The Oguaa Educator (*TOE*)

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ISSN 0855 - 0913

Published By

COLLEGE OF EDUCATION STUDIES, UNIVERSITY OF CAPE COAST, CAPE COAST, GHANA, WEST AFRICA

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VOLUME 13 JUNE 2019

Editorial Comment

The Oguaa Educator is a peer reviewed journal that provides the platform for tutors of Colleges of Education, school teachers, headteachers and educational researchers to disseminate their insights into innovative teaching and learning as well as educational leadership practices at the pre-tertiary level. The journal therefore publishes original research on innovative and best practices in teaching and learning in all school subjects as well as school management and leadership. Four (4) well researched topics from seasoned and well experienced academics make up this volume. The articles discuss various issues that relate to curriculum delivery at the school level. They provide great insight into the issues raised, whilst the authors bring their rich and varied backgrounds to bear in their respective articles.

Ernest Ampadu used the survey research design to examine Ghanaian Junior and Senior High School mathematics teachers problem-solving strategies and their professional development needs about problem-solving in the Cape Coast Metropolis of Ghana. The results of the study showed, amongst others, that, although teachers appreciate the importance of problem-solving in improving mathematics teaching and learning, there has not been the needed problem-solving training to support teachers in this regard. The author provides the implication of the findings of the study for professional learning programmes for mathematics teachers

Ernest Kofi Davis, Mark Owusu Amponsah, Christopher Yaw Kwaah and Christopher Beccles report on a study that draws on conceptualization of levels of curriculum as planned, implemented and attained curriculum to explore the alignment between the planned and implemented English Language, Mathematics and Science curricula in Ghana. The authors used the survey research design to carry out their investigation. The results from their study revealed amongst others that gaps existed between the planned and the implemented English Language, Mathematics and Science curricula. The authors provide implications of the findings from their research for practice, policy and research in Ghana and countries that share similar situation as Ghana.

Donusem Yao Asamoah and Godwin Kwame Aboagye used the survey research design to examine how practical work is integrated into the teaching and learning of physics at the senior high school level in the Volta Region of Ghana. Results from the study showed that though

teachers accept practical work as an essential ingredient for students' understanding of concepts, they are not up-to-date on how practical work should be integrated into the teaching and learning of physics as prescribed by the syllabus for physics. Also, the teaching of practical work is done via group work, hands-on activity, interactive demonstrations, discussion and lecture. The authors recommend the need for teachers to integrate practical work into lessons instead of separating them from theory.

Amadu Musah Abudu reports of a study that examined the effects of curriculum planning activities of heads of senior high schools on students' academic performance in Ghana using a cross-sectional survey research design. The results from the study revealed that of the eight predictors of high academic performance, four predictors emerged as significant. Based on the findings of the study, the author argues that the curriculum leadership roles played by heads of schools contribute to the academic performance of their students directly and recommends that only competent and committed people should be appointed as heads of schools.

Eric Nyarko-Sampson, PhD
(Editor-in-Chief)

The Oguaa Educator
Vol. 13, June 2019, pp. 1-18

Mathematics Teachers' Perceptions about Problem-Solving: The case of Ghana

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Abstract

Most students experience different levels of difficulties in learning mathematics. TIMSS results have shown that most students in Ghana do not perform well in higher level tasks designed to assess applications and non-routine problems. This study, therefore, aimed at examining Ghanaian Junior and Senior High School mathematics teachers problem-solving strategies and their professional development needs about problem-solving. 114 mathematics teachers from 28 Junior High School (JHS) and Senior High School (SHS) in the Cape Coast Metropolis took part in the study. Quantitative and qualitative data were collected using a semi-structured questionnaire. The results from the study show that although teachers appreciate the importance of problem-solving in improving mathematics teaching and learning, there has not been the needed problem-solving training to support teachers in this regard. The researcher, therefore, argue that despite the numerous advantages associated with problem-solving strategy of teaching and learning, continuous professional development training for teachers should be paramount in our quest for helping students develop problem solving skills. Ghanaian JHS and SHS students can be in a disadvantageous position as they compete with their peers from other countries in international comparison examinations if our teachers are not given the needed support to become proficient in the use of problem-solving strategies in the classrooms.

Key words: Problem-solving, constructivism, teaching, learning, curriculum.

Introduction

Improving the teaching and learning of mathematics in schools; particularly, at a pre-tertiary level has become a global issue of concern

for the past three decades. Consequently, the mathematics curricula in various countries have undergone a series of restructuring. One of the underlying principles enshrined in most of these new mathematics curricula is the move from teacher-centred to a more student-centred pedagogies. For example, Mosvold (2005) reported that as a means of improving teaching and learning of mathematics in Norway, a new mathematics curriculum was introduced in 1997 which places much emphasis on student-centred pedagogies to help students make connections with school mathematics and everyday life. Similarly, Chambers (2008) reveals that low students' achievements in mathematics and the need for improved teaching and learning pedagogies led to the introduction of a national mathematics curriculum in England in the 1980's. In achieving this, a number of teaching and learning strategies that promote students' conceptual understanding of mathematics have been outlined in these mathematics syllabi.

One way of promoting effective teaching and learning of mathematics in schools; which is broadly discussed in literature is the use of problem-solving strategies which have become one of the fundamental goals of teaching mathematics in schools (Stacey, 2005). The term problem-solving has been defined differently by different researchers and authorities. National Council of Teachers of Mathematics (NCTM) report defined problem-solving as the process of engaging the learner in a task for which the solution or method is not already known (NCTM, 2000). In a similar vein, Lester and Kehle (2003) described problem-solving as "an activity that involves the students' engagement in a variety of cognitive actions including accessing and using previous knowledge and experience" (p. 510). The advantages of using problem-solving in mathematics teaching and learning are well documented in the literature. For example, according to Polya (1981) developing problem-solving skills helps students to think critically and be innovative in their learning process. Research by Higgins, Hall, Baumfield, and Moseley (2005) and Martin, Liem, Mok and Xu (2012) have shown that problem solving is significantly associated with high achievement and that students who develop problem-solving competencies perform well. Schoenfeld (1992) also argued that problem-solving approaches promote a deeper and meaningful understanding of mathematics as it presents a change in focus of mathematics programmes that promoted the development of

basic mathematical skills and memorisation. Stacey (2005) reports that problem-solving strategies help in achieving the goal of teaching students, which is to help students conduct mathematical investigations by themselves and identify where the mathematical concepts and skills they have learned are applied in real world situations.

In Ghana, like in most African countries, the last two decades have seen a rise in attention on how to improve mathematics education and students achievements in mathematics. This has led to the initiation and implementation of strategies aimed at helping in the development of conceptual understanding in mathematics among students. The 2012 Junior High School and Senior High School mathematics syllabi suggests that teachers employ student-centred pedagogies where mathematics classrooms demonstrate teaching strategies such as group work and investigative approaches to help students improve their problem-solving skills (MoE, 2012). This is in line with Kilpatrick, Swafford and Findell (2001) suggestion that every mathematics curriculum which has the prime objective of helping children develop conceptual understanding of the mathematical skills they learn, should have five strands: "conceptual understanding-comprehension of mathematical concepts; procedural fluency (skills in carrying out procedures flexibly); strategic competence (ability for formulate); adaptive reasoning (ability for reflection), and productive disposition (see mathematics as sensible)" (p.115). Developing problem-solving skills helps students to apply the basic mathematical knowledge they learn in schools to solve real life problems. This gives students the needed competence to solve non-routine problems. According to Polya (1981) understanding and solving non-routine problems requires developing the needed problem solving, decision making, and higher order thinking skills.

Although Ghanaian students, like most other students, face a number of challenges in their mathematics classrooms however, developing the necessary problem-solving skills needed to apply the mathematical skills and concepts they have learned in solving real life problems continues to be a major problem (Anamuah-Mensah & Mereku, 2005). Solving non-routine problems, therefore continue to be one of the common challenges most Ghanaian students go through in their mathematics classrooms as in many other countries and setting (Nicolaidou & Philippou, 2003). This has become evident from the

analysis of Ghanaian students' performance in both national and international examinations. For example, the distribution of mathematics achievement across the three main domains (knowledge, applying and reasoning) is a clear manifestation of this problem. Figure 1 shows the analysis of students' achievement across these three domains from the 2007 and 2011 TIMSS results.

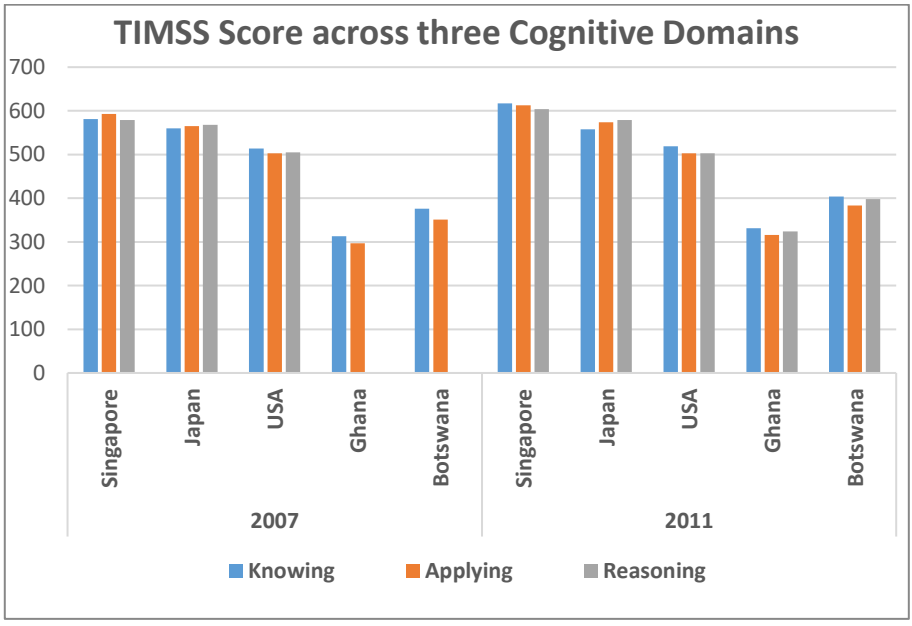

Figure 1: Distribution of Mathematics Achievement across three Cognitive Domains

From Figure 1, it can be seen that apart from Singapore and Japan, most 8th grade students did not perform well in questions testing their application knowledge. For example, Ghana's 2007, and 2011 results show that despite students overall poor performance across all the three domains, students did not perform well on tasks requiring the application of mathematical concepts in solving non-routine and real life problems. This leads to low performance in the international comparative tests and reduces Ghanaian students' capabilities in comparison with their peers from other countries. It is evident from Figure 1 that like Ghana, most students' scores on questions testing their ability to remember what they have learnt was higher than questions

testing their ability to apply the mathematics they have learned in solving real life problems.

This shows that despite the fact that most school curricula place much emphasis on problem-solving as a means of applying and integrating mathematical concepts in solving real life problems, most students are still struggling to acquire this knowledge and skills. This is, therefore, an issue of concern in our quest for improving the teaching and learning of mathematics and producing students who are nationally and internationally competent in problem-solving and decision making (Mullis, Martin & Foy, 2008).

Literature Review

According to Tambychik and Meerah (2012), developing problem-solving skills has become an integral part of the national curriculum in most countries. They further argue that problem-solving skills in mathematics have become very crucial in most mathematics classrooms because most students are unable to apply the mathematical skills they have acquired in school to solve real life problems. These competencies are clearly outlined in the curriculum; however, the curriculum does not provide specific pedagogies for teachers to guide them in helping students develop these critical competencies that they need to be successful in mathematics. It is an undeniable fact that most of these teachers completed their in-service teacher training programmes before the introduction of this new curriculum and may not have been introduced to these problem-solving skills and how to help students acquire these critical competencies during their training.

Despite the numerous advantages associated with problem-solving, little is known about the Ghanaian mathematics teachers' perceptions regarding problem-solving and the kind of support they require to enhance their problem-solving teaching skills. One of the most important factors that influence the quality of mathematics teaching and learning is the teacher's belief in the mathematical concepts they teach and mathematics education in general. Ernest (1989) opines that "teaching reforms cannot take place unless teachers' deeply held beliefs about mathematics teaching and learning change consistent with the policy documentation" (p. 249).

The implementation of any new methods of teaching mathematics "depends fundamentally on the teacher's system of beliefs,

and the teacher's conception of the nature of mathematics" (Ernest 1994, p.1). Research has shown that teachers' instructional practices do reflect the kind of perspective they have of the subject (e.g. Perkkila, 2003; Handal & Herrington, 2003). For example, Perkkila (2003), in his studies involving Finnish primary school teachers, outlined that recollections of their experiences (e.g. difficulties with mathematics learning) had a significant influence on their teaching practices and the way in which a teacher teaches can be traced back to his/her school days. According to Mereku (2003) despite the uniformity of the mathematics curriculum in Ghana, the implementation and adaptation of this school curriculum and its associated teaching methods and learning strategies have not been the same in all classrooms due to the different beliefs held by mathematics teachers.

Their beliefs directly influence Teachers' classroom practices about teaching and learning; hence one can impact a teacher's practice by understanding his/her beliefs about a particular issue or practice. Although it is acknowledged that other factors influence teachers' instructional practices, research (e. g. Ernest, 1989; Handal & Herrington, 2003; Philipp, 2007; McLeman & Fernandes, 2012; Sapkova, 2014) have shown that most teachers teach based on their beliefs. Therefore, developing ways of enhancing students' problem-solving skills is paramount in overcoming the problem above. One area that needs some empirical research to help improve student's problem-solving skills and competencies is our understanding of teachers' beliefs and perceptions regarding problem-solving. The overarching goal of this research is to understand better and describe mathematics teachers' perceptions about problem-solving and understand the professional development needs of teachers about problem-solving. The present study is therefore guided by the following research questions:

- To what extent do Ghanaian teachers report that they incorporate problem-solving approaches in their planning and teaching of mathematics?
- What is the difference between Ghanaian mathematics teachers perception of their use of traditional teaching practices and problem-solving practices?
- What are Ghanaian mathematics teachers perceived professional development needs about problem-solving?

Methodology

Research Design

The exploratory survey research design was adopted in view of the fact that very little is known about the issue under consideration within the Ghanaian context. As highlighted above, the school curriculum places much emphasis on enhancing students' problem-solving skills and competencies, but very little is known when it comes to Ghanaian mathematics teachers beliefs and perceptions about problem-solving. The study was conducted using a survey approach to understanding mathematics teachers' views regarding problem-solving and their professional development needs in implementing problem-solving in mathematics classrooms.

Participants and Setting

Data for this study were collected from one hundred and fourteen (114) mathematics teachers drawn from 28 Junior Secondary Schools (JHS), and Senior Secondary Schools (SHS). The 28 schools are located in the central region of Ghana. The sampling of the participants was done in two phases. In phase one, 4 JHS were randomly selected from each of the six educational circuits in the Cape Coast Metropolis. In addition to this, the 12 SHS in the Metropolis were divided into four groups of three and one school was randomly selected from each group. In all there were 118 mathematics teachers in these schools and four teachers decided not to be part of the study.

Survey Instrument

A semi-structured questionnaire was used for the collecting the data used in this study. The questionnaire had four sections. The first section was used to elicit teachers' biographical data, and the second section was used to elicit teachers' beliefs on issues relating to problem-solving in mathematics. A four-point Likert scale (strongly agree, agree, disagree and strongly disagree) was used in eliciting information regarding teachers' beliefs. The third section examined teachers' perceived teaching practices, and this information was gathered using a four-point Likert scale (hardly ever, sometimes, often and always) where teachers were asked to indicate how often they used a specific instructional practice in their respective classrooms. The last section consisted of two open-ended questions which were used to elicit

qualitative data relating to the professional development needs of the mathematics teachers and their views regarding the importance of problem-solving in a mathematics classroom. The reliability of the questionnaire used was confirmed (*Alpha Cronbach = 0.785).*

Data Analysis

The quantitative data from the survey was analysed descriptively using SPSS 20 and Origin 6.0 to generate percentages and inferential statistics to help provide robust analysis to understand the issues under consideration. The qualitative data from the open-ended questions was analysed using coding to generate common themes to help produce a holistic picture of the situation under consideration.

Findings and Discussions

Extent to which Teachers' Incorporate Problem Solving in their Teaching

To measure teachers' perception about the extent to which they incorporate problem-solving strategies in their lessons, teachers were asked to indicate how often they perform 10 different strategies in their classrooms. The result is shown in Figure 2.

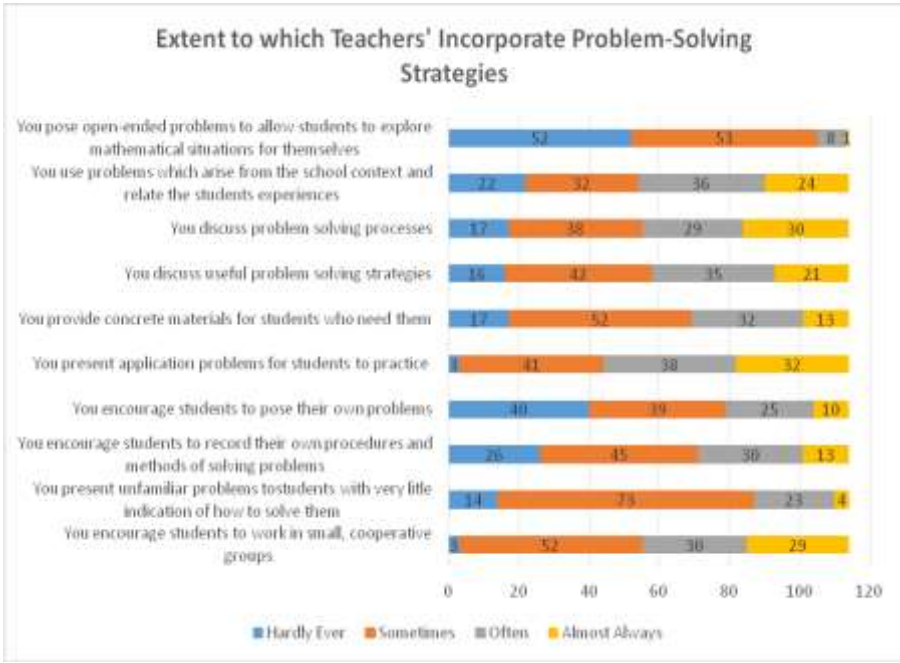

Figure 2: Extent to which teachers incorporate problem-solving approaches

Figure 2 shows that even though majority of the respondents indicated that they incorporate problem-solving strategies in their teaching, it was interesting to note that the majority of these teachers do not incorporate some of the underlining principles of problem-solving in their teaching. For example, almost half of the respondents indicated that they hardly pose open-ended problems to allow students to explore mathematical situations for themselves. In addition to this, just 10(8.8%) indicated that they encourage students to pose their own problems. Similarly, only 32 (28%) indicated that they always present application problems for students to practice.

Using open-ended questions, asking students to pose their own problems and presenting application problems for students to practice, do not only encourage critical thinking among students but also help students to be independent learners. As suggested by Grigg and Benson (2012) students' ability to pose their own questions and make meaning of open-ended questions leads to higher cognitive workload capacity which is predictive of higher performance and decision-making capabilities.

Teachers' Perceived Traditional and Problem-Solving Practices

Participants were asked to determine the extent to which they agree to seven-statements relating to traditional practices and seven statements relating to problem-solving teaching practices using a four-point Likert scale. The results are depicted in Table 1 and Figure 3.

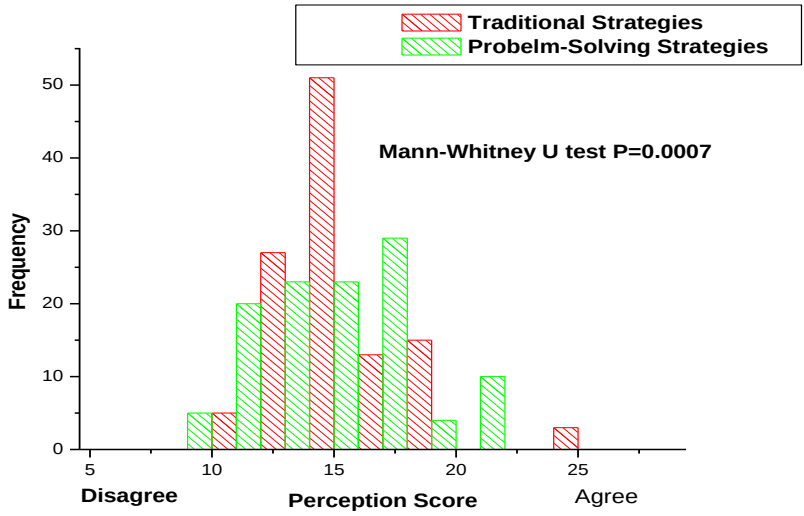

Figure 3: Mathematics Teachers' Perceived Teaching Practices

Table 1: Mathematics Teachers' Perceptions about Traditional and Problem-solving Practices

	Statements	Agree	Disagree
Traditional Practices	Student should learn basic number facts before they do application and unfamiliar problems	93%	7%
	Students should learn algorithms before they do application and unfamiliar problems	85.1%	14.9%
	Students cannot solve problems until they know how to perform the four operations	73.6%	26.4%
	The best problems are those which directly deal with the number facts and algorithms the students have to practice	73.5%	26.5%
	Application and unfamiliar problems are best left to further topics in mathematics	52.7%	47.3%

	Mathematics lessons should focus on practicing skills	79%	21%
	Some students have trouble solving problems unless they know how to do the mathematics before they begin	61.4%	38.6%
Problem-Solving Practices	Some students find problem-solving difficult because of the language involved in the problem	78.3%	21.7%
	It is a good strategy to begin a topic with unfamiliar problems	48.3%	51.7%
	Mathematics lesson should focus on problems rather than on practice of algorithms	65.7%	34.3%
	Problems help motivate students to learn basic facts and algorithms because they can see a reason for learning them	79.8%	20.2%
	All mathematics questions should challenge students to think about what mathematics they know and how they can use them	95.7%	4.3%
	Students can learn most mathematical concepts by working out for themselves how to solve unfamiliar or open-ended problems	82.5%	17.5%
	Students should be allowed to explore their ways of doing mathematics questions before being shown the teacher's method	29.6%	70.4%

Table 1 and Figure 2 show that the perceptions of these mathematics teachers are complex as it contains some elements of both traditional and problem-solving strategies. However, the inferential statistical analysis from the Mann-Whitney U-Test ($p = 0.0007$) shows that the teachers ascribed more to traditional teaching practices as compared to that of problem-solving strategies. Similarly, analysis of Table 1, shows that the average percentage of the respondents who ascribed positively to traditional teaching strategies was 74% as against 69% for those who were in support of problem-solving teaching strategies. These beliefs create novel challenges in our quest for improving students' problem-solving skills. This does not only limit individual student's problem-solving skills, but it also does not encourage higher order thinking among students as suggested by Dean (2011). Although Lim (2007) have argued that the learning and acquisition of basic mathematical principles and concepts are

important; it can also be argued that current teaching practices as reported by teachers in this sample are not geared toward developing students who can apply these mathematical skills in concepts in making decisions to solve real life problems.

Professional Development needs of Mathematics Teacher

Figure 3: In-service Training attended by Teachers

Both the quantitative data from the closed-ended questions, and the qualitative data from the open-ended questions were used to answer this research question. The quantitative data was used to map-out the situation on the ground, and the qualitative data was used to validate the results from the quantitative data. It was interesting to note that majority 60 (52.6%) of the respondents had more than seven years teaching experience. This suggests that it is likely that a majority of these teachers completed their teacher training education before the introduction of the new mathematics curriculum. This new curriculum is underpinned by the principles of constructivism -learning through active participation in the teaching-learning process to create new knowledge structures from personal experience (Kumar, 2006) and problem-solving strategies. It was therefore expected that these teachers would be involved in some in-service training that will help them understand the underlining principles of constructivism and problem-solving. However, from Figure 2, it is worth noting that majority 70

(61.4%) of these teachers have attended only one in-service training during this school year. Also, 74 (64.9%) of the participants indicated none of the in-service training they have attended focused on problem-solving. These teachers might have learned these concepts during their college and university mathematics lessons, but it can be argued that their understanding and implementation of these problem-solving skills in their classrooms have not been fully conceptualized. This perhaps resulted from how they were taught as student-teachers which may be completely different from them teaching their students to develop these skills for critical thinking and solving challenging mathematical problems.

To probe further, respondents were asked about their perceived professional development needs in the area of teaching using problem-solving approaches. Most of the respondents indicated the need for sensitisation workshops on problem-solving as a way of ensuring that the aims and objectives of the new mathematics curriculum are materialised. Also, the results from the study suggest that the teaching of problem-solving skills at the Colleges of Education and teacher education programmes should be strengthened. For example, 56 of the respondents indicated that they had not even heard of the concept of problem-solving before and were not sure how they could incorporate this into their teaching. It was therefore not surprising to note that one of the teacher's reported that "*teachers lack problem solving skills and that problem solving should training should be integrated into teachers professional development programmes*" Also, another teacher indicated that, "*teachers must be encouraged to attend problem solving workshops and that there is the need for more adequate training on problem solving*".

As suggested by Fulan (1993) it is only when enough of the people within an organisation change that the organisation can be transformed to the needed level of development. That is to say, no matter how well structured or beautiful the curriculum is, it is only when those who are supposed to implement this curriculum are well trained and equipped with the needed resources; that we can be assured of reaping the benefits associated with such curriculum. For example, as suggested by Cohen, Raudenbush and Ball (2003) provision of resources and access to schooling and introduction of new curricula alone does not affect outcomes; but the provision of academically more

demanding curricula. That is academically more demanding curricula do not only lead to high achievement outcomes but help in producing students and graduates who are critical thinkers. This result also shows the major challenges in the implementation of the new mathematics curriculum in schools as such academically challenged curricula require teachers who are well trained and innovative in their teaching. It is possible that we may not have the qualitative human resources competent enough to implement this new curriculum. The development of the "*implementers"* should be an issue of concern in our quest for training and produce high-quality graduates who will be highly competitive at both national and international levels and capable of making critical mathematical decisions in solving real-life problems.

Conclusion and Implications

The purpose of this study was to explore JHS and SHS mathematics teachers perceived problem-solving strategies and their professional development needs. Overall, the results indicated that the majority of these teachers acknowledge the importance of problem-solving in improving the teaching and learning of mathematics in schools. From the results, majority of these teachers showed some level of self-confidence in implementing problem-solving strategies in their classrooms. As suggested by Ozmentes and Bilen (2005) self-confident teachers tend to be more matured and can easily be trained to implement any new strategies. From Table 1 majority of the teachers ascribed positively to the problem-solving statement and so it can be argued that having such positive perceptions can be a great asset for the country in our quest for improving mathematics education using problem-solving strategies. It is also important to note that despite the fact that majority of the teachers ascribed positively to the problem-solving practices, most of them acknowledge the fact that they lack the professional competencies in implementing problem-solving strategies in their respective classrooms, hence their request for more workshops and training sessions on problem solving. The analysis of the results also brought to light some challenges in achieving the aims underlined in the new mathematics curriculum for pre-tertiary students.

From the results it is clear that more than half (59 representing 51.7%) of the respondents have taught for seven years or more which means they completed their teacher training education programmes

before the introduction of the 2007 curriculum; hence the need for sensitisation workshops and training programmes on problem-solving for these teachers. However, most of these teachers have not attended any training that focuses on problem-solving. The policy implication here is that there is the need for a second look into the kind of staff development training programmes organised for teachers if we wish to achieve the goal of the new curriculum which is to train and produce internationally competitive students. In addition to this, the Ministry of Education in collaboration with the Ghana Education Service and Teacher Education Division should provide textbooks that provide ideas on how to use problem-solving and collaborative approaches.

About research implications, the author argues that there is the need for longitudinal research in examining the impact of problem solving skills on teachers teaching and how this influence students problem-solving skills and ability to solve non-routine problems. Some of the underlining principles of these strategies include the use of concrete materials in teaching and open-ended and unfamiliar questions in class so that students can examine and compare these unfamiliar questions with the ones they know and critically think this through to make an informed judgment. However, the results show that majority of these teachers do not want to lose their authority in their classrooms, but rather control most of the classroom activities. As suggested by Boaler (2006) and Mapolelo (2009) in such situations, students just become passive learners and are not able to think critically.

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