Influence of Ghanaian Junior High School (JHS) Teachers' Problem Solving Beliefs on Their Approaches to Teaching Mathematics

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ABSTRACT

This study investigated the kind of beliefs Ghanaian Junior High School (JHS) mathematics teachers held about mathematical problem solving and how they integrate the beliefs in teaching mathematics. The sample of the study consisted of 97 JHS mathematics teachers in 71 JHS in Keta District of Volta Region. Data were collected in 2009/2010 academic year. Participants completed a survey composed of questionnaires and classroom observations which were carried out on five JHS mathematics teachers. The results of this study indicated that, in general, JHS mathematics teachers held positive beliefs about mathematical problem solving, which means that their beliefs were in line with the new approaches. However, the results revealed that they did not actually integrate their beliefs in the teaching of mathematics. In order to gradually challenge teachers' negative beliefs about mathematical problem solving, suggestions have been made regarding adequate educational interventions.

Introduction

Mathematics is at the heart of many successful careers and successful lives (National Council of Teachers of Mathematics[NCTM], (1998), and it is one of the subjects in the Junior High School Curriculum in Ghana which is compulsory for all students to study. One of the general aims of JHS mathematics syllabus is to use mathematics in daily life by recognizing those situations that require mathematical problem solving strategies and applying them; (Curriculum Research and Development Division of Ghana Education Service [CRDD-GES] 2007) p.ii. Under the Ghana's Education System, the District Teacher Support Team (DTST) provides an anchor for improving the quality of teaching and learning at the district level. It provides support to schools in the area of good practices in literacy, numeracy and problem solving.

The term problem may have different meanings depending on one's perspective. From a mathematical perspective, problem is defined as 'a situation where something is found or shown and the way to find or show it is not immediately obvious' (Gruows, 1996, p72). For a teacher of mathematics, problem is an engaging question for which students have no readily available set of procedures, but the necessary factual and procedural knowledge to do so (Schoenfeld, 1989).

Problem solving is an important component of mathematics education, mainly because it provides an environment for students to reflect on their conceptions about the nature of mathematics, and develop a relational mathematical understanding (Lester, 1994)

In addition, reports by (NCTM 1989) stated that, there is a significant shift towards applying mathematical concepts and skills in the context of "authentic problems" and for students to appreciate concepts rather than merely following a sequence of procedures. The reports further stated that, the essential aim of mathematical education is to help students learn how to describe, tackle, and ultimately solve problems which require the use of mathematical knowledge and techniques.

The foregoing discussions indicate the emphasis now being placed on problem solving in school mathematics programme. Nevertheless, if JHS teachers in Ghana were asked to suggest one aspect of mathematics which is difficult to teach, it is likely that problem solving would be a popular choice. The traditional approaches to mathematics teaching and learning have been challenged by new and innovative approaches based on the significant shift towards applying mathematical concepts and skills in the context of "authentic problems" and for students to understand concepts rather than merely following a sequence of procedures. As a way of helping to analyse, describe, tackle, and ultimately solves problems which require the use of mathematical knowledge and techniques, hence the need for this study.

The conventional teaching was what most of the teachers practiced while delivering their lessons. This observation was made during researcher's years of teaching in training college. Teacher trainees often practiced the conventional teaching approach during their teaching practice, though these teacher trainees were taken through methodology that calls for problem solving approaches.

Nahid, (2002) stated that teachers holding the absolutist views about mathematics and its teaching and learning are more likely to create teacher-centered instructional environment, teach mathematics as rules to be memorized, and portray mathematics as an infallible discipline. Nahid continued to say that teachers with the absolute views tend to present the subject to students in a way that suggests mathematics as a linear subject, concentrating on facts and skills, related to numbers which generally feature paper and pencil activity. He further stated that since the teachers' main objective is the learners' mastery of mathematical skills, the clear presentation of the step by step of any mathematical procedure and the emphasis on right or wrong answers are likely to be practiced. These teachers according to him are said to be engaged in non-problem solving approach in teaching mathematics.

According to Bishop (1985) mathematics is seen by the social constructivists as an extension of natural language and, as a language, is acquired and developed through social interaction. To him, individuals, through observations of patterns in the physical world and reflection on previously constructed concepts, develop new mathematical ideas. He further stressed that, mathematics teachers, many of whom may not have formally studied philosophy of mathematics, might not describe their personal conceptions of the nature of the subject in terms of the absolutist, platonist, formalist (instrumentalist), or social constructivist (problem-solving) positions, but such categories may be employed in the analysis of teachers' less formally defined images of the subject.

Hersh (1986) states that, teachers holding constructivist views of mathematics are expected to adopt teacher-student interaction mode of instruction by allowing students to explore and investigate any mathematical problem, while teachers reside in the classrooms as facilitators. Hersh stated that, one's conception of what mathematics is, affects one's conception of how it should be presented. One's manner of presenting it is an indication of what one believes to be most essential in it. The issue, then, is not, what is the best way to teach? But, what is mathematics really about?

Clark and Peterson (1985) following the line of the constructivists view asserted that the behaviour of teachers is greatly influenced by their thought processes. Describing the thought processes of teachers is one way to gain a fuller understanding of classroom practices such as teaching of strategies in problem solving in mathematics. Teachers' actions in classroom and the observable effects of those actions can be better understood if the non-observable phenomena of their thought processes are better understood. One aspect of the thought processes of teachers falls under the category of beliefs. Ford (1994) states that beliefs are convictions or opinions that are formed either by experience or by the intervention of ideas through the learning process. Clark and Peterson (1985) as cited by Ford (1994), suggested that, in general, teacher's beliefs about attributions for the causes of student behaviour and teachers' beliefs about teaching and learning affect the teachers' actions, which in turn affect student behaviour and achievement. The views as expressed by Clark and Peterson and emphasis on problem solving approaches to teaching of mathematics issues in the schools are welcoming ideas but the influence of Ghanaian JHS teachers' problem solving beliefs on their approaches to teaching mathematics is relevance to this study.

Statement of the Problem

According to (Child, 1970; Cobb, 1986; Kloosterman, 1996), poor problem solving skills by students have been found to be as a result of beliefs held by teachers about teaching and learning of mathematics, particularly at the Basic and Secondary School levels of Education in London and Nertherland. This available evidence indicates that in other countries poor performance of students in mathematics arise from lack of problem solving skills, for which Ghana is not an exemption.

The Ghana Human Development Report (2000) indicated that the percentage pass in core mathematics of Senior Secondary School Certificate Examination (SSSCE) in 1995, 1996, 1997 were 40.1%, 44.2% and 37.6% respectively. According to the report, the views held by most Educationists in Ghana are that these poor performances by the students could be attributed to Ghanaian JHS teachers' poor problem solving approaches to teaching mathematics at the JHS levels.

Results of the Trends in International Mathematics and Science Study (TIMSS, 2003) in which six African countries participated indicated that, Ghana's overall performance of the JHS2 students on mathematics test was poor and was significantly below the international mean. Ghana was ranked 46th out of forty-nine countries on the international benchmark for mathematics. In support to the Ghanaian Educationists views, the TIMSS report did not mince words stressing that candidates were very weak in using mathematical facts and concepts to solve word problems. Candidates were not able to translate statements into mathematical language, hence their inability to use mathematical algorithm to solve problems.

Judging by Ghanaian JHS students' performances on (TIMSS, 2003) in which Ghanaian students scored below the international average at all grade levels on problem solving, one can say that Ghanaian JHS students seem not yet ready to be meeting the expectations of the mathematics education community.

Furthermore, the Chief Examiner's Reports on Basic Education Certificate Examination (B.E.C.E) in mathematics gave summary of candidates' weaknesses as follows:
Year 2002 and 2003
• Most candidates did not take their time to read and understand the questions before attempting to answer them and wrote down answers to certain questions without showing any working,
• Candidates did not answer questions step by step but rather used shortcut methods which made them loose vital marks.
B.E.C.E (2005).
• Candidates were very weak in using mathematical facts and concepts to solve word problems.

This evidence indicated that candidates' exposure to several heuristics such as the one suggested by Polya (1957) as, understanding the problem; devising a plan; carrying out the plan and looking back might not have been applied by the JHS teachers during their teaching, hence the candidates' weaknesses.

Purpose of the Study

The difficulty of teaching problem solving is not new: teachers have been concerned about their students' inability to solve problems since problems first appeared in mathematics textbooks (Randall & Lester 1984). The study seeks to investigate whether or not Ghanaian JHS teachers believe in problem solving approach to teaching mathematics and also find out whether or not Ghanaian JHS teachers who believe in problem solving integrate such beliefs into their mathematics teaching.

The study sought to find out the beliefs teachers have concerning problem solving and the effects on approaches to teaching of mathematics at JHS. The following research questions and hypotheses were formulated to guide the survey of those beliefs:

Research Questions

• What problem solving beliefs do Ghanaian JHS teachers hold about their mathematics teaching?
• .How do Ghanaian JHS teachers who hold problem solving beliefs integrate such beliefs into their mathematics teaching?
• What are the differences in classroom practice of JHS teachers who believe in the problem solving approach to teaching mathematics from those who do not?

Hypotheses

• The proportion of female Ghanaian JHS teachers who hold problem solving beliefs about their mathematics teaching is significantly higher than their male counterparts.

- The proportion of Ghanaian JHS teachers below 40 years who hold problem solving beliefs is significantly higher than their counterparts of the age 40 and above.
- The proportion of Ghanaian JHS teachers with up to 5 years teaching experience who hold problem solving beliefs is significantly higher than their counterparts with 5 years teaching experience and above.

Complexity of Change of Attitudes of Mathematics Teachers

Fennema and Nelson (1997) as cites by Pehkonen, (1999) comment that there have been several attempts to improve and to develop mathematics instruction. Careful programs have been developed, interesting materials for problem solving produced, students working in small group have been suggested, and appropriate models for assessment have been produced, but these actions did not seem to have a major influence on the way of teaching/learning school mathematics. Pehkonen further stressed that although the research community in Finland knows rather well what kind of change in school instruction one wants to have, most of practicing teachers are still in favour of conventional teaching.

Cooney and Shealy (1997) as cited by Pehkonen, (1999) stated that, for many teachers, changing their attitudes to the teaching of mathematics is problematic and fraught with difficulties. In addition, Pehkonen stated that, some teachers changed whiles others do not, despite the best efforts put in place. Pehkonen also believes that some mathematics teachers will change regardless of whether there are external efforts at all. And that, behind mathematics teachers' unwillingness to change there might be their experiences during studies in teacher training, as well as the teaching habits they have developed and considered as effective.

Pehkonen, (1994) stated that, although there is the knowledge that the conventional teaching methods produce superficial learning, for some teachers these are the best functioning teaching methods. Further, Pehkonen, said that plenty of trials to prevent conventional teaching methods and to improve mathematics school teaching are implemented all over the world, and many of them reported in scientific journals. Fennema and Nelson (1997) stated that, many of the research reports give an optimistic view on the possibilities for teacher change. But according to Fennema and Nelson, when looking nearer in the research results, there are usually some teachers who have changed and some have not. Thus, there seems to be existing factors which hinder some teachers from changing.

Keynes (2007) cited that, the real difficulty in changing the course of any enterprise lies not in developing new ideas but in escaping from the old one. For that matter there is the need to examine teachers' beliefs towards problem solving in mathematics and come out with findings which may need a change in teachers' attitudes toward problem solving in mathematics classrooms in Ghana.

Methodology

Research design

A descriptive survey design was used to sample views of mathematics teachers on problem solving using constructivists approach (constructivism) in Volta Region. According to Cozby, (2001) survey research employs questionnaires and observations to ask people to provide information about themselves, facts such as peoples attitudes and beliefs, demographics (age, gender, income, and so on) and other facts past or intended future behaviours. Cozby stressed that survey research have become extremely important as society demands data about issues rather than only intuition and anecdotes.

Also Doyle, (2004) describes surveys as creating a questionnaire and collecting responses from a sample, to draw a profile of the group as a whole, and perhaps perform some cause and effect analysis to understand their feeling. Survey research was considered appropriate for the study because the researcher intended to use questionnaire and observation to collect data on teachers' views on problem solving and teachers' problem solving approach to teaching mathematics.

Population

The population of the study is all teachers of Mathematics in all JHS in the Volta Region of Ghana. Statistics gathered from the Volta Regional directorate of the Ghana Education Service (GES) of the Ministry of Education indicated that the total number of Mathematics teachers in JHS in the region was eight-hundred and twenty (820) at the beginning of 2009. Out of the total number of teachers who teach mathematics in the region, ninety seven (97) of them teach in seventy-one (71) JHSs in Keta District. Out of the total mathematics teachers, 25 were female and the remaining 72 were male.

Technique and Sample

Keta District in the southern part of Volta Region was selected using convenience sampling. Convenience sampling refers to a sampling process in which the researcher selects a sample primarily because it is accessible and reasonably representative of the population of interest (Harris, 2002). In the views of Baumgartner, Strong and Hensley (2002), convenience sampling as the name suggest, is selecting the research participants on the basis of being accessible and convenient to the researcher.

Keta District is a neighbouring district to Dzodze, Ketu and Akatsi and they implement the same government educational policies as it is being done everywhere in the country. It is important to note that in Ghana all JHSs operate a national curriculum. Purposive sampling was used to select all teachers of mathematics in all JHS in the Keta District. In all, seventy-one (71) schools with ninety-seven (97) permanent mathematics teachers were targeted for the study.

The researcher coded the questionnaires before distribution them to the teachers. The coding of the questionnaires made it easy for the researcher to sample the teachers who were for the constructivists' views and non-constructivists views.

Female teachers' questionnaires with problem solving views were separated from those with non-problem solving views. The coded number on each questionnaire was re-written on pieces of papers. These papers were put in separate boxes and random picking was done to select one female teacher from each category i.e. teacher who holds the problem solving views and the other who do not. The same procedure was done to select two male teachers from those who hold the problem solving beliefs and one male teacher from those who do not hold the problem solving views. The sampling was done in such a way that, not more than one teacher was observed at a school. The researcher observed teachers who were teaching in JHS1 and JHS2.

Instrument

Questionnaires were used to collect data for the study. This was appropriate for the study because descriptive survey lends itself to questionnaire (Borg, Gall, and Gall, 1993) According to these authors; survey research typically employs the questionnaire, observation and to determine the opinion, attitude, beliefs and preferences of persons of interest to the study. Since the researcher is interested in assessing teachers' beliefs about problem solving and teachers' problem solving approach to teaching mathematics it was appropriate to use

questionnaire and observations procedures. Also because of the anonymity of questionnaires, questionnaires are particularly suitable and since problem solving is recommended by NCTM, (1991) respondents should feel free to give their real views without fear of criticism.In designing the questionnaire for this study five-point scale of 22 items adapted from Van Zoest, Jones and Thornton,(1994) was used to measure teachers' problem solving beliefs approaches to teaching mathematics. The five point scales were: "strongly agree", "agree", "uncertain". "disagree", "strongly disagree"

The demographic component of the questionnaire elicited information on the background of the respondents that were considered useful. The variables covered the gender, age, and number of years of teaching mathematics. To encourage teachers to respond as honestly as possible, questions about beliefs were presented as representing the views system suggesting problem solving as a focus for learning mathematics. Respondents were required to record their level of agreement with each of the statements.

Classroom observations were an integral part of the research because it was important to observe teachers problem solving approach in the classroom. Thompson (1992) suggests that any investigations of teacher beliefs should use verbal data and should also include observational data on instructional practice. This is a status study so the observations were to establish the status of classroom practice i.e. find out what practice goes on in the classroom to see if there are any differences in classroom practice of JHS teachers who believe in the problem solving approach to teaching mathematics from those who do not. An observation instrument was developed based on Geelan's (1997) strategies. According to Geelan teachers that teach with constructivists' ideas might be seen doing the following:

• helping students identifying their views and ideas;

• creating opportunities for students to explore their ideas and to test their robustness in explaining phenomena, accounting for events and making prediction;

• providing stimuli for students to develop, modify and where necessary, change their ideas and views; and

• supporting students' attempts to re-think and reconstruct their ideas and views.

The researcher observed the teachers using the observation guide. The statements in the guide were used as a yard stick to determine whether influence of Ghanaian JHS teachers' problem solving beliefs interfere with their approaches to teaching mathematics.

Five teachers selected for observation represented both teachers who had been identified from the questionnaire as having strong non-constructivists (absolutists) and constructivist (problem solving) views. Teachers who were of the non-constructivists (absolutists) views consisted of one female teacher and one male teacher, and those with constructivist (problem solving) views were made of one female and two male teachers.

These five teachers observed were teachers who teach in five JHSs in the district. The observations were not intended to pass judgements on the teachers' performance but were intended to investigate differences in the teaching practices of the teachers with differing teacher beliefs about problem solving and non- problem solving views. Each teacher was observed taught four lessons at different days. The duration of each lesson was 30mins.The observation exercises were intended to investigate differences in the teaching practices of the teachers

with differing teacher beliefs about problem solving and non-problem solving views.

Results

Results of the personal information obtained from the questionnaires were computed into percentages and presented in Tables 1-3

Table 1 above shows the statistics of the respondents, which consists of twenty-five (25) female teachers (25.8%) and seventy-two (72) male teachers (74.2%)

Table 2 above shows the statistics of the respondents, which consists of 34 teachers with age of 40 and above forming 35.1% and the age of teachers below 40, is 63 forming 64.9%.

The data suggests that majority of the teachers are young and have had their training within the past fifteen years.

The number of teachers with up to five years mathematics teaching experience was 57(58.8%) and those with five years and above were 40(41.2%).as shown in table 3 above. The table 3 shows that majority of teachers had below 5 years teaching experience in mathematics at the JHS.

In order to find out how teachers responded to the questionnaires items on problem solving views, the researcher used agree to represent responses of teachers who believe in the problem solving approaches(constructivists) and disagree to represent responses of teachers who do not believe in the problem solving approaches(non-constructivists).

Information from table 4 showed the responses of the teachers classified into two categories of views. In summary, 44 teachers (45.4%) are non constructivists and 53 (54.6%) are constructivists. An indication that majority of the teachers believe that problem solving approach should be the practice in teaching of mathematics. These teachers' beliefs about constructivism are evidence that these teachers are of the view that problem solving should be the focus of mathematics teaching in Ghanaian JHSs.

Majority of the teachers under this study consider what Resnick (1987) proposed, that problem solving approach contributes to the practical use of mathematics by helping people to develop the facility to be adaptable when technology breaks down. And also that of Cockcroft (1982) advocacy that, problem solving ability lies at the heart of mathematics, because it is the means by which mathematics can be applied to variety of unfamiliar situations

This means that, despite the modern technology, there is the need for the teachers to consider problem solving approaches in the Ghanaian schools to help students to be adapted to any technological break down. Again, by the Cockcroft advocacy teachers in Ghanaian schools would consider problem solving approaches in mathematics teaching which will enhance students' ability in application of mathematics in variety of unfamiliar situations.

Analysis of observed mathematics lessons of the constructivists teachers.

In order to answer the second research question that; how do Ghanaian JHS teachers who hold problem solving beliefs integrate such beliefs into their mathematics teaching; the researcher observed three constructivists teachers who were sampled from constructivists category.

During the researcher's classroom observations, one of the three teachers among those who believe in problem solving approaches, from the four lessons taught, got students to suggest ways of finding a solution, not to call out answers only, but, got students to actually participate in finding solution. He solved problems together with the students.

Table 1: Gender of Teachers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	72	74.2	74.2	74.2
	Female	25	25.8	25.8	100.0
	Total	97	100.0	100.0	

Table 2: Ages of Teachers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 40	63	64.9	64.9	64.9
	40 and above	34	35.1	35.1	100.0
	Total	97	100.0	100.0	

Table 3: Number of years of teaching Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5	57	58.8	58.8	58.8
	6+	40	41.2	41.2	100.0
	Total	97	100.0	100.0	

Table 4. Constructivist and non-constructivist teachers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Non-Constructivists	44	45.4	45.4	45.4
	Constructivists	53	54.6	54.6	100.0
	Total	97	100.0	100.0	

Table 5. Gender Belief Category

			Belief Category		
			Non_constructivis	Constructivis	Total
gender	male	Count	21	51	72
		% within gender	29.2%	70.8%	100.0%
	female	Count	9	16	25
		% within gender	36.0%	64.0%	100.0%
Total		Count	30	67	97
		% within gender	30.9%	69.1%	100.0%

Table 6. Age of teachers belief Category

			Belief Category		
			Non-constructivist	Constructivist	Total
Age of respondent	below 40	Count	16	47	63
		% within age of respondent	25.4%	74.6%	100.0%
	40 and above	Count	14	20	34
		% within age of respondent	41.2%	58.8%	100.0%
Total		Count	30	6	97
		% within age of respondent	30.9%	69.1%	100.0%

Table 7. Years of teaching experience belief category

			BELIEF		
			Non-Constructivist	Constructivist	Total
No of years of teaching	1-5	Count	20	38	58
		% within no of years of teaching	34.5%	65.5%	100.0%
	6-10	Count	10	29	39
		% within no of years of teaching	25.6%	74.4%	100.0%
Total		Count	30	67	97
		% within no of years of teaching	30.9%	69.1%	100.0%

The kinds of examples used were from Ghanaian JHS mathematics textbooks and BECE mathematics past questions. His approaches to teaching were appropriate procedures to solve problems.

The female teacher among the constructivists teachers exhibited teacher dominated lessons. Though in one of her lessons students' participation was good, the three lessons were teacher centered. She depended on the.Ghanaian JHS mathematics textbooks for examples. She engaged the students in solving a lot of BECE past questions. The third teacher in constructivists' category had more teacher dominated lessons than the two teachers. Students were seen as passive learners. Communication between teacher and students was one way, as the teacher was the center of affaires in the lesson delivery. None of his four lessons actually portrayed problem solving approaches as helping students identifying their views and ideas. He also depended on the Ghanaian JHS textbooks and BECE past questions for his examples.

The problem solving views as stated by Ernest,(1991) that teachers holding problem solving or social constructivist views of mathematics would see their classroom role as a facilitator, providing stimulating problems for investigation and building an environment in which students may discuss their emerging understandings; were not demonstrated by the two constructivists' teachers during their teaching. And also the questions that most students forget mathematics procedures and so it is best to let them work out their own methods first; it is essential for students to explore their own ways of doing mathematics questions before being shown the teacher's methods; and all mathematics questions should challenge students to think about what mathematics they know and how they can use it which they agreed on were not integrated in their teaching.

This may be due to constraints such as: fixed curricula, time pressures, external examinations, and school or departmental rules and standards, provide competing incentives for the guidance of practice, there is evidence that teachers' instructional practices do reflect their visions of subject.(Ernest,1991).

One can, on the basis of the classroom observations analysis of the constructivists' teachers, therefore say that, the Ghanaian JHS teachers do not actually integrate the positive beliefs they hold about problem solving into their mathematics teaching.

Analysis of observed mathematics lessons of the non-constructivists' teachers

In order to answer the third research question ;What are differences in classroom practice of JHS teachers who believe in the problem solving approach to teaching mathematics from those who do not, the researcher observed two non-constructivists teachers who were sampled from non-constructivists category.

The female teacher in non- constructivists' category lessons' were fewer teacher dominated. She sometimes asked students to solve problem on the chalkboard but could not allow students to express themselves fully before she could come in. She directed most of her questions to the brilliant students in the class. Most of her exercises were from the textbook. Her lessons were teacher-centered created instructional environment; teach mathematics as rules to be memorized.

The second teacher in this category lessons' were all about going through Ghanaian JHS textbooks and BECE past questions. He portrayed mathematics as a one way subject (mathematical knowledge transmitted from the teacher to the students). He did not create opportunities for students to explore their ideas and to test their strength in explaining observable fact. He presented the lessons to students in a way of concentrating on facts and skills, related to numbers which generally featured paper and pencil activity.

From the classroom observations of the constructivists' teachers, only one teacher out of the three teachers demonstrated some amount of problem solving strategies in his teaching. His strategies could be said to be in line with Polya's heuristics such as, students understanding the problem; devising a plan; carrying out the plan and looking back. He demonstrated characteristics of problem solving approaches in the literature by Lester et al (1994) which include interactions between students/students and teacher/students; and teacher accepting right/wrong answers in a non-evaluative way.

However, the two constructivists' teachers did not use the problem solving strategies. They demonstrated what Raymond (1993) in the literature observed that, agreement between conceptions of mathematics and instructional styles with six beginning Elementary School teachers, where practice was not entirely consistent with beliefs; teachers possessing problem solving images explained deviations from their desired approaches as accommodations to time constraints and lack of resources.

The two non-constructivists' teachers, as whole demonstrated the non-constructivists strategies in their teaching. Their teachings were in line with what Nahid, (2002) stated that, teachers holding the non-constructivists (absolutists) views about mathematics and its teaching and learning are more likely to create teacher-centered instructional environment, teach mathematics as rules to be memorized, and portray mathematics as an infallible discipline, concentrating on facts and skills related to numbers which generally feature paper and pencil activity.

From the classroom observations of the five teachers the researcher observed, one can therefore conclude that, there are no distinct differences in classroom practices of JHS teachers who believe in the problem solving approach to teaching mathematics from those who do not. This is because the two

constructivists' teachers demonstrated non-constructivists approach to teaching mathematics which is different from their beliefs.

TIMSS-2003 report indicated that in Ghana, 89% of the JHS2 students were taught mathematics by male teachers and 11% by female teachers. Considering TIMSS- 2003 report, a question one would like to ask is that, will there be likelihood that female teachers who hold problem solving beliefs will be less than their male counterpart?

Table 5 below displays the proportion of female and male Ghanaian JHS teachers' who hold problem solving beliefs about mathematics teaching.

In the table 5 above the analysis, revealed that, of 97 respondents, 72 were male mathematics teachers and 25 female mathematics teachers; of the 72 male teachers, 51 have constructivists' views and 21 have non-constructivists' views, representing 70.8% and 29.2% respectively. For the 25 female teachers, 16 have constructivists' and 9 have non-constructivists' views, representing 64.0% and 36.0% respectively Proportionally, it is observed that female teachers who hold problem solving views are not significantly higher than the male counterparts. This means, though the number of female teachers in mathematics classrooms in Ghanaian JHS is lower than the male teachers, their beliefs in the problem solving approach are not significantly different from the male. Out of a total of 30 non-constructivists' teachers' group respondents, 21were male teachers and 9 were female teachers. And also out of a total of 67 constructivists' teachers' group respondents, 51 were male teachers and 16 were female teachers.

Chi-square was used to analyse the hypothesis that, the proportion of female Ghanaian JHS teachers who hold problem solving beliefs about their mathematics teaching is significantly higher than their male counterparts. With a chi-square test statistics of χ^2 (1, N=97) =0.406 and a ρ>0.05 the result is not significant. This means that problem solving beliefs don't depend on gender. From table 5, greater number of males and females Ghanaian JHS teachers holds problem solving beliefs about their mathematics teaching.

The results can be said to confirm what Fennema (2000) said that females appear to hold more negative values about mathematics and their own relationship to mathematics than do males but there is some evidence that these differences are decreasing.

TIMSS-2003 again reported that about 50% of the JHS students were taught by mathematics teachers who were 29 years or younger, 30% by teachers between 30 and 39 years, 13% by teachers between 40 and 49 years and 7% by teachers who were 50 years or older. That is, majority of the JHS2 students (80%) were taught by mathematics teachers were in their twenties and thirties. One can say that about half of the students were taught by young and inexperience teachers in their twenties.

The researcher would like to find out whether the proportion of Ghanaian JHS teachers below 40 years who hold problem solving beliefs is higher than their counterparts of the age 40 and above. Table 6 of the study displays proportion of Ghanaian JHS teachers' below 40 years of age and above 40 years of age who hold problem solving beliefs about mathematics teaching.

Available information from table 6 indicates that out of 97 respondents sixteen (16) of them below the age of 40 were non-constructivists and forty-seven (47) of them constructivists, representing 25.4% and 74.6% respectively. Mathematics teachers at the age of 40 and above; 14 were non-constructivists and 20 of them were constructivists, representing 41.2%% and

58.8% respectively The age of mathematics teachers below 40 form the majority who believe in the problem solving view of teaching mathematics.

Out of a total of 30 non-constructivists' teachers' group respondents, 16 teachers were below 40 years of age and 14 teachers were above 40 years. And also out of a total of 67 constructivists' teachers' group respondents, 47 teachers were below 40 years of age and 20 teachers were above 40 years.

Chi-square was used to analyse the hypothesis that, the proportion of Ghanaian JHS teachers below 40 years who hold problem solving beliefs is significantly higher than their counterparts of the age 40 and above.

With a chi-square test statistics of χ^2 (1, N=97) =2.574 and a ρ>0.05) the result is not significant. This means that problem solving beliefs don't depend on age. From table 6 greater numbers of Ghanaian JHS teachers below 40 years and above 40 years of age holds problem solving beliefs about their mathematics teaching.

Though TIMSS-2003 report indicated, that, majority of the JHS 2 students (80%) in Ghana were taught by mathematics teachers were in their twenties and thirties, their problem solving views do not differ from mathematics teachers in the forties.

In the table 7 above the analysis, revealed that, of 97 respondents, 20 were non-constructivists 'and 38 were constructivists' teachers with teaching experience from 1-5 years. For the teachers with 6-10 years teaching experience, 10 were non-constructivists and 29 were constructivists. The constructivists' teachers according to table 7, were 67 out of 97 respondents, an indication that majority of Ghanaian JHS mathematics teachers in respect of teaching experience hold problem solving beliefs approach to teaching of mathematics.

With a chi-square test statistics of χ^2 (1, N=97) =0.853 and a ρ>0.05 the result is not significant. This means that problem solving beliefs don't depend on teaching experience. From table 7 greater numbers of Ghanaian JHS teachers with teaching experience from 1-5 years and 6-10 years teaching experience hold problem solving beliefs about their mathematics teaching. This means that teaching experience does not influence problem solving belief approach to teaching of mathematics.

Main findings

The results of the questionnaires items revealed that majority of the Ghanaian JHS teachers held positive beliefs about mathematical problem solving. That is, their beliefs are in line with the first four standards by NCTM (1989) (Mathematics as Problem Solving, Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections). This finding might be an indicator of the significant improvements and innovations in the Ghanaian mathematics curriculum and also the District Teacher Support Team (DTST) workshops that are organized by the GES Inspectorates.

However, their beliefs were not in line with the problem solving approach in teaching and learning in mathematics classrooms. These were revealed after the three constructivists' teachers were observed. Two of them could not integrate their beliefs in the teaching and learning of mathematics, as their lesson presentations were teacher-centered created instructional environment; teach mathematics as rules to be memorized. This may mean that Ghanaian JHS mathematics teachers hold problem solving beliefs but do not integrate such beliefs into their mathematics teaching. That is, their problem solving beliefs do not influence their approaches to teaching mathematics.

Furthermore, the classroom observation made by the researcher on two non-constructivists' teachers revealed that

their beliefs actually influence their teaching. Their lesson presentations were teacher-centered instructional environment; teach mathematics as rules to be memorized in their lessons presentations. This is evidence that there are no differences in classroom practice of JHS teachers who believe in the problem solving approach to teaching mathematics from those who do not.

In addition, from the analyses of the three hypotheses stated indicated that, gender, age and teaching experience of Ghanaian JHS mathematics teachers don't influence their problem solving beliefs approaches to teaching mathematics.

Discussion

The analysis of the questionnaires revealed that, in general most teachers held positive beliefs in problem solving approaches in mathematics classrooms. Majority of these teachers who believe in problem solving approaches in mathematics classrooms are below the age of 40 years. This is an indication that the problem solving issues mostly initiated by NTCM (1989) can be said to be having positive results in the mind of Ghanaian JHS mathematics teachers. In the literature, it suggested that one of the aims of teaching through problem solving is to encourage students to refine and build onto their own processes over a period of time as their experiences allow them to discard some ideas and become aware of further possibilities (Carpenter, 1989).

In addition, it recommended that the focus is on teaching mathematical topics through problem solving contexts and enquiry-oriented environments which are characterized by the teacher "helping students construct a deep understanding of mathematical ideas and processes by engaging them in doing mathematics: creating, conjecturing, exploring, testing, and verifying" (Lester, et al,1994, p.154).

The constructivist beliefs hold by the teachers has some influence on their classroom practices as some of the teachers exhibited the problem solving strategies in their lessons delivery during researcher's classroom observations. Though these JHS teachers believe in problem solving approaches, classroom observations revealed that these teachers do not actually integrate their beliefs into mathematics teaching.

The non-constructivists teachers' classroom practices were manifested in some of their lessons. This was observed as these teachers depended a lot on the textbook and BECE examinations past papers as their sources of materials for teaching mathematics. The researcher also observed that most teachers are not creative in their classroom practices. That is, teachers do not depend on other material apart from the textbook. Though the textbooks are written to cover the problem solving approaches, students may find it difficult to relate their learning outside the classrooms if teachers do not use problem solving strategies in their lesson delivery. From the classroom observation based on teachers who do not hold problem solving view revealed that these beliefs influence their lessons delivery as they could not exhibit any of the problem solving strategies.

Some of the reasons why teachers adopt the absolutes way of teaching the subject, may be too much activity in the school curriculum that gives way to little time to be spent in classroom practices. Another reason may be large number of students as compare to the size of the classroom that prevents classroom activities to be carried out properly. External examination pressure may be another reason that compels teachers to teach instrumentally. Mathematics teachers can perform efficiently if adequate teaching/learning materials are available.

Recommendations

The NCTM (1980) recommends that problem solving should be the focus of school mathematics. Implementing a problem-based curriculum is a slow and challenging process.

The researcher is therefore of the view that sufficient time must be given to teachers to become familiar with the new curriculum and learn new instructional approaches. . Mathematics instruction should shift from the transmission model to transaction model, in which the teacher allows the class to engage in critical discussion of mathematical ideas. Mathematics teachers during their lessons deliveries should allow students to write their own mathematical questions or problems and find answers to them. Alternatively, teachers should encourage students to share their questions or problems and present the solutions to the class and get feedbacks from their fellow students while teacher supervises.

Teachers should be aware that beginning students should be best introduced to problem solving by acting out problems, drawing pictures, checking for extra information, reasoning logically, making lists and tables, using simple graphs, and writing number sentences.

In addition, teachers should encourage students to show how they use various strategies to solve a problem, instead of just writing what the answer was. Formulas still have their place: many real applications depend upon them. They are, however, best reserved for the later grades, when students understand their appropriate use. Furthermore, teachers should be sure problems are problems. This is to remember that one student's problem may be another student's exercise. They should be sure that even bright students get a chance to work on really challenged problems.

Teachers should be resourceful enough to enable them change their mode of teaching mathematics. WAEC should also change their mode of setting mathematics questions. Seventy percent (70%) of mathematics questions should be challenging enough to make students think beyond exercise levels.

In order to gradually challenge teachers' negative beliefs about mathematical problem solving, adequate educational interventions should be planned and implemented in teacher education programs.

Finally teachers must encourage students to practice the reflective process that helps organize new knowledge and to apply problem solving beyond the classroom. Students who see problem solving as a valuable and creative activity are likely to build a truer and stronger concept of mathematics. .

Suggestions for further Research

The focus of this study was on Ghanaian JHS teachers' practice of the problem solving approaches in teaching mathematics. Although students appear as characters in the narratives of classroom experience, they are there primarily as foils for the teacher. There is a need for studies that shift this focus and examine the learning of students in classrooms lead by teachers.

The study into influence of Ghanaian Senior High Schools (SHS) teachers' and students' problem solving beliefs on their approaches to teaching and learning mathematics respectively is suggested to help differentiate between teachers' beliefs and that of the students' beliefs. Another suggested study can be: The cultural dimension of the mathematics curriculum in Ghana: Teacher beliefs and teacher practices.

Conclusion

The findings of the research show that the teachers' expressed beliefs are clearly in line with NCTM (1989, 1991) policies; one of the general aims of JHS mathematics syllabus; one of the topics in College of Education mathematics syllabus

and the objectives of District Teacher Support Team (DTST) workshops in Ghana. Teacher responses to the questionnaire indicated that the teachers are aware of problem solving in mathematics. From the analysis of the results of the questionnaires there is clear evidence that majority of the Ghanaian JHS teachers believe that problem solving approach should be the practice in teaching of mathematics.

However, these beliefs were not implemented or manifested in their classroom practices. This means that Ghanaian JHS mathematics teachers hold problem solving beliefs but do not integrate such beliefs into their mathematics teaching. That is, their problem solving beliefs do not influence their approaches to teaching mathematics. These were revealed after the three constructivists' teachers were observed taught four mathematics lessons each at different days. And also, the classroom observation made by the researcher on two non-constructivists' teachers revealed that their beliefs actually influence their teaching. Their lesson presentations were teacher-centered instructional environment; teach mathematics as rules to be memorized. This is evidence that there are no differences in classroom practice of JHS teachers who believe in the problem solving approach to teaching mathematics from those who do not.

Furthermore, gender, age and teaching experience of Ghanaian JHS mathematics teachers don't influence their problem solving beliefs approaches to teaching mathematics. But, the problem solving beliefs of the mathematics teachers in Junior High Schools in Ghana are not manifested in their classroom practices. One would have expected according to the beliefs to influence their approaches to teaching mathematics. It is therefore necessary for the GES to intensify the DTST workshops to enhance the problem solving approaches to teaching of mathematics.

References

B.E.C.E. (2002, 2003, 2005) *Chief Examiner's Report on Mathematics*

Bishop, A. (1985). The social construction of meaning- a significant development for mathematics education; *For the Learning of Mathematics*; 5(1), 24-28

Borg, W. R., Gall, J. P. & Gall, M. D. (1993). "Applying Educational Research: A

Child, D., (1970) The Essential of Factor Analysis, London, Holt, Rinehart & Winston

Clark, C.M. & Peterson, P.L. (1985) Teachers' thought processes.In M.C Wittrock (Ed.), *Handbook of research on teaching* (pp. 255-296) New York: Macmillan

Cobb, P., (1986) Contexts, goals, beliefs and learning Mathematics; *For the Learning of Mathematics,* 6(2), 2-9 No 1, 41-47

Cockcroft, W.H. (Ed.) (1982). *Mathematics Counts.* Report of the Committee of Inquiry into the Teaching of Mathematics in Schools, London: Her Majesty's Stationery Office..Companies Inc. New York.

Cozby, P.C. (2001) Methods in Behavioral Research 7th edn. McGraw-Hill Companies, Inc; 1221 avenue of the Americas, New York, NY10020.

CRDD-Curriculum Research and Development Division of GES, (2004), *Mathematics Syllabus for Junior Secondary Schools.* Tema Ghana:GPC Tema Ress

CRDD-Curriculum Research and Development Division of GES, (2007), *Mathematics Syllabus for Junior Secondary Schools.* Tema Ghana:GPC Tema Ress

Doyle, J. K. (2004). Introduction to Survey: Methodology and Design. Worcester

Ernest, P. (1992). The nature of mathematics: Towards a social constructivist account. *Science & Education*, 1(1), 89-100.

Ford, M.I., (1994) Teachers' Beliefs about Mathematical Problem Solving in the Elementary School. *School Science and Mathematics vol 9* (p, 314)

Geelan, D. R. (1997, Mar). *Impressionistic tales, surrealistic tales: Exploring critical classroom events through fictionalised stories*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Chicago, IL.

Ghana Human Development Report by United Nation (2000) Unimax publication

Grouws, D. A (1996*). Critical Issues in Problem Solving Instruction in Mathematics*. In D. Zhang,T.Sawanga,&J.P. Becker(Eds), Proceedings of the China-Japan-US. Seminar on mathematical education(pp.70-93). Carbondale,IL:Board of Trustees of Southern Illinois University.

Harris, M. .B. (2002). Basic Statistics for Behavioral Science Research. Viacom Company,

Hersh, R. (1986). Some proposals for revising the philosophy of mathematics In T. TYMOCZKO (Ed*), New Directions in the Philosophy of Mathematics* Boston

Keynes, P. (2007) *Teacher's Mind Resources* Available online at mhtml:file://A:\Teacher%20Beliefs.mht

Kilpatrick, J. (1987) 'What Constructivism might be in mathematics education" In Bergeron,J.C.,Herscovics,N.and Kieran, C (eds) *Proceedings of the Eleventh International Conference for the Psycholgy of Mathematics. Montrea*

Kloosterman, P. (1996) Students' Beliefs about Mathematics: A Three-Year Study. *The.-*

Nahid, G. (2002) Teachers' Conceptions of Mathematics and their Instructional National Council of Teachers of Mathematics (1980); *An agenda for action: Recommendations for school mathematics of the 1980's*. Reston, VA: author.

National Council of Teachers of Mathematics (1998, Oct.). Principles and Standards for School National Council of Teachers of Mathematics (NCTM) (1989) *Curriculum and Evaluation Standards for School Mathematics,* Reston, Virginia: NCTM

National Council of Teachers of Mathematics (NCTM). (1991*).Professional standards for teaching mathematics.* Reston,VA: Author Needham Heights.

Pehkonen, E. (1999) Beliefs as an obstacle for implementing an educational change in problem solving .*International Journal of mathematics Education in Science and Technology 30(3), 234-267*

Polya, G. (1980). 'On solving mathematical problems in high school' In S. Krulik (Ed); *Problem Solving in School Mathematics* (pp.1-2). Reston, Virginia: NCTM

Polya, G., (1957) *How to solve it;* (2nd Ed) Garden City, N.J., Doubleday Anchor Practical Guide," (3rd Ed). White Plains, NY: Longman publishing Group

Randal, C and Lester, F. (1984) Teaching Problem Solving. Dale Seymour Publication

Schoenfeld, A. H (1989).Explorations of Students' Mathematical Beliefs and Behavour. *Journal for Research in Mathematics Education*,20(4),338-355.

Thompson, A. G., (1992) *Teachers' Beliefs and Conceptions: A Synthesis of the Research*. In D. A.Grouws (Ed), *Handbook of Research on Mathematics Teaching and Learning,* (pp. 127-146) New York: Macmillan Publishing Company Trends in International Mathematics and Science Study (TIMSS, 2003)

Van Zoest, L., Jones, G. and Thornton, C. (1994) 'Beliefs about mathematics teaching held by pre-service teachers involved in a first grade mentorship program' *Mathematics Education Research Journal* 6(1): 37-55.