, a pilot test was carried out in the Ekumfi and KEEA districts. Ekumfi and KEEA district were selected because schools within these districts have common characteristics with the rural and urban schools that were sampled for this study. The piloting allowed the researcher to modify and restructure the instruments for gathering a good data. Researcher administered questionnaires and also interviewed a sample of teachers from the two selected districts. The responses of the respondents in the pilot test helped to refine and check the suitability of both the questionnaires and the semi-structured interview scheme. (See Appendix A).

A reliability value of 0.60, according to Shweta, Bajpai and Chaturvedi (2015), provides sufficient statistical evidence of consistency and approval for use. Abubakar, Wimmer, Bereznicki, Dwan, Black, Bezabhe, (2020) also were of the view that a reliability value of 0.70 is acceptable evidence that the results obtained from the two instruments are comparative and hence measure similar constructs. Nahid (2003) also remarks that reliability in research can only be a matter of degree since it is not possible to get a perfect score. To increase the validity of the instruments and make them appropriate for this

Digitized by Sam Jonah Library

study, based on the comments from my supervisor and the results from the pilot test the necessary corrections suggestions, and modifications were made. The Cronbach's alpha reliability coefficient realized was 0.86 which proved the instrument were reliable for gathering data.

Interviews

An interview guide aided the conduct of all the interviews. It was semi-structured in nature. The interviews gave the teachers a chance to elaborate on some of the issues in the questionnaire about their use of the problem-solving instructional strategy and how it is implemented in the classroom. (See appendix C)

Observations

An observation was conducted on those teachers who indicated they used the problem-solving method of instruction. Van de Walle's guide to teaching through problem-solving was used in drawing the lesson observation checklist to observe how the teachers taught mathematics through problem-solving. The observation checklist was a Likert scale type checklist which consisted of four scales. Namely; not observed, ineffective, somewhat effective and effective. The observation checklist reflected the Van De Walle scale for PSIA. The model divides the problem-solving approach to instruction into three main stages; the Before Problem Solving stage, During Problem Solving and After Problem Solving activities. Each of these three stages is further divided into either 4 or 5 subdivisions depending on the activities expected to be carried out at a particular phase they include; activating prior knowledge, Ensuring Understanding of the Problem, Establishing Clear Expectations, Providing Appropriate Support, Providing worthwhile

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Extension, Promotion of community of learners, listening without evaluation and Summarizing the main idea. Summary (See Appendix B)

Data Collection Procedure

I sought ethical clearance before the fieldwork on data collection. After ethical clearance was granted by Institutional Review Board (IRB) UCC, an introductory letter to the schools where data will be collected was collected from the mathematics education and ICT education department. The letters were submitted to the heads and the school's administration in an effort to get their approval to carry out the study at that institution. After permission was granted, the researcher met the heads of the mathematics department in those schools and discussed with them the nature of the project and how data collection will be done. The researcher then met and explained to teachers the nature of the project and the need for them to participate. The researcher was in charge of administration of the questionnaires. In schools where all sampled teachers were not available during the visit of the researcher, the head of the mathematics department did the administration of the questionnaire at the appropriate times.

Data from the questionnaires were gathered over a three weeks' period, and data from interviews and observations were also gathered over the course of another two weeks. Each of the interviews was completed within a period of 30 to 40 minutes. The interviews were successful with the help of a semi-structured interview guide. Seven teachers in total were interviewed for this study. The observation was also done using an observation checklist. Each of the 7 teachers was observed for one period (50 minutes to 1 hour) in their classroom.

Digitized by Sam Jonah Library

All teachers participating in this study answered a questionnaire, however, a sample of teachers who indicate “yes” for use of the problem-solving approach to instruction were interviewed and observed in their classrooms at their various schools. The questionnaires were administered first, after which the observation and the interview were carried out. The observation and interview were done after the collection and analysis of the data from the questionnaire. The interview and observation were administered on the same day.

Ethical issues

This study was carried out taking into consideration all provisions of accepted ethical regulations on the conduct of academic research. Institutional Review Board (IRB), UCC was consulted to clear the research of any ethical issues. All necessary ethical protocols were observed during and after the conduct of the study.

Data collected are secured to avoid third-party access or use. All information relating to the subjects are under lock. All soft copies of data are secured on a laptop under a password.

Before the conduct of this research, permission was obtained from the teachers and school management authority. Respondents were free to leave the research any moment as and when they became disinterested participating in the study. Before administering the questionnaire, a consent form was given to each of the teachers for them to give their consent to participate in the study. Respondents' were assured of their anonymity in participating in the study. All authors cited were also duly referenced (see references)

Digitized by Sam Jonah Library

Data Analysis Procedure

Data collected from the questionnaires and the interviews were analyzed separately and the results were put together for final discussion. First, the quantitative data which involved the questionnaires consisting of five-point Likert scale type questions were analyzed. The scales on the questionnaire range from Strongly Disagree as the lowest to strongly agree as the highest. Positively framed items on the questionnaires were coded from the lowest to the highest as follows; Strongly Disagree -1, Disagree - 2, Uncertain -3, Agree - 4 and Strongly Agree - 5. Negatively framed items on the questionnaires were coded from the lowest to the highest as follows; Strongly Disagree - 5, Disagree - 4, Uncertain -3, Agree - 2 and Strongly Agree – 1

Also, with the open-ended items, the various salient and general ideas that emerged from the responses given were put into themes and then coded. Data from the open-ended questions were also inputted into SPSS and analysed. Descriptive and inferential statistics tools were used to analyze the data obtained from the closed-ended questions.

The data from the open-ended questions were analysed using only descriptive statistical methods. The tools that were utilized from descriptive statistics were standard deviation, percentages, means and frequencies. The tools employed to present the results for the inferential statistics were Pearson product correlation and the Wilcoxon sign rank test.

Data from interview were also analysed using thematic coding processes and methods. The responses from the interviews were transcribed. The common ideas that emerged were used as the themes for the various topics covered in the interview.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter caters for the findings and also discusses the reported findings from the research. The findings are given in relation to the research questions put forth to give a direction to the study. The research findings are examined in relation to the research questions after presentation of results. The discussion of findings and presentation of results are organized under the headings; respondents' biographical data, teachers' perception, practices of teachers' and knowledge base of teachers in relation to using of the problem-solving instructional approach.

Respondents Biographical Data

This study sought some biographical information from the respondents. The biographical data included; sex, age, academic background, professional background and years of teaching. Table 1 shows the biographical information of teachers.

Digitized by Sam Jonah Library

Table 1: Respondents Biographical Data

Item	Categories	Frequency	Percentage
	Male	119	87.5
Sex	Female	17	12.5
	20-29 year	30	22.1
Age	30-39 years	86	63.2
	40-49 years	18	13.2
	50-59 years	2	1.5
	BEd. Mathematics	105	77.2
Academic	BSc. Mathematics	12	8.8
Qualification	MEd. Mathematics	7	5.1
	MPhil. Mathematics	7	5.1
	MSc. Mathematics	3	2.2
	Other	2	1.5
Training	Professional Non-	122	89.7
Background	Professional	14	10.3
	Less than 4 years	40	29.4
Years of Teaching	4-8 years	51	37.5
	9-12 years	19	14.0
	13-16 years	13	9.6
	Above 16 years	13	9.6

Source: Field Data, 2021

Findings from Table 1 indicate that the senior high schools which took part in this study had more male mathematics teachers than female mathematics teachers.

Digitized by Sam Jonah Library

The study also sought to find out, the age range of the mathematics teachers who participated in this research. The results show that 85.3% of the teachers are below age 40. This suggests, majority of mathematics teachers in public senior high school in central region are youthful. This also implies that any rolled-out program that seeks to enhance mathematics teachers' instructional approach, especially the problem-solving approach will be useful for the schools since these teachers have more years to apply those strategies and also to gain experiences from them.

On mathematics teachers' academic qualifications, 119(87.4%) (The number of BEd. Mathematics, MEd. Mathematics, MPhil. Mathematics education) of the respondents (the mathematics teachers) have a background in mathematics education. This implies that the majority of the senior high school mathematics teachers have had training on the methods and strategies for mathematics instruction. Few of these mathematics teachers do not have a professional background. However, there are still mathematics teachers in senior high schools whose academic and professional qualifications are not mathematics-related. This implies that some mathematics teachers teach mathematics without any training on how mathematics should be taught.

The data on teachers' teaching experience shows that 70(51.5%) out of 136 respondents have more than 4 years and less than 13years experience in teaching at senior high school level. This suggests that more than half of the mathematics teachers in the senior high schools have gained enough knowledge of the various teaching strategies including teaching via problem-solving. It also suggests that many of the more experienced mathematics teachers might have left from the senior high school level.

Digitized by Sam Jonah Library

Research Question 1: What are the perceptions of Senior High School mathematics teachers about the use of problem-solving as an instructional strategy?

This question sought to examine how teachers perceive mathematics lessons that use the problem-solving method of instruction. Questions, relating perception were posed to respondents for them to indicate whether they disagree, agree or are neutral about the statements. A five-point Likert scale which had Strongly Disagree (SD = 1), Disagree (D = 2), Uncertain (U= 3), Agree (A = 4) and Strongly Agree (SA = 5) the scales were used. Any of the variables that obtain a mean score of 3.5 or more is regarded as a positive perception of the statement but a score of 2.4 or less is regarded as a negative perception. A score between 2.5 and 3.5 is an indication that those teachers are inclined to a positive perception. To find out about teachers' general perception of the use of the problem-solving approach to instruction, an open-ended question was also posed. (See appendix A). Table 2 shows a summary of teachers' response.

Digitized by Sam Jonah Library

Table 2: Teachers Perceptions on the Use of the Problem Solving Approach to Instruction

Statements	SD(%)	D(%)	U(%)	A(%)	SA(%)	Mean	Std.D
I am motivated to plan lesson using the problem solving approach in mathematics	6(4.4)	11(8.1)	13(9.6)	73(53.7)	33(24.3)	3.9	0.96
I need enough space, resources and feasible environment in the class in order to use the problem solving strategy	8(5.9)	20(14.7)	12(8.8)	52(38.2)	44(32.4)	3.8	1.2
I find the problem solving approach to instruction more supportive of learners of all abilities	3(2.2)	10(7.4)	13(9.6)	66(48.5)	44(32.4)	4.0	0.95
It is more difficult to satisfy slow and weak learners when teaching through problem solving	12(8.8)	25(18.4)	16(11.8)	43(31.6)	40(29.4)	3.6	1.3
I think the problem solving approach is useful for mathematical instruction	0(0.0)	2(1.5)	9(6.6)	65(47.8)	60(44.1)	4.3	0.7
The problem solving method is not suitable when time span is short for teaching	10(7.4)	21(15.4)	15(11.0)	47(34.6)	45(33.1)	3.7	1.3
The problem solving method is difficult when students are larger in number in the classroom	9(6.6)	28(20.6)	16(11.8)	49(36.0)	38(27.9)	3.7	1.3
The problem solving approach develops students' confidence and critical thinking abilities	4(2.9)	3(2.2)	6(5.1)	40(29.4)	83(61.0)	4.4	0.9
Overall						3.9	0.6

Digitized by Sam Jonah Library

The results from Table 2 shows that,

In general, the results from Table 2 connotes that the mathematics teachers have very positive perception about the problem solving method of instruction and it implementation in the classroom. The results show an overall mean teacher perception of use of the problem solving instructional strategy of 3.9 and standard deviation 0.6. This finding represents a higher positive perception of mathematics teachers on the use of the problem solving instructional strategy. An overall mean of approximately 4 indicate an over whelming support and good impression about the problem solving instructional approach. From the table it can be seen that items like the problem solving approach develops students' confidence and critical thinking abilities and problem solving is useful for mathematics instruction had over 90% of the respondents agreeing with those statements. Again items such as I am motivated to plan lesson using problem solving approach" and "I find problem solving approach to instruction more supportive of students of all abilities had more than 70% of the mathematics teachers responding positively to them. None of the items has less than 60% of teachers supporting it. This evidence clearly suggests that mathematics teachers have a very positive perception about the problem solving approach to instruction.

Teachers were also asked to give their views about the use of the problem solving instructional strategy. Their responses were coded and summarized into themes. Table 3 shows the results from the data.

Digitized by Sam Jonah Library

Table 3: Teachers' Views of the Problem Solving Approach to Instruction

Question	Theme	Frequency	Percent	Examples of teachers Responses
What are your views about the problem solving approach to mathematics instruction	Best instructional Approach for Math	39	28.7	1. It is the best teaching method to enhance better understanding of mathematics 2. It is the best way to teach mathematics 3. Problem solving approach to mathematics instruction is the best approach to teaching mathematics howbeit, the number of topics and nature of assessment makes it less beneficial to be used in our classroom.
	Students' critical thinking, confidence and understanding	43	31.6	1. In my view problem solving approach to mathematical instruction develops confidence of students and make them critical thinkers. 2. This approach to teaching encourages innovation and critical thinking of students and therefore must be used in teaching mathematics. 3. It helps students build confidence in the subject, they understand both the concept and practical aspect.
	Time factor, Class size, Resources	16	11.8	1. Though teaching through problem solving is highly recommended approach to teaching mathematics, it is time consuming, especially in large class sizes and with weak students 2. is a good approach but time factor, inadequate resources and huge class size make it difficult to use 3. Problem solving approach would have been the best to teach mathematics if there more time allocated for mathematical instruction. Also if practical teaching learning materials with normal class size would have made the problem solving approach the best instructional strategy for mathematics

Digitized by Sam Jonah Library

Table 3:Cont.

Teachers Knowledge and Skills	2	1.5	It is very good to have adequate knowledge in problem solving approach to teach mathematics at the SHS level
Others	30	22.1	1. The problem solving approach is pupil centered in mathematical instruction unlike the traditional approach which is teacher centered. 2. It is the ability to solve problems in an effective and timely manner without any impediments. 3. the problem solving approach to mathematical instruction helps both the teacher and students to do more research and also know the purpose of they are studying

Digitized by Sam Jonah Library

The results in Table 3 indicate that the teachers' responses did not deviate from their responses in the likert scale questions. The teachers' responses indicated that most mathematics teachers appreciate the effectiveness of the quality of the problem solving instructional approach on students' achievements. From Table 3, over 60% of the teachers expressed that the problem solving approach is the best approach that can help develop students' critical thinking, confidence and understanding in mathematics. This indicates that a large number of senior high school mathematics teachers are familiar with the problem-solving approach and understanding its benefits.

Research Question 2: What is mathematics teachers' knowledge on the Problem Solving Instructional Approach?

This question aimed at exploring mathematics teachers' knowledge base in relation to Problem Solving Instructional Approach (PSIA). Four open ended questions were posed to teachers for them to express their knowledge on the various aspect of problem solving instruction. Teachers were asked if they knew about the problem solving approach to instruction. The summary of teachers' response is indicated in Table 4.

Table 4: Teachers Who Know or Not the Problem Solving Approach

Item	Knowledge of PSIA	Frequency	Percent (%)
Do you know about the problem Solving instructional strategy	YES	117	87.3
	NO	17	12.7

Digitized by Sam Jonah Library

The results in Table 4 indicates that majority of senior high school mathematics teachers in the senior high schools have knowledge about the problem-solving approach. This implies that teachers in one way or the other have either read, studied or have applied the problem solving method of teaching in their lessons.

Respondents were then asked; what it means to teach through problem solving. The responses obtained from teachers were analyzed and summarized. Table 5 shows the themes which is a summary from the various responses.

Digitized by Sam Jonah Library

Table 5: Teachers Responses on What It Meant to Teach through Problem Solving

Item	Response Types	Frequency	Percent	Examples of Teachers Responses
What does it mean to teach through Problem Solving?	Solving Practical or Real life Problems	31	23.7	1. I understand it to mean using practical and real life scenarios to teach. 2. teaching through problem solving deals with applying already acquired knowledge to solve practical problem which can be represent mathematically
	Using strategies	16	12.2	Teaching through problem solving involves the practice where by the teacher guides the learners to employ strategies such as heuristics, role play and brainstorming to acquire mathematical concept To teach through problem solving is when you implore the heuristics to solve problems.
	Using intellectually challenging Problems	29	22.1	1. It means using problems, questions or tasks that are intellectually challenging and invite mathematical thinking in our students. 2. It begins with a problem to be solved and students through reflective thinking try to come out with the solution to the problem.
	Discovery Learning	21	16.0	1.To teach through problem solving is to teach from practice to theory 2.We teach from the unknown to known 3.Come about knowledge and fact through guided discovery
	Solving word problems	2	1.5	This is a situation where by questions are put in a word statements to allow students to read and apply to solve the problem
	Others	22	16.8	Teaching through problem solving is to allow students at various ability levels to explain their answers to questions in their own unique way. 2. to encourage learners in a more reasoning practical and mind provoking ways of tackling problems 3. it is the process of finding solutions to difficult or computer issues

Digitized by Sam Jonah Library

From Table 5 it is evident that, most teachers of mathematics concept of teaching through solving is all about solving practical real-life problems with students or using intellectually challenging problems for mathematics instruction. These responses shared by teachers' reveals the mathematics teachers' conception of the problem solving approach.

The teachers were further questioned about whether or not they use the problem solving instructional strategy for their mathematics lessons. Table 6 shows the responses provided by teachers.

Table 6: Teachers use of the PSIA

Item	Response	Frequency	Percent
Do you use the problem solving instructional strategy in teaching?	YES	72	53.7
	NO	62	46.3

Table 6 shows that a little more than one half of mathematics teachers said they use the problem solving approach for their lessons. This makes it clear that not all teachers who know about the problem solving approach use it.

Teachers who responded in the affirmative about using the Problem Solving Instructional Approach (PSIA) were then asked to write the steps or the processes they use when teaching through problem solving. The answers provided by teacher were analyzed and compared with regular and existing models of mathematics instruction through problem solving like that of Van De Walle's. Table 7 indicates teachers' responses.

Digitized by Sam Jonah Library

Table 7: Steps for Teaching Through Problems Solving

Item	Response type	Frequency	Percent	Extract from teachers Responses
Steps teachers follow to apply the problem solving instructional strategy	Polya's Strategy	34	25.0	*I mostly adopt Polya's four stage model: 1. Help students understand the problem, 2. Devise a plan, 3. Execute the plan 4. Finally together with the students we reflect on the completed process(look back)*
	Inductive-Deductive Approach	5	3.7	*Pose a problem on the board, ask students on how to solve the problem, students come with different ideas, give a summary of students responses to class then generate a rule or formula and use it to solve general or similar problems*
	Problem Solving Approach	5	3.7	*We begin with a simple version of the problems, brainstorm with the class, I ensure learners understand the problem, I help students to relate the task with others, I support students without taking the challenging aspect of the problem*
	Algebraic Word Problems Strategy	6	4.4	*Read the problem carefully, use variables to represent the unknown quantities, use the variables and the conditions in the question to write a mathematical statement, solve or simplify your expression or statement.*
	Others	18	13.2	*Introduction by revising related and known topic, linking the old topic to the new topic by following steps in solving that particular question, variation of questions and variation of solution in the steps required, testing students on the formed concept for evaluation*

Digitized by Sam Jonah Library

The findings in Table 7 reveal that most of mathematics teachers are familiar with Polya's problem-solving method and believe it to be the approach for teaching mathematics through problem-solving. Only 5 out of the 72 teachers who indicated they use the problem solving approach could enumerate most of the steps which are grounded in literature for teaching mathematics through problem solving. These responses further illustrate the low level of teachers' knowledge about using the problem solving approach.

Research Question 3: What factors influence mathematics teachers' use or not use of the Problem Solving Instructional Approach?

This question aimed at inquiring from mathematics teachers, the various factors that influence them to use or not use the PSIA. Two open ended question were posed; whether teachers have adopted the PSIA or not and why do they adopt or do not adopt the PSIA in their mathematics lessons.

On the question of if mathematics teachers have adopted the problem solving approach as their instructional strategy or not, Table 8 shows a summary of teachers' responses.

Table 8: Teachers Adoption of the PSIA

Item	Response	Frequency	Percent
Adopt or not	Adopt PSIA	43	42.6
PSIA	Do not adopt PSIA	58	57.4

The results from Table 8 indicate that more than 50% of mathematics teachers have the PSIA as not their instructional strategy though 72 of them have earlier stated they use the PSIA.

Digitized by Sam Jonah Library

Respondents were asked to explain they have adopted or have not adopted the PSIA as their teaching approach. The responses that were provided for adopting the PSIA are organized in Table 9.

Table 9: Teachers Reasons for Adopting the PSIA

	Reasons for Adopting PSIA					
	Time Factor	Critical Thinking and Confidence	Resources and Class Size	Difficult Method	Active Class	Others
Adopt PSIA	2(4.6%)	19(44.1%)	1(2.3%)	0	8(18.6%)	13(30.2%)

Table 9 reveals that most mathematics teachers who adopt the problem solving approach to instruction do so due to its benefit on students' mathematical achievements. Surprisingly, from the results, as many as 30% of teachers gave reasons which are not exactly derived from the benefit of using the problem solving instructional approach.

Table 10: Teachers Reasons for Not Adopting the PSIA

	Reasons for not Adopting PSIA					
	Time Factor	Critical Thinking and Confidence	Resources and Class Size	Difficult Method	Active Class	Others
Do not Adopt PSIA	36(62.1)	1(1.7%)	10(17.2%)	4(6.9%)	0	7(12.1.0%)

Digitized by Sam Jonah Library

Table 10 also shows the results on why teachers do not adopt the problem solving approach.

Results from Table 10 shows that time factor and resources are the major deciding factors for most teachers who do not adopt the problem solving approach.

Table 11: Extract from Teachers Responses on Why Adopt or Not PSIA

Item	Response Types	Adopt or Do Not Adopt PSIA		Examples Of Teachers Responses
		Adopt	Do Not Adopt	
Reasons For Adopt Or Not PSIA	Time Factor	2	36	*I do not adopt the problem solving teaching method because it is time consuming*
	Critical Thinking And Confidence	19	1	*I adopt the problem solving teaching method because it develops students confidence and critical thinking abilities*
	Resources And Class Size	1	10	*I do not adopt the method because the resources are unavailable. 2. I adopt the method f I could be made more flexible on the part of the teacher and the class size is suitable with adequate teaching aids provided.*
	Difficult Method	0	4	*It is difficult to use*
	Active Class	8	0	*I adopt to make the lesson learner centered*
	Others	13	7	*I adopt problem solving because it gives room to training and development of students. 2. It does not work effectively on below average students*

Digitized by Sam Jonah Library

Table 11 presents extract from teachers' responses on the various factors for adopting or not adopting the PSIA.

The reasons assigned by teachers for the adopting or not adopting the problem solving approach to instruction from Table 11 suggest that majority of the teachers have very similar reasons that encourages them to use or discourages them not adopt the problem solving instructional approach. Some of these reasons might be personal with most teachers.

Research Question 4: What processes do Senior High School teachers' apply in teaching mathematics through Problem Solving?

This question sought to find out how teachers apply the PSIA in their mathematics lessons based on the knowledge they possess on the teaching approach. To answer this question, close ended consisting of 22 items which reflected the Van De Walle scale for PSIA was administered to find out how teachers use the PSIA in their classrooms. Teachers were also observed in their classroom, using an observation checklist which is also in the domain of the Van De Walle scale for PSIA. This was done in order to ascertain how teachers' knowledge and perception of the PSIA reflect their actual classroom practices. The Van De Walle model and guide for teaching through problem was structured into a 4 point likert scale (1=SD = Strongly Disagree, 2= D = Disagree, 3= A = Agree and 4= SA= Strongly Agree) for the teachers who indicated they teach through problem solving. The model divides the problem solving approach to instruction into three main stages; the Before Problem Solving stage, During Problem Solving and After Problem Solving activities. These three stages are further divided into; activating prior knowledge, Ensuring Understanding of Problem, Establishing Clear Expectation,

Digitized by Sam Jonah Library

Providing Appropriate Support, Providing worthwhile Extension, Promotion of community of learners, listening without evaluation and Summarizing main idea. Summary of teachers reported practices on their use of the PSIA in their classroom is presented in Table 12.

Digitized by Sam Jonah Library

Table 12: Teachers Responses on Their Problem Solving Instructional Practices (PSIA)

Item	Activity	SD(%)	D(%)	A(%)	SA(%)	Mean	Std.D.
Activating Prior Knowledge	The teacher starts lesson with an easy version of the task	5(3.7)	6(4.4)	54(39.7)	68(50.0)	3.4	0.7
	The teacher brainstorms with students various approaches or solution strategies	7(5.1)	11(8.1)	61(44.9)	54(39.7)	3.2	0.8
	The tasks provided builds on students' prior knowledge of mathematics	1(0.7)	5(3.7)	60(44.1)	67(49.3)	3.5	0.6
Ensuring Understanding of Problem	Teacher ensures learners understood the problem before setting them to work.	1(0.7)	3(2.2)	55(40.4)	74(54.4)	3.5	0.6
	Help students to relate the task with other problems solved in the past	4(2.9)	7(5.1)	57(41.9)	65(47.8)	3.4	0.7
Establishing Clear Expectations	Teacher tell students whether they are working in small groups or individually on the task given	1(0.7)	17(12.5)	62(45.6)	53(39.0)	3.3	0.7
	Teacher establishes with students how their solutions and reasoning will be shared	1(0.7)	19(14.0)	63(46.3)	50(36.8)	3.2	0.7

Digitized by Sam Jonah Library

Table 12:Cont.

Letting go	The teacher demonstrate confidence and respect for students' abilities by allowing them to work	1(0.7)	3(2.2)	47(34.6)	82(60.3)	3.6	0.5
Noticing Students Mathematical Thinking	Listens to students attentively and motivates them intrinsically	3(2.2)	34(25.0)	96(70.6)		3.6	0.6
Providing Appropriate Support	Encourage students to consider many strategies	1(0.7)	3(2.2)	55(40.4)	74(54.4)	3.5	0.6
	Encourages students to test their ideas	4(2.9)	4(2.9)	53(39.0)	72(52.9)	3.5	0.7
	Provides hints and suggestions to students.	2(1.5)	8(5.9)	61(44.9)	62(45.6)	3.4	0.7
Providing Worthwhile Extension	Support students without removing the challenging aspect of the problem	6(4.4)	16(11.8)	66(48.5)	45(33.1)	3.1	0.8
	Allot appropriate amount of time to the task	4(2.9)	11(8.1)	61(44.9)	57(41.9)	3.2	0.7

Digitized by Sam Jonah Library

Table 12:Cont.

	Patient to listen students' reflection without interruption	1(0.7)	9(6.6)	57(41.9)	66(48.5)	3.4	0.7
Promotion of Community of Learners	Allow students to listen and respect the idea of others	3(2.2)	5(3.7)	60(44.1)	65(47.8)	3.4	0.7
	Allows students to defend their answers, and then open the discussion to the class	1(0.7)	10(7.4)	51(37.5)	71(52.2)	3.4	0.7
	Ask questions that shows an interest in students idea	1(0.7)	7(5.1)	60(44.1)	65(47.8)	3.4	0.6
Listening Without Evaluation	Encouraging students to focus in developing thinking skills and strategies in solving problems rather than on obtaining one right answer	4(2.9)	4(2.9)	57(41.9)	68(50.0)	3.4	0.7
Summarizing Main Idea	Summarizes the main points which are anticipating to challenge students	1(0.7)	3(2.2)	57(41.9)	72(52.9)	3.5	0.6
	Overall					3.4	0.5

Digitized by Sam Jonah Library

The responses of teachers in Table 12 indicate that majority of mathematics teachers in the senior high schools follow through recommended procedures in using the problem solving instructional approach in their classroom. Each of the construct in the model for teaching through problem solving had more than 85% of teachers supporting it usage in the classroom during mathematics instruction. The overall mean of 3.4, shows that most mathematics teachers agree to the use of the Before, During and After phases for mathematics instruction through problem solving. This represents a good indication of teachers' practicing the use of the PSIA.

Teachers were observed in their classroom during their mathematics instruction in order to find out how their reported activities and practices on the application of problem solving instructional method reflected their actual classroom activities and practices during lessons. A 4-pointobservation scale, having 0 = Not Observed, 1 = Ineffective, 2 = somewhat effective and 3 = Effective as their key, was used to observe the lesson of teachers who indicated they adopt and use the PSIA.7 of such teachers were sampled; 4 of them from the urban schools and 3 from the rural schools. Table 13 indicates the summary of teachers' actual practices of the PSIA as observed in their classrooms.

Digitized by Sam Jonah Library

Table 13: Summary of Mathematics Teachers Observed Lesson on PSIA

Item	Activity	Not(%) Observed	Ineff(%)	S.E(%)	Eff.(%)	Mean	Std.D.
	The teacher starts lesson with an easy version of the task	5(71.4)	2(28.5)	0(0.0%)	0(0.0%)	0.3	0.5
Activating Prior Knowledge	The teacher brainstorms with students' various approaches or solution strategies	0(0.0%)	5(71.4)	2(28.5)	0(0.0%)	0.3	0.5
	The tasks provided builds on students' prior knowledge of mathematics	0(0.0%)	2(28.5)	3(3.7)	2(28.5)	1.0	0.8
Ensuring Understanding of Problem	Teacher ensures learners understood the problem before setting them to work.	1(14.2)	6(85.7)	0(0.0%)	0(0.0%)	0.9	0.4
	Help students to relate the task with other problems solved in the past	2(28.5)	3(42.8)	2(28.5)	0(0.0%)	1.0	0.8

Digitized by Sam Jonah Library

Table 13:Cont.

Establishing Clear Expectations	Teacher tell students whether they are working in small groups or individually on the task given	5(71.4)	2(28.5)	0(0.0%)	0(0.0%)	0.3	0.5
	Teacher establishes with students how their solutions and reasoning will be shared	4(57.1)	3(42.8)	0(0.0%)	0(0.0%)	0.4	0.5
Letting go	The teacher demonstrates confidence and respect for students' abilities by allowing them to work	2(28.5)	3(42.8)	2(28.5)	0(0.0%)	1.0	0.8
Noticing Students Mathematical Thinking	Listens to students attentively and motivates them intrinsically	4(57.1)	3(42.8)	0(0.0%)	0(0.0%)	0.4	0.5
Providing Appropriate Support	Encourage students to consider many strategies	4(57.1)	2(28.5)	1(14.2)	0(0.0%)	0 .6	0.8
	Encourages students to test their ideas	4(57.1)	3(42.5)	0(0.0%)	0(0.0%)	0.4	0.5

Digitized by Sam Jonah Library

Table 13:Cont.

	Provides hints and suggestions to students.	3(42.5)	4(57.1)	0(0.0%)	0(0.0%)	0.6	0.5
	Support students without removing the challenging aspect of the problem	3(42.5)	4(57.1)	0(0.0%)	0(0.0%)	0.6	0.5
Providing Worthwhile Extension	Allot appropriate amount of time to the task	4(57.1)	2(28.5)	1(14.2)	0(0.0%)	0.6	0.8
	Patient to listen students' reflection without interruption	5(71.4)	2(28.5)			0.3	0.5
	Allow students to listen and respect the idea of others	1(14.2)	5(71.4)	1(14.2)		1.0	0.6
Promotion of Community of Learners	Allows students to defend their answers, and then open the discussion to the class	1(14.2)	5(71.4)	1(14.2)		1.0	0.6
	Ask questions that shows an interest in students' idea	3(42.8)	4(57.1)	0(0.0%)	0(0.0%)	0.6	0.5
Listening Without Evaluation	Encouraging students to focus in developing thinking skills and strategies in solving problems rather than on obtaining one right answer	3(42.8)	4(71.4)	0(0.0%)	0(0.0%)	0.6	0.5

Digitized by Sam Jonah Library

Table 13:Cont.

Summarizing Main Idea	Summarizes the main points which are anticipating to challenge students	4(57.1)	3(42.8)	0(0.0%)	0(0.0%)	0.4	0.5
	Overall					0.6	0.1

Digitized by Sam Jonah Library

Table 13 shows that all teachers who were observed could not effectively exhibit the practices on PSIA in each of the constructs. Almost all the teachers could not effectively activate students' prior knowledge. However, it was observed that teachers presented students with a task to be solved after explaining the topic and concept of the lesson. The results from Table 13 further shows that almost all teachers (6 out of the 7) listened to students' ideas without interruption and also encouraged their students to listen to the ideas of other colleagues. The overall mean of 0.6connotes that most of the constructs teachers claim they apply in their classroom were not actually practiced by teachers during their lessons. Teachers practice very little of the activities and procedures for instruction through problem solving.

Teachers' performance on the various subscales in the reported practices and the observed practices were compared to find out if there exist differences in their performance. Figure 1 gives a summary of the results of the PSIA scores delineated by the teachers' expressed reported practices and observed teaching practices through PSIA. Based on these results, it is very apparent that the reported practices recorded high scores for PSIA and all its dimensions. The high scores were noticing students mathematical thinking 3.77, summarizing main idea 3.70 and listening without evaluation 3.57 whiles establishing clear expectations, providing worthwhile extensions and activating prior knowledge obtained low average scores. However, the observed practices had a highest score of 0.92 on ensuring understanding of problem, and noticing mathematical thinking with a score of 0.71. Providing appropriate support had the lowest score of 0.28.

Digitized by Sam Jonah Library

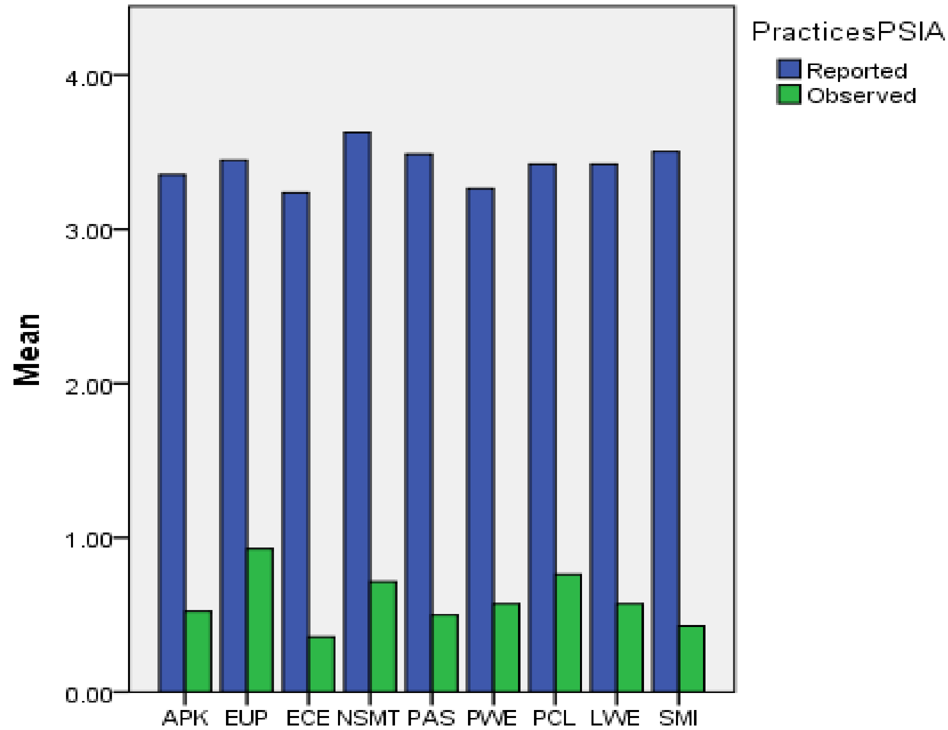

Figure 1: Graphical summary of teachers reported

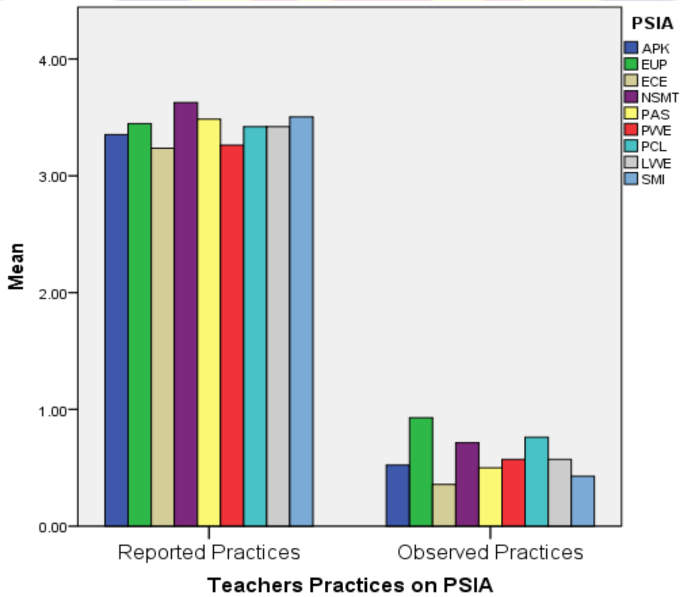

Figure 2: Observed practices of PSIA.

The charts show the disparities that exist between the reported and the observed data.

Digitized by Sam Jonah Library

The teachers reported practices and observed practices in applying the problem solving instructional approach is shows that the reported practices indicated by teachers had higher means scores as compared to their corresponding means for the observed lessons. Activation of prior knowledge which included the presentation of the problem had a reported mean of 3.35 but a mean of 0.52 in the observed lesson. This implies teachers did not sufficiently activate the students' knowledge about the problem to be solved. Most teachers during the observation stage did not even present students with problems to be solved in the beginning of the lesson.

The study also found out if there exist difference in the averages of the reported and the observed practices. A Wilcoxon Signed Rank Test -being the non-parametric alternative of t-test- was used to analyze the differences in scores for the reported and the observed lesson data.

Table 14 shows the results from the Wilcoxon sign rank test of the two data sets.

Table 14: Results from Wilcoxon Sign Rank Test

Number	Sig.	Standard Error	Statistic Standardized test
7	0.018	5.906	-2.371

The results from the sign ranked test in Tables 14 indicates there exist statistically significant difference in averages of the teachers reported practices and their observed practice with a sig value of 0.018 at alpha level of 0.05.

After analyzing the quantitative data, a qualitative data was then collected to obtain further explanation of teachers' practices on the use of the problem solving approach. They were asked to clarify the steps and process they

Digitized by Sam Jonah Library

adopted teaching through the problem solving instructional method. Some of the responses provided are presented in italics.

Teacher A

> *"Like I started with explanation how I understand problem solving, if it is something that is related to the real life situation then I have to get task or work example which will lead them to really understand that what we are doing is practical and can be related to our daily activities. If it isn't so then I will have to get them task that will make it easier for them to throw their thinking. So I prepare by fetching them if it is something that can be related to our daily activities examples and questions and I try to relate my teaching to daily life activities".*

Teacher B

> *"I try most at times to employ polya's 4 key areas to so we work around that and at the end we just try as much as we can to look back or reflect on what we have done in the classroom. So let look at this this way. In the classroom I get to the classroom and then for example I'm teaching three set problem now. So when I get to the class what I do is that we reach out to the question, so the question given then we try as much as we can to l live the question if I say live the question we try to see the reality of the question so that the question wouldn't look too abstract. So we try to live the question, try to understand the question in the simplest way and after that we will now try and let say attack or we try to solve the question.*

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

We solve the question by employing various methods. I give the children the opportunity to solve. At the end of the day you realize that the children are solving using different approaches or different methods but we go through and then we realize which one best fit the problem. And after that we now look at which solution satisfies the problem that was given".

Teacher C

"You first explain the concept to them. After explaining the concept, you give them exercises relating to the concept for them to solve. Because they cannot solve problems without knowing the concept. So you first give them the concept, after giving them the concept then you give them related problems to solve"

Research Question 5: What relationship exists between teachers' perception and observed practices?

Question 5 sought to find out if there is a correlation between teachers' perception of the PSIA and their practices for using of the PSIA in the classroom. A correlation was carried out between the two variables to establish the relationship. Table 15 shows the findings.

Digitized by Sam Jonah Library

Table 15: Correlation between Teachers Perception and Observed Practices on PSIA

Item		Observed
Perception	Correlation Coefficient(r)	0.490
	Sig.	.264
	Number	7

From Table 15, it could be seen that there exist a weak but positive correlation between teacher perception and their observed practices. However according to the data there is no statistically significant relationship between the two variables, at an alpha level of 0.05.

Discussion of Results

The present study investigated senior high mathematics teachers' perception and knowledge of the use of the problem-solving instructional approach. The results indicated that most teachers did not have any formal training in mathematics instruction through problem-solving during their pre-service teaching programs and also during their in-service period. Teachers' responses from the interview suggested that they studied the concept of problem-solving and instruction through problem-solving but such programs were not detailed enough to equip them with the relevant skills and understanding to use instructional method such as problem-solving. In line with this, Matlala (2015) stated that the inability of teachers' previous professional development programs to mold them to use the problem-solving approach has been a major setback for most teachers of mathematics.

Digitized by Sam Jonah Library

However, the results suggest that due to the nature of the discussions on problem-solving and the use of the problem-solving approach to instruction, most teachers view the problem-solving approach as a good instructional approach to adopt. The results from teachers' responses connote that they have a very positive perception of the problem-solving method of instruction and its implementation in the classroom. The data showed a higher and a good perception of mathematics teachers about the use of the problem-solving instructional strategy. Although teachers had a good impression of the PSIA, it was observed from the data that most teachers viewed the PSIA differently.

The views expressed by teachers about the use of the problems solving approach to instruction suggest that the different mathematics teachers have very different perceptions about mathematical instruction via problem-solving approach. In relation to this finding, Donaldson (2011) expressed that the problem solving instruction approach looks differently for every teacher. The data indicated that the different views about problem-solving approach were based on their knowledge of what problem solving and instruction through solving is all about. Some view the approach based on its importance to mathematics instruction. So a greater number of teachers agreed and suggested that problem solving approach to mathematics instruction is the most suitable approach for mathematics instruction that builds on students' confidence, critical thinking and understanding. Though Akhter, Akhtar and Abaidullah (2015) support this concept, that problem solving is the most suitable approach to use. There are those whose view of the concept of mathematics instruction through problem solving is in terms of its usage. The data shows that teachers

Digitized by Sam Jonah Library

hold the perception that the problem solving approach to mathematics instruction is based on enough time, resources and smaller class size.

One contradictory view expressed by teachers was that, teachers agreed that the Problem Solving Approach (PSIA) to mathematics instruction is suitable for all abilities however they also suggest that the PSIA is not suitable for slow and weak learners. This contrasting perceptions, presuppose that mathematics teachers are likely to neglect the so called slow and weak students in the event that the problem solving approach to instruction is being used as the method of instruction. This may reduce the weak or slow learners' interest with respect to solving mathematical problems and mathematics in general.

In the long run, it will thereby increase the disparity between the high achieving and low achieving students in the classroom. It could also be argued that since mathematics teachers hold the perception that the problem solving approach to instruction is not suitable for large classes and weak or slow learners, they may feel reluctant to use the strategy for their mathematics instructions as pointed out by Attom (2017) that human behaviour is influenced by perception. It could be said based on the data that mathematics teachers generally have a good perception of the problem solving method of teaching with respect to its benefits. This resonates with the finding of Akhter, Akhtar and Abaidullah (2015).

The finding from the data obtained in this study about teachers' knowledge of the PSIA shows that 87.3% of the teachers indicated they possess' knowledge about the problem solving approach. Literature indicates that one of the sources of teachers' knowledge of problem-solving instruction

Digitized by Sam Jonah Library

method emanates from teachers' professional development programs. The majority of teachers indicated that teaching through problem-solving meant solving real-life or practical problems. Others think of the problem-solving approach as using strategies to solve problems. These views do not agree with the concept of teaching through problem solving from the various literature which indicates that teaching through problem solving implies that important math concepts are learnt by the student via solving math problems using their strategies and their existing cognitive tools kids (Brhane, 2012; Matlala, 2015). The data suggest that mathematics teachers in senior high school possess an inadequate understanding of the use of the problem-solving teaching approach. This also buttresses the assertion of Matlala (2015) that improving understanding with the problem-solving approach poses a lot of challenges for teachers having a limited level of knowledge in the use of the problem-solving approach. If teachers' source of knowledge of the problem-solving instructional approach is from their pre-service training, then it can be inferred that teachers' pre-service training did not equip them with adequate knowledge of the concept of mathematics instruction through problem solving. This was confirmed when the teachers were interviewed about the training on instruction through problem-solving that they received during their teacher education program. Teachers were asked whether they had formal professional training on the problem-solving approach to instruction, and if yes, what did the training entail? Below are some of their responses:

> "*Yeah, I will say yes. I will say that I had that training from my master's degree from UCC so I did MEd so I had lectures to take me through. We did a full course on problem-solving*

Digitized by Sam Jonah Library

so I believe this is the training I can say I have…… it entailed a lot. We were made to realize that it is not just like the normal word problems that we see. In the classroom teacher tries to put a word problem on the board and then we try to find answers, it isn't like that. It entails a lot" (Teacher B field interview, 2021).

Teacher C responded that *"In my initial teacher training I was taught how to teach through problem-solving and when I travelled outside too for further studies I was given training on problem-solving. It has to do with methods of explaining lessons so that children understand properly. Breaking concept down so that children will understand*".

However, teacher A expressed a different view on his training.

"Ahhh I will say in school we didn't do much in the tertiary we didn't do much and it is rather when we came out I have had the opportunity to engage myself in three different workshops even with that they don't talk about we are talking particularly on problem solving we are talking about problem solving in this but we take a topic or we treat a topic may be how to make a topic easier and eerh students will be able to solve problems in that. I can't really say that ok this workshop or this particular meeting is on problem solving".

Teacher D also said, *"I learnt it myself."* This implies that most teachers did to receive proper and adequate training in using the PSIA.

Digitized by Sam Jonah Library

Given this Chapman (2015) proposed that teachers must be acquainted with knowledge of instructional practices for strategies and metacognition to gain proficiency in problem-solving instructional approach. This data also implies that there are teachers who said they used the problem-solving instructional method in their lesson but could not enumerate the steps and processes they follow through for the lesson.

Naturally, a lack of knowledge and understanding of a teaching method does not encourage the use of such a method. However, whereas over 50% of respondents indicated they use the problem-solving approach for their lessons only 5% of such teachers could demonstrate some knowledge of the processes of teaching through problem solving which are grounded in the theories of Van de Walle (2004) and Lappan et al. (2014). Most teachers indicated George Polya's strategy as their method for mathematics instruction via problem-solving. But Masingila, Olanoff and Kimani (2017) explained that Polya's (1957) problem-solving heuristics explains teaching about problem solving rather than teaching through problem-solving. This implies that teachers possess inadequate knowledge of the process and steps for implementing the problem-solving teaching strategy. It is not much surprising that other teachers indicated the inductive-deductive and algebraic word problem strategies as problem-solving instructional approaches, though it can be said that these approaches are embedded in the PSIA. The results suggest that mathematics teachers could not differentiate between teaching for problem-solving, teaching about problem-solving and teaching through problem-solving and thereby confuse the previous two for the latter. Teachers'

Digitized by Sam Jonah Library

ability to differentiate between problem-solving instructional strategy and problem-solving depends largely on their knowledge.

The findings from the study suggest that the problem-solving instructional approach comes with some challenges for teachers as indicated by Buschman (2004). Teachers cited problems such as time factors, inadequate resources and large class size as their hindrances for not adopting the problem-solving strategy are largely also due to the how senior high school educational system is structured in Ghana. During the interview, some teachers explained that, due to the structure of the mathematics curriculum for senior high schools, the number of topics to be treated within a semester and the high emphasis on students passing the West Africa Senior High School Certificate Examination (WASSCE) in Ghana, it was not possible to adapt the problem-solving instructional method. To them, problem-solving strategy requires the use of adequate resources, time, small class size, and a good classroom environment. Though this view of teachers is consistent with that of Anderson, White, and Sullivan, (2005), Samuel (2002) as cited in Akhter, Akhtar and Abaidullah (2015) and Xiuping (2002) other literature indicates that it behooves on the teachers to decide on how to put in place the necessary protocols in order to be abreast with the use of the problem-solving teaching approach in mathematics (Liu, Jones and Sadera 2010). They indicated that the teachers' ability to adopt the problem-solving method of teaching is based on the teacher's willingness to implement new instructional practices.

The results also demonstrate that teachers' lack of confidence in using the problem-solving approach in their mathematics lessons is due to their inadequate knowledge of the problem solving instructional approach.

Digitized by Sam Jonah Library

Researchers have suggested that mathematics teachers' pre-service education was unable to equip them with skill to teach using the problem-solving approach to mathematics instruction (Artzt, Armour-Thomas, & Curcio, 2008; Matlala 2015).

The teachers' knowledge is one of the major resources needed for mathematics instruction through problem-solving however teachers in this study could not exhibit the possession of enough knowledge on the problem solving approach and therefore did not reflect in their readiness and ability to adapt to the PSIA in their lesson. The interview with some of the teachers with respect to their practices and how they apply the PSIA in their classroom further buttressed the point of teachers' inadequate knowledge on the use of the PSIA. Teacher A's explanation in connection with how he applies the problem-solving strategy contradicts his self-reported activities during problem-solving approach to instruction. He rather affirmed the majority view that mathematics instruction through problem solving is about presenting problems that are practical to students. However, during his implementation of the concept of teaching through problem-solving in the class, it was observed that the steps of his instruction were somewhat not the problem-solving approach but rather his concept problem-solving approach was about the type and the nature of questions he pose to his students after teaching the topic. Teacher B rather explained the concept of teaching about problem-solving and he tried demonstrating the same during his teaching. He taught (three set problem) concepts and asked students to solve similar problems. After a while, he discussed with students how the ideal solution will be by asking students questions about how they solved the question given using the Polya strategy.

Digitized by Sam Jonah Library

Teacher C also implemented his explanation of his teaching through problem-solving during the observation section. But the type of problems given to students was not challenging enough for students to deal with. Using the observation checklist, his teaching did not conform to the steps for implementing mathematics lessons via problem-solving.

Teachers' explanation during the interview further confirms the disparities in the means between the reported practices and their actual practice. It was evident that teachers' explanations and the report did not conform to what they practice in the classroom which supports the findings from Agyei and Voogt, 2015; Matlala, 2015. The results suggest that teachers overestimated their knowledge and practice with respect to applying the problem solving approach to mathematics instruction. Teachers' responses seem that they misconstrued helping students with problem solving skills for teaching through problem solving. The data imply that mathematics teachers seem to possess theoretical knowledge about the instruction via problem solving but lack in-depth knowledge about how the teaching approach is applied in practice and also the ability to practice it in their mathematics classrooms (Akhter, Akhtar & Abaidullah, 2015).

Teachers must come to accept the fact that their modes of mathematics instruction through problem-solving do not conform to what theories on problem-solving instruction suggest and thereby do not help to achieve the mathematics curriculum goals which advocate the problem solving strategy to mathematics teaching. It can be noticed that teachers' approach to instruction is likely to create an inconsistency with respect to teachers' classroom practices and what the mathematics curriculum requires from mathematics

Digitized by Sam Jonah Library

teachers (Brodie, Lelliott, & Davis, 2001; Matlala, 2015). Most teachers attributes their inability to adopt mathematics instruction through problem solving to the nature of the curriculum and the current demands in Ghana's educational system which looks out for students passing rate in the exam. It is also clear that most teachers find it difficult to change their current modes of mathematics instruction for a new strategy because their current approach to mathematics instruction looks very easy for them to implement.

Findings on teachers' perceptions and actual classroom practices demonstrate that teachers' perceptions have little influence on those their practices. So any change in teacher perception might not influence their classroom practices with respect to the use of PSIA. This also connotes that teachers may not necessary revise their way of implementing the PSIA in the classroom if any decision is made to help teachers with their perception of the PSIA. This result is in line with the finding of Akhtar, Akhter and Abaidullah (2015) who reported that, though teachers have a very good perception of the problem-solving approach to instruction, the majority are not interested in using the approach due to the fact many of them have the view that that the curriculum and assessment systems do not support using of the problem-solving strategy in their classrooms.

Digitized by Sam Jonah Library

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Summary, conclusions, and recommendations are the subheadings discussed under this chapter.

Summary

This research used the sequential exploratory mixed method design for data gathering and collection. Questionnaire, observation protocol and interviews were the instruments employed to obtain data for this research. All mathematics teachers in Central Region senior high schools formed the research population. 136 senior high school mathematics teachers were chosen for the study using a multiple sampling techniques.

Descriptive and inferential statistical methods were used in reporting the finding from this research. standard deviations, means, percentages and frequency counts were the descriptive statistical tools employed to present teachers' perception of use of the PSIA, teachers' reported practices of use of the problem solving instructional approach, their observed practices of use of the PSIA in their mathematics classroom and teachers' knowledge of the PSIA and the factors that promoted their adoption of the approach or not. Teachers' perception and their observed practices use of the PSIA were correlated to ascertain the relationship between these variables. The medians or means of teachers' reported practices and their observed practices were compared using a Wilcoxon sign rank test to determine whether there were any differences. In order to learn more about the teachers' knowledge of the usage of the problem solving approach to instruction, a sample of mathematics teachers who claimed utilizing the PSIA in their mathematics lessons were interviewed

Digitized by Sam Jonah Library

using a semi-structured interview guide. Evidence from teachers' response on the interview were used to support the quantitative data obtained

Key Findings

This study revealed that mathematics teachers possess a positive perception on mathematics instruction using the problem solving strategy, however this perception does not influence their practice of use of the problem solving approach to mathematics instruction. Their perceptions of the problem solving instructional approach also influence their thinking on how their mathematics instruction through problem solving should be done. Majority of them indicated they do not use the PSIA for their mathematics instructions. They gave reasons such as time factor, resources, class size, as some of the major reasons for not adopting such a good approach to instruction. Few of them claimed they use the approach for their mathematics instruction due to students' critical thinking, confidence and active class. However, these few teachers could not demonstrate and outline how instruction through problem solving is done.

Again the study found a weak positive correlation between perception and teachers observed practices on PSIA in the classroom but this relationship was statistically not significant.

Conclusions

The following conclusions were made in light of the findings;

1. The Mathematics teachers possess a positive perception of the problem solving approach to mathematics instruction. However there seem to be a gap between their perception and their use of the problem solving approach to

Digitized by Sam Jonah Library

mathematics instruction. This may be due to inadequate training on the use of the problem solving approach to mathematics instruction

2. About 91% of the senior high school mathematics teachers professed knowledge of use in teaching about problem solving and teaching for problem solving rather than teaching through problem solving.
3. There was a gap between teachers knowledge of use and actual practice of the PSIA
4. Teachers reported practices for instruction through problem solving were very good. This implies they appreciate the kind of practices they are expected to do but due to other reasons they do not actually use them.
5. Observed classroom practices and teachers' perception on PSIA had a weak and positive correlation between them but the correlation was not statistically significant.
6. Teachers appreciate the importance of the PSIA but due to other reasons they do not actually use it.

Recommendations

The following recommendations are given based on the findings of the study.

1. In-service mathematics teachers should be given adequate professional development training on the problem solving instructional approach so as to meet the demand of the current trend of Ghana‘s educational system which is geared towards

Digitized by Sam Jonah Library

education in Science, Technology, Engineering and Mathematics (STEM) and emphasizes the use of the PSIA.

2. Less emphasis should be placed on categorization of schools base on students WASSCE results and rather emphasis and attention be placed on students' critical thinking and problem solving abilities. This will also shift teachers' attention from preparing students for WASSCE to developing students' mathematical abilities. In addition, the STEM education program, be replicated in as many as possible senior high schools so that those teachers who have positive perception and sound knowledge of the PSIA will be motivated to use the approach as expected of them.

Suggestions for Further Studies

This research is not comprehensive. To determine whether the study's findings hold true in other regions of the nation, it is advised that this study be replicated in those regions. Furthermore, it is advised that research to support the implementation of the problem-solving instructional technique be carried out.

Digitized by Sam Jonah Library

REFERENCES

Abubakar, I. J., Wimmer, B. C., Bereznicki, L. R., Dwan, C., Black, J. A., Bezabhe, W. M., & Peterson, G. M. (2020). Development and Validation of an Atrial Fibrillation Knowledge Assessment Tool (AFKAT). *Journal of Environmental Research and Public Health, 17(21)*, 2-12.

Adeyemi, T. O., & Adu, E. T. (2012). Teacher Quality and Internal Efficiency in Primary Schools in Ekiti State, Nigeria. *American journal of Economics. 2(5)*, 87 - 95.

Agyei, D. D., & Voogt, J. M. (n.d.). Determining Teachers TPACK Through Observation and Self Reported Data. Ghana.

Akhter, N., Akhtar, M., & Abaidullah, M. (2015, June). The Perceptions of High School Mathematics Problem Solving Teaching Methods in Mathematics Education. *Bulletin of Education and Research, 37(1)*, 55-77.

Akyeampong, K., Lussier, K., Pryor, J., & Westbrook, J. (2013). Improving Teaching and Learning of Basic Mathematics and Reading in Africa: Does Teaching Preparation count? *International Journal of Educational Development, 33(5)*, 272 - 282.

Alemayehu, B. (2010). Teachers Belief and Actual Practice of Problem Solving Approach in Teaching Mathematics. *Ethiop Journal of Education and Science, 6(1)*, 1-15.

Arafeh, S., Steedly, K., Dragoo, K., & Luke, S. D. (2008). Effective Mathematics Instruction. *Evidence for Education, 3(1)*, 1-11.

Digitized by Sam Jonah Library

Arbaugh, F., Chval, K., Webb, M., & Jackson, C. (2009). The Growth of Mathematics Teacher Knowledge. *Annual Meeting of the American Educational Research Association.* San Diego: CA.

Artzt, A. F., Armour-Thomas, E., & Curcio, F. R. (2008). *Becoming a Rflective Mathematics Teacher: A Guide for Observation and Assessment. Second Edition.* New York: Lawrence Erlbaum.

Ary, D., Jacobs, L. C., Razavieh, A., & Sorensen, C. (2006). *Introduction to Research in Education(Seventh Edition).* Canada: Thomson Wadsworth.

Atteh, E., Andam, E. A., Obeng-Deteh, W., Okpoti, C. A., & Amoako, J. (2014). The Problem Solving Strategy of Solving Mathematical Problems: The Case Study of Esaase Bontefufuo Senior High Technical School,Amansie West District of Ghana. *International Journal of AppliedScience and Mathematics, 1(2)*, 40-45.

Attom, S. N. (2017). *Perception of Authentic Assessment and its practices among Teachers in public Senior High Schools in Cape Coast Metripolis.* Retrieved from https://erl.ucc.gh/jspui.

Awinyam, I. J. (2018). *An Investigation the Relationship Between Perception of Mathematics Teachers TowardsS Assessment and their Assessment Practices in the Binduri District(Masters thesis, University of Cape Coast).* Retrieved from https://ir.ucc.edu.gh/xmlui/handle /123456789/3667.

Baki, M., & Arslan, S. (2012). Investigating Prospective Primary Teachers' Knowledge in Teaching Through Lesson Study. *12th International Congress on Mathematical Education Program* . Seoul: COEX.

Digitized by Sam Jonah Library

Ball, D. L. (1988). Knowledge and Reasoning in Mathematical Pedagogy: Examining What Prospective Teachers Bring to Teacher Education. *The Elementry School Journal, 105(1)*, 1-15.

Boz, N., & Boz, Y. (2008). A Qualitative Case Study of Prospective Chemistry Teachers' Knowledge About Instructional Strategies: Introducing Particulate Theory. *Journal of Science Teacher Education, 19(2)*, 135-156.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How People Learn: Brain, Mind, Experience and School.* Washington DC: National Academy Press.

Brhane, B. (2012). The Implementation of Problem Solving Approach in Mathematics at Governmeent Secodary Schools of addis Ababa. *Masters Thesis*. Addis Ababa: Addis Ababa University.

Brodie, K., Lelliott, A., & Davis, H. (2001). forms and substance in Learning-Centered Teaching: Teachers Take-Up from an In-service Programme in South Africa. *Teaching and Teacher Education 18(202)*, 541-559.

Buschman, L. (2004). Teaching Problem Solving in Mathematics. *National Council Of Teachers, 10(6)*, 302 - 309.

Butakor, P. K., Ampadu, E., & & Cole, Y. (2017). Ghanaian Students in TIMSS 2011: Relationsip Between Contextual Factors and Mathematics Performance . *African Journal of Research in Mathematics, Science and Technology Education, 21(3)*, 316-326.

Cai, J. (2003). What Research Tells Us About Teaching Mathematics through Problem Solving? *International Journal of Mathematical Education in Science and Technology,34(5)*, 25-36.

Digitized by Sam Jonah Library

Cai, J., Kaiser, G., Perry, B., & Wong, N. (2009). *Effective Mathematics Teaching from Teachers' Perspectives National and Cross-National Studies.* Rotterdam/Boston/Taipei: Sense.

Carthcart, W. G., Pothier, Y. M., Vance, J. H., & Bezuk, N. S. (2001). *Learning Mathematics in Elementary and Middle Schools* . Columbus: Merrill Prentice Hall.

Chapman, O. (2015). Mathematics Teachers' Knowledge for Teaching Problem Solving. *LUMAT: International Journal on Math, Science and Technology Education, 3(1)*, 19-36.

Cheeseman, J. (2019). Teachers Perception of Obstacles to Incorporating a Problem Solving style of Mathematics into their Teaching.In A. Downton, S. Livy, & J. Hall (Eds.). *Proceedings of the 41st Annual Conference of the Mathematics Education Research Group of Australia* (pp. 210 - 217). Auckland, Australia: MERGA.

Cho, J. H. (2014). Teachers Perceptions of Changes to Teaching Practice and the Influence of Professional Development: Experience EFL Teachers in South Korea/ . *Masters Thesis*. Wellington: Victoria University.

Choy, D., Wong, A., Lim, K., & Chong, S. (2013). Begining Teachers Perception of their Pedagogical Knowledge and Skills in Teaching: A Three Year Study. *Australian Journal of Teacher Education, 38(5)*, 68-77.

CRDD. (2010). *Teaching Syllabus for Senior High School Core Mathematics (SHS 1- 3).* Accra: Ministry of Education.

Digitized by Sam Jonah Library

Creswell, J. W. (2012). *Educational Research : Planning ,Conducting and Evaluating Quantitative and Qualitative Research(4th ed.)* . Boston: MA: Pearson.

Davis, E. K., & Chaiklin, S. (2015). A Radical-Local Approach to bringing cultural practices into Mathematics Teaching in Ghanaian Primary Schools, Exaemplified in the case of Measurement. *Africa Journal of Educational Studies in Mathematics and Science, 11(1)*, 1-13.

Donaldson, S. E. (2011). Teaching through Problem Solving: Practices of Four High School Mathematics Teachers. *Dotoral Thesis*. Athens, Georgia: University of Georgia.

Eryaman, M. Y., & Bruce, B. C. (2015). *International Handbook of Progressive Education* . New York: Peter Lang.

Fletcher, J. A. (2010). Applying Mathematics in Real Life Problems: A Case Study of Two Senior High Schools in Ghana. *Africa Journal of Educational Studies in MAthematics and Science, 8(2)*, 81-93.

GES. (2020). *Resgister for Courses for Public Senoir High, Technical and Vocational Institutions, 2020.* Retrieved from https://www.ges.gov.gh/2020/09/21

Gyesi, Z. K., & Addo, S. A. (2014). *Ghana-History and Background*. Retrieved from Retrieved from http://education.stateuniversity.com/page/529/Ghana history-BACKGROUND.html

Hiebert, J., & Wearne, D. (2003). *Teaching Mathematics Through problem Solving : Grades 6 - 12. Developing Understanding Through Problem Solving.* Reston: VA: National Council of Teachers of Mathematics.

Digitized by Sam Jonah Library

Krejcie, R. V., & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Education and Psychological Measurements, 30*, 607-610.

Kulzle, A. (2018). Problem Solving as an Instructional Method: The use of Open Problems in Technology Problem solving Instruction. *LUMAT: International Journal of Science and Mathematics Education, 3(1)*, 69-85.

Lappan, G., Phillips, E. D., Fey, J. T., & & Friel, S. N. (2014). *A Guide to Connected Mathematics 3: Understanding, Implementing and Teaching.* Boston, : MA: Pearson.

Lester, F. K. (2013). Thoughts About Research on Mathematical Problem-Solving Instruction. *The Mathematics Enthusiast, 10(1)*, 245-278.

Liu, L., Jones, P., & Sadera, W. A. (2010). An Investigation on Experienced Teachers' Knowledge and Perception of Instructional Theories and Practice. *Computers in the Schools, 27(1)*, 20 - 34.

Managhan, J., Pool, P., Roper, T., & Threlfall, J. (2009). Open-Start Mathematics Problems: An Approach to Assessing Problem Solving. *Teaching Mathematics and Its Appplications, 28(1)*, 21 - 31.

Martin, T. S. (2007). *Mathematics Teaching Today: Improving Practice, Improving Students Learning, Second Edition.* VA: NCTM.

Masingila, J. O., Olanoff, D., & Kamani, P. M. (2017). Mathematical knowledge for taching teachers : Knowledge Used and Developed by Mathematics Teacher Educators in Learning to Teach through Problem Solving. *Journal of Mathematics Teacher Education, 21(5)*, 429 - 450.

Digitized by Sam Jonah Library

Matlala, S. (2015). *The Experince of Secondary Mathematics Teachers Teaching Mathematics Through Problem Solving(Master's thesis,Stellenbosch University).* Retrieved from https://scholar.sun.ac.za

MoE. (2019, May). *(Ministry of Education) Global Partnership for Education: Ghana Education Sector Analysis 2018.* Retrieved from www.globalpartnership.org

Mohajan, H. (2017). Two Criteria for Good Measurement in Research: Validity and Reliability. *Annals of Spiru Haret University, 17(4)*, 56-82.

Munter, C., & Correnti, R. (2017). Examining the Relations Between Mathematics Teachers' Insstructional Vision and Knowledge, and Change in Practice. *American Journal of Education, 123(5)*, 171-190.

Nabie, M. J., Akayuure, P., & Sofo, S. (2013). Integrating Problem Solving and Investigations in Mathematics: Ghanaian Teachers' Assessment Practices. *International Journal of Humanities and Social Science, 3(15)*, 46-52.

Nahid, G. (2003). Understanding Reliability and Validity in Qualitative Research. *Qualitative Report, 8(4)*, 597-607.

NCTM. (2000). *Principles and Standards for School.* Reston: National Council of Teachers of Mathematics.

Nelson, M. A. (2011). Oral Assessment: Improving Retention , Grades, and Understanding. *PRIMUS, 21(1)*, 47-61.

O'Shea, J., & Leavy, A. M. (2013). Teaching Mathematical Problem Solving feon an Emergent Constructivist Perspective: The Experiences of Irish

Digitized by Sam Jonah Library

Primary Teachers. *Journal of Mathematics Teacher Education*. Retrieved from https://www.researchgate.net/publication/257583684

Osiakwan, J. K., Wilmot, E. M., & Sopke, Y. B. (2014). Relationship Between Teachers Knowledge for Teaching and Students' achievements in Algebra in Some Selected Senior High Schools in Ghana. *Elixir Educational Technology, 75(10)*, 82 - 87.

Osmanoglu, A., & Dincer, E. O. (2018). Prospective Mathematics Teachers' Perceptions on and Adaptation of student-Centred Approach to Teaching. *International Journal of Progressive Education, 14(1)*, 75-85.

Polit, D. F., & Beck, C. T. (2012). *Nursing research: Principles and Methods.* Philadelphia, PA: Lippincot Williams and Wilkins.

Polya, G. (1957). *How to Solve It, (2nd Ed.).* Princeton, New Jersey: Princeton University Press.

Rittle-Johnson, B., Mathews, P., Taylor, R. S., & McEldoon, K. L. (2010). Assessing Knowledge of Mathematical Equivalence: A Construct-Modelling Approach. *Journal of Educational Psychology, 103(1)*, 85-104.

SAIDE. (2008). *Teaching and Learning Mathematics in Diverse Classrooms.* Braamfontein, South Africa: South African Institute for Distance Education (SAIDE).

Selmer, S., & Kale, U. (2013). Teaching Mathematics through Problem Solving. *Innovacion Educativa, 13(62)*, 1665 - 2673.

Shweta, B., Bajpai, R., & Chaturvedi, H. K. (2015). Evaluation of Inter-Rater Agreement and Inter-Rater Reliability for Obsevational Data: An

Digitized by Sam Jonah Library

Overview of Concepts and Methods. *Journal of the Indian Academy of Applied Psychology, 41(3)*, 20-27.

Siswono, T., Kohar, A. W., Kurniasari, I., & Astuti, Y. P. (2016). An Investigation of Secondary Teachers' Understanding and Belief on Mathematical Problem Solving. *Journal of Physics: Conference Series, 6(93)*, 1-14.

Susanta, A. (2012). *Professional Learning for Teaching Mathematics through Problem Solving in Indonesian Primary Schools(Doctorial thesis, Curtin University)*. Retrieved from Curtin University: https://espace. curtin.edu.au/handle/20.500.11937/947

Swanson, H. L. (2001). searching for the Model for Instructing Students with Learning Disabilities. *Focus on Exceptional Children. 34(2)*, 1-15.

Tatto, M. T., Lerman, S., & Novotna, J. (2010). The Organisation of the Mathematics Preparation and Development of Teachers (A Report from The ICMI Study 15). *Journal of Mathematics Teacher Education, 13(4)*, 313 - 324.

UNESCO. (2010, September). *World Data on Education, 7th Edition, 2010/2011*. Retrieved from www.ibe.unesco.org/en/document/world-dataeducatio-seventh-edition-2010-2011

Vagle, M. D. (2009, October). Locating and exploring teacher perception in the reflective thinking process. *Teachers and Teaching: theory and practice, 15(5)*, 579-599.

Van de walle, J. A. (2003). *Desining and Selecting Problem-Based Task: Teaching Mathematics through Problem Solving Prekingdergarten-Grade 6* . Reston: VA: NCTM.

Digitized by Sam Jonah Library

Van de walle, J. A. (2004). *Elementry and Middle School Mathematics : Teaching Developmentally.* New York: Pearson Education, Inc.

Van de walle, J. A. (2006). *Elementry and Middle School Mathematics: Teaching Developmentally (Sixth Edition)* . New York: Pearson Education, Inc.

Van-Dalen, D. (1979). *Understanding Educational Research(4th Ed.).* New York: McGraw Hill, Inc.

WAEC. (2017). *General Resume of the Mathematics Chief Examiners' Reports for the West African Senior School Certificate Examination for School Candidates.* Accra: WAEC.

Wasike, A., Ndurumo, M., & Kisilu, K. J. (2013). The Impact of Perception on Performance in Mathematics of Female Students in Secondary Schools in Teso District, Kenya. *Journal of Education and Practice, 4(20)*, 104 -109.

Wilmot, E. M. (2009). Teacher Knowledge and students Performance: Beglere-visited in Ghana. *Journal of Science and Mathematics Education, 4(1)*, 13 - 30.

Wilmot, E. M., Davis, E., & Ampofo, C. B. (2015). Why are Non-routine Mathematics Word Problems Difficult? : Lessons from Pre-service Basic School Teachers in Ghana. *Ghana Journal of Education: Issues and Practices, 1(1)*, 1 - 28.

Xiuping, Z. (2002). The Combination of Traditional Teaching Method and Problem Based Learning. *The China Papers, 1(2)*, 30-36.

Digitized by Sam Jonah Library

Zaslavsky, O., & Leikin, R. (2004). Professional development of Mathematics Teachers Education: Growth in Practice. *Journal of Mathematics Teacher Education, 7(1)*, 5-23.

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

APPENDICES

Digitized by Sam Jonah Library

APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF MATHEMATICS AND ICT EDUCATION

KNOWLEDGE AND PERCEPTION OF TEACHERS PROBLEM-SOLVING APPROACH TO INSTRUCTION

TEACHERS QUESTIONNAIRE

This survey is being used to learn more about mathematics teachers' knowledge and perceptions on problem-solving-based mathematics instruction in public senior high schools. The data collection is done in support of a master's thesis. Therefore, it is solely intended for academic purposes. Realizing the purpose of this research is strongly dependent on the data you provided, I will be delighted if you participate in the study by providing truthful answers to the questions. Please know that we will treat your information with the utmost confidentiality. Many thanks.

Directions:

1. Not important to write your name
2. Please give brief and clear answer to open ended questions

VERITAS LUMEN NOBIS

Digitized by Sam Jonah Library

Part I: General Information

1. Name of school ………………………………………

For items 3 – 8, tick [√] in the appropriate space the response that applies to you.

2. Sex : Male ☐ Female ☐
3. Age: Below 20 [ ] 20-29 [ ] 30-39 [ ] 40-49 [ ] 50-59 [ ]

4. Teacher's work load (number of periods per week)…………

5. What is your academic background?

a. BEd. Mathematics[ ] b. BSc. Mathematics [ ] c. MEd. Mathematics [ ] d. MPhil. Mathematics [ ] e. MSc. Mathematics [ ] f. Others [ ]

6. Training background

Professional ☐ Non Professional☐

7. How long have you been a teacher?

Less than 4 years [ ] 4-8years [ ] 9-12 years [ ] 12-16 years [ ] above 16 years [ ]

Digitized by Sam Jonah Library

Part II: PERCEPTION OF SHS TEACHERS ON THE USE OF PROBLEM SOLVING INSTRUCTIONAL STRATEGY.

Please respond to items given below by putting a tick [√] in the appropriate space using the following scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Uncertain (U), 4 = Agree (A) and 5 = Strongly Agree (SA)

No	Statements	SD	D	U	A	SA
1	I am motivated to plan lesson using the problem solving approach in mathematics					
2	I need enough space, resources and feasible environment in the class in order to use the problem solving strategy					
3	I find the problem solving approach to instruction more supportive of learners of all abilities					
4	It is more difficult to satisfy slow and weak learners when teaching through problem solving					
5	I think the problem solving approach is useful for mathematical instruction					
6	The problem solving method is not suitable when time span is short for teaching					
7	The problem solving method is difficult when students are larger in number in the classroom					
8	The problem solving approach develops					

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

	students confidence and critical thinking abilities					

9. What is your view about the problem solving approach to mathematical instruction?

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

PARTIII: TEACHERS KNOWLEDGE OF PROBLEM SOLVING INSTRUCTIONAL APPROACH

1. Do you know about the problem solving instructional strategy?

a. YES b. NO

2. What does it mean to teach through problem solving?

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

Digitized by Sam Jonah Library

3a. Do you use the problem solving instructional strategy in teaching? A YES b.NO

3b. If your answer in 3a above is YES, kindly list the steps you follow to use the problem solving instructional strategy in your class.

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

…………………………………………………………………………..

4. Explain why you adopt or do not adopt the problem solving teaching method.

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

5. What is your view about the use of the problem solving instructional approach?

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

Digitized by Sam Jonah Library

PART IV: PRACTICES AND PROCEDURES TEACHERS FOLLOW WHEN USING THE PROBLEM SOLVING APPROACH TO INSTRUCTION.

Direction: Put a tick (√) in the column next to the comment that most accurately reflects how you are incorporating these concepts into your mathematics lessons.

NB: 1= Strongly Disagree, 2= Disagree, 3= Agree and 4= Strongly Agree

	Item (Teacher's activities in the classroom)	1	2	3	4
1.	I begin with a simple version of the task				
2.	I brainstorm with students, the various approaches or Solution strategies				
3.	The tasks provided builds on students' prior knowledge of mathematics				
4.	I ensure learners understood the problem before setting them to work.				
5.	I help students to relate the task with other problems solved in the past				
6.	I tell students whether they are working in small groups or individually on the task given				
7.	I establish with students how their solutions and reasoning will be shared				
8	I demonstrate confidence and respect for students' abilities by allowing them to work				
9	Listens to students attentively and motivates them				

Digitized by Sam Jonah Library

	intrinsically				
10.	Encourage students to consider many strategies				
11.	Encourages students to test their ideas				
12	Provides hints and suggestions to students.				
13	I support students without removing the challenging aspect of the problem				
14	I allot appropriate amount of time to the task				
15	I patiently listen students' reflection without interruption				
16	I allow students to listen and respect the idea of others				
17	I allow students to defend their answers, and then open the discussion to the class.				
18	Ask questions that shows an interest in students' ideas				
19	Encourage students to focus on developing thinking skills and strategies in solving problems rather than for obtaining one right answer				
20	Summarize the main points which are anticipated to challenge students.				

Digitized by Sam Jonah Library

APPENDIX B

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF MATHEMATICS AND ICT EDUCATION

Observation Checklist on Mathematics Instruction through Problem Solving

This checklist is designed for teachers who are going to be observed as they teach mathematics through problem solving in the classroom. This checklist was designed using the Van De Walle framework for teaching through problem solving; before problem solving, during problem solving and after problem solving. Teachers' lessons are observed in the window of this framework with some specific items under each stream to be considered throughout the lesson observation.

This observation checklist is developed to collect data on the implementation of mathematics instruction through problem solving approach in public senior high schools in the central region of Ghana.

General Information

1. Name of School…………………………..
2. Number of students presented in the class……………..

Date…………………………… Lesson Duration……………………

Grade level…………………………………………

Topic………………………………

NB: 0 = Not Observed 1= ineffective, 2= somewhat effective and 3= Effective

Digitized by Sam Jonah Library

Stage		No	Item (Teacher's activities in the classroom)	0	1	2	3
Before phase of a problem solving instructional strategy	Activating Prior Knowledge	1.	The teacher start lesson with an easy version of the task				
		2.	The teacher brainstorms with students various approaches or solution strategies				
		3.	The tasks provided builds on students' prior knowledge of mathematics				
	Ensuring Understanding of Problem	4.	Teacher ensures learners understood the problem before setting them to work.				
		5.	Help students to relate the task with other problems solved in the past				
	Establishing clear expectations	6.	Teacher tell students whether they are working in small groups or individually on the task given				
		7.	Teacher establishes with students how their solutions and reasoning will be shared				

Digitized by Sam Jonah Library

	Letting go	8.	The teacher demonstrate confidence and respect for students' abilities by allowing them to work				
During phase of a problem solving instructional strategy	Noticing students mathematical thinking	9	Listens to students attentively and motivates them intrinsically				
	Providing appropriate support	10.	Encourage students to consider many strategies				
		11.	Encourages students to test their ideas				
	Providing worthwhile extension	12	Provides hints and suggestions to students.				
		13	Support students without removing the challenging aspect of the problem				
		14	Allot appropriate amount of time to the task				
		15	Suggest extensions or generalizations.				

Digitized by Sam Jonah Library

After Phase of problem solving instructional strategy	Promotion of community of learners	16	Patient to listen students' reflection without interruption				
		17	Allow students to listen and respect the idea of others				
		18	Allows students to defend their answers, and then open the discussion to the class.				
	Listening without evaluation	19	Ask questions that shows an interest in students ideas				
		20	Encouraging students to focus in developing thinking skills and strategies in solving problems rather than on obtaining one right answer				
	Summarizing main idea	21	Presses students to forward their solutions and strategies				
		22	Ask the extension of the				

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

			problem				
		23	Summarizes the main points which are anticipating to challenge students				

Provide a summary of your observation of the lesson

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

APPENDIX C

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF MATHEMATICS AND ICT EDUCATION

Semi-Structured Interview Questions

These questions will be responded to by those respondents who will indicate they Use the Problem Solving Approach in their classroom.

Interview Questions

1. If you have received a professional training in using the problem solving approach to instruction, briefly explain what the training entailed.
2. What is your understanding of the problem solving method of teaching in mathematics?
3. How do you apply the problem solving method of teaching in your classroom?
4. Briefly explain the differences between the problem solving approach and solving word problems.
5. What do you consider as a problem, when adopting the problem solving instructional method?
6. What motivates you to use the problem solving approach to teach?

Digitized by Sam Jonah Library