

The State of Mathematics Education at the Senior High School Level in the Sekondi-Takoradi Metropolis

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Abstract:- The study sought to investigate the state of teaching and learning mathematics at the Senior High School level in the Sekondi-Takoradi Metropolis. Stratified sampling and the census sampling techniques were used to select the sample for the study. The study considered 26 mathematics teachers and 90 students from three Senior High Schools. The quantitative data were analysed using descriptive statistics. The findings revealed that most of the mathematics teachers had not received professional training in mathematics education. Also, it was revealed that constructivists approach was used in teaching mathematics nevertheless, poor usage of ICT in the teaching and learning of mathematics was also exposed. Finally, it was discovered that there was enough teaching and learning resources, although technological resources were inadequate. One key implication of these findings is that there is the need for school administrations to provide adequate technological tools and resources that will enhance the teaching and learning of mathematics and increase the use of ICT materials in the mathematics classroom.

Keywords:- State of mathematics, Perception, Teaching Resources, Mathematics Education, Teachers' Teaching Practices.

I. INTRODUCTION AND STATEMENT OF THE PROBLEM

The quality of education in both developed and developing countries is a pertinent issue of concern which is increasingly gaining policy attention. At international, regional and national levels, efforts are being made by stakeholders to bolster the quality of education in their countries. The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2005) has recommended therefore, that "quality education should not only be made universally available but also more relevant to the socio-economic needs of nations". This declaration affirmed that quality education should be seen as a prerequisite for attaining the ultimate goal of equity. The reason is that extending access by itself is completely inadequate for education to make a full contribution to the development of the society and the individual. (UNESCO, 2005). In light of this, the World Bank (2007) identifies and continues to maintain that equitable access to high-quality secondary education is a key element that enhances the economic

development of nations. Knowledge in mathematics and science is regarded as the key component for growth in virtually all spheres of life. It is quite evident, that without any knowledge and skills in these fields there can literally be little or no practical advance in any sphere of human life. This has necessitated various countries concerned with development to place much emphasis on the teaching and learning of mathematics. Dede (2019) discovered that relevance of mathematics was a similar reason among students when he investigated into why mathematics is valuable for Turkish, Turkish immigrant and German students. Mathematics continues to hold a critical position throughout the school system and is a key component of the curriculum in virtually all nations around the world (Keith, 2000). In a nutshell, Keith (2000) reiterated that mathematics is also regarded as a crucial field of study, both in its own capacity and because of its significant links to various disciplines including the sciences, social sciences, technology, healthcare and engineering.

Consequently, the way in which students experience mathematics in schools as well as the underperformance of students in mathematics throughout the past years is a major issue of concern in almost every part of the world. For instance, despite the government's attempts, studying mathematics has still not experienced much reform in how it is organized and delivered, and has led to consistently low rates of performance among high school mathematics students (see for example Ottevanger, Van den Akker, & de Feiter, 2007; Mullis, Martin, & Foy 2008). It has been asserted that the most commonly employed technique in teaching and learning mathematics is the teacher-centered method, wherein teachers do much of the talking and analytical activity, whereas students become passive receivers of the information presented (Ottevanger et al., 2007). Explaining further, Ottevanger et al. (2007) reported that the teachers mainly dominates during mathematics instruction when this approach of teaching is used (while students are silent). This method also encompasses; copying lots of notes for students, whole class teaching, and barely involve hands-on activities. In several circumstances, teachers hurry to quickly teach all the topics so as to complete the syllabus for examinations, instead of seeking in-depth teaching and learning where students will have the opportunity understand the concepts been taught (Ottevanger et al., 2007). These teacher-centered teaching methods have been critiqued for not preparing students to achieve the highest levels of achievement in mathematics

(Hartsell, Herron, Fang, & Rathod, 2009). Likewise, Baker (2008) notes that many other students are unable to conceptualize and implement their problem-solving skills while addressing daily problems they encounter. Consequently, enhancing mathematics instruction has become a subject of great interest in almost all parts of the world throughout the last three decades.

In Ghana, a number of initiatives have been introduced by government and other stakeholders in the education sector to encourage efficient and effective mathematics instruction with the intention of making the subject more enjoyable and exciting to study (Anku, 2008). For example, the Ministry of Education (MoE) reviewed the teacher education curriculum in 2003 in collaboration with the Teacher Education Division (TED) and converted all Initial Teacher Training Colleges (ITTC's) to the diploma awarding institutions with the aim of improving teachers' knowledge of content and pedagogical skills in the numerous areas of study. Teacher training colleges were elevated as accredited institutions to award degrees in 2018 in order to improve the quality of teachers produced in the country. Moreover, in partnership with several other international organizations including United States Agency for International Development (USAID), Japan International Cooperation Agency (JICA) and Department for International Development (DFID), Ampiah Akwesi, Kutor, and Brown-Acquaye, (2000) reports that the Ministry of Education, have also shown remarkable commitment by undertaking initiatives to strengthen mathematics and science education at the primary, secondary and tertiary levels. The government introduced a new mathematics curriculum in September 2007 which demonstrated a paradigm shift in the country's mathematics education and other subjects in the school curriculum. While there is no agreement as to what actually constitutes the ideal mathematics teaching and learning activities in Ghana, the 2007 curriculum presents new concepts and orientations centred on constructivism philosophies (MoESS, 2007).

Studies in Ghana, (see for example; Eshun, 2004; Eshun-Famiyeh, 2005) also revealed that mathematics remains one of the most challenging subjects in the curriculum of the school; this particular perception is manifested in the performance of the students over the years. Obviously the performance of students in WASSCE (2017) declined in core mathematics particularly in comparison with that of 2016. For some time now, the ways employed in teaching and learning mathematics in Ghana, as well as how to improve the mathematics instruction in schools at all levels has been the subject of national enquiry. In reference to this, several scholars (e.g. Eshun, 2004; Mereku, 2004; Eshun-Famiyeh, 2005), educators as well as other academic stakeholders carried out observational research on the issue and the path forward. In addition, comparably a handful of studies have looked at mathematics teaching and learning within the Ghanaian context, specifically, in the Sekondi-Takoradi metropolis. Whereas a number of studies (see for example Eshun, 2004; Mereku, 2004; Eshun-Famiyeh, 2005) have

investigated classroom activities in mathematics in the Cape Coast Metropolis at the primary and junior secondary levels, very little is known about the state of the teaching and learning of mathematics at the senior high school level in the Sekondi-Takoradi Metropolis, thus, this study seeks to investigate into the state of mathematics education in the Sekondi-Takoradi metropolis. The research therefore aims to examine the status of variables such as the quality of teachers, methods used in teaching mathematics, students' perception about the teaching practices of their teachers, resources including technological tools available for teaching and learning mathematics in this era of massive government support for the senior high schools in Ghana.

II. RESEARCH QUESTIONS

The specific research questions addressed in this research comprised:

- What is the background qualification and years of teaching experience of mathematics teachers at the Senior High School level?
- What instructional methods are used for teaching mathematics in the Sekondi-Takoradi Metropolis?
- What are students' perception of their mathematics teachers' teaching practices?
- What is the extent of coverage of content of mathematics syllabus?
- What resources are available for teaching mathematics at the Senior High Schools?

III. DESIGN AND INSTRUMENTATION

The descriptive survey design was employed for this study. The descriptive survey design, as said by Gay (1992), is an effort to gather data from members of the population to establish the present status of that group with regards to one or more variables. This justifies the choice of descriptive survey design by the researchers because in this study, the researchers drew out samples with the aim of making generalisations about the population on the basis of the sample analysis. Also, Kothari (2004) accentuated that research studies concerned with specific predictions, with narration of facts and characteristics concerning individual, group or situations are all examples of descriptive research studies. This exactly was the primary focus of the study, hence adopting the descriptive survey design. Questionnaire was the main instrument used for data collection for the study. Two separate forms of instruments of which both were closed ended for teachers and students were developed and used for data collection. The questionnaires were divided into two aspects (Sections A and B). Section A, which was made up of four items required respondents to provide their background information especially their educational qualification and section B, comprised 15 items which aided in answering the research questions.

IV. SELECTION OF PARTICIPANTS

The population for the study comprised mathematics teachers and second year students in the public SHS in Western Region of Ghana, specifically, the Sekondi-Takoradi metropolis. Second year students were targeted because these students would have experienced mathematics teaching for almost two years since final year students were busy preparing for their final examinations. The sampling procedure for this study was in two phases. The schools that were involved in the study were selected based on the Ghana Education Service categorisation of schools (Ministry of Education, 2009). These categories form the strata where simple random sampling technique was used to select a school from each stratum within the Sekondi-Takoradi Metropolitan Assembly (STMA). A school was randomly selected from this number of categorizations in order to increase the maximum variation of the study sample and to have a fair idea of what is happening in terms of the research focus. The census sampling method was used to select all the mathematics teachers in the 3 selected schools, since the population was small, data was collected from all the mathematics teachers in the schools involved.

V. VALIDITY AND RELIABILITY OF INSTRUMENT

A team of lecturers from the department of mathematics and ICT education, University of Cape Coast, who are well versed in the issues of mathematics education were deployed to critically scrutinise the research instrument to ensure that the items on the questionnaire have a logical link (face validity) with objectives of the study. It is equally important to note that, the items on the research instrument were subjected to further scrutiny to ensure that it covers the full range of the issue being measured which is the content validity of the instrument. Kumar (2011) describes reliability of an instrument as the quality of a measurement procedure that provides repeatability and accuracy. In order to certify that the research instrument has the ability to produce consistent measurements each time, internal consistency was used to measure the reliability of the instrument. A Cronbach alpha of 0.742 was recorded which indicates a strong reliability for the instrument that was used for the study. To support

this assertion, Jackson (2015) stated that a Cronbach's alpha of 0.7 or above signifies strong reliability for the instrument.

VI. DATA COLLECTION PROCEDURE

Collection of data for the study started with negotiating access to the schools. Permission was sought from the school authorities in the region. An official letter of introduction was sent to these schools which were eventually selected for the study. Students were made to complete the questionnaire at a sitting. The completed questionnaires were collected the same day. The teachers' questionnaires were also administered to the mathematics teachers in all the three selected SHSs for the study. In all 26 mathematics teachers in the 3 Senior High Schools completed the teachers' questionnaire whereas 90 students were made to complete the questionnaire at a sitting.

VII. DATA ANALYSIS AND DISCUSSION

To be able to identify the state of mathematics education in the STMA, the data collected was processed and analysed. After screening the completed questionnaires for errors, they were coded and data was entered for the analysis. Descriptive statistics (frequencies, percentages, mean and standard deviation) were the statistical computations that were performed during the data analysis stage.

A. Results

➤ Research Question One

- What is the background qualification and years of teaching experience of mathematics teachers at the Senior High School level?

The first research question sought to collect information about the teachers' professional qualifications and experience of teaching mathematics. The purpose of this question was to ascertain the number of teachers who have undergraduate degrees or postgraduate degrees in education or non-education but nonetheless were teaching in the Sekondi-Takoradi Metropolitan Assembly (STMA).

Background Qualification			Teaching Experience	
	Frequency	Percent (%)	Years of Teaching	Frequency
M.Ed.	8	30.8	0-5	0
1st Degree (BSc/BA)	11	42.3	6-10	15
1st Degree (Ed.)	7	26.9	11-15	11
Total	26	100.0	≤16	0

Table 1:- Level of Qualification and Experience of Mathematics Teachers

The results indicate in Table 1 revealed that, out of the 26 teachers who participated in the study, 15 representing 57.7% were have a background qualification in mathematics education. On the other hand, 11(42.3%) of the teachers involved in the study had no background training in mathematics education. Also, the results revealed that 15 out of the 26 mathematics teachers have taught mathematics for 6-10 years whereas 11 teachers have taught mathematics for 11-15 years. This result shows that 42.3% of the teachers are more experienced as against 57.7% of the mathematics teachers.

➤ *Research question two*

- What instructional methods are used for teaching mathematics in the Sekondi-Takoradi Metropolis?

This research question sought to find out from the mathematics teachers the instructional methods they use for teaching mathematics. To answer this research question, teachers were asked to tick in the appropriate column for response to the statements where 5=Always, 4=Most of the times, 3= sometimes, 2= not often, 1= never. Frequencies and percentages were used to analyse the results. It was revealed that most of the teachers representing 20(76.9%) “Not often” teach mathematics through teacher centred approach. On the contrary, 15(57.7%) of the teachers ‘Always’ and 11(42.3%) of the teachers ‘Most of the time’ teach mathematics through student centred approach. On the Teacher feedback and guidance, all the teachers agreed to always and most often, giving students constructive feedback and guidance. Also, 16(60%) and 10(40%) of the teachers always and most of the times respectively allow students to ask questions. In a nutshell, majority of the teachers expressed a poor usage of ICT in the teaching and learning of mathematics, as all the teachers (100%) agreeing to the fact that they have never looked for information on the internet at school to teach mathematics, one respondent representing 3.3% indicated that he/she does not often use computers to model mathematical concept and the remaining respondents representing 96.7% never use the computers to model mathematical concept.

➤ *Research question three*

- What are students’ perception of their mathematics teachers’ teaching practices?

The purpose of this research question was to find out from the students their perception of their teachers teaching practices. To answer this research question, students were asked to tick on a four-point Likert scale in the appropriate column for response to the statements where they: Strongly Disagree (1), Disagree (2), Agree (3), Strongly Agree (4). Frequencies, percentages, mean and standard deviations were run to explore the students’ perceptions of their teachers teaching practices. On the students’ perception of their teachers’ teaching approaches, all the students strongly agreed to the fact that their teachers use the constructivists approach to the teaching and learning of mathematics. As most of the students, 48(53.3%) and 42(46.7%), strongly agreed and agreed respectively that their teachers always expect them to work on their own asking question from time to time. From the results, the overall and individual means and standard deviation scores

provide evidence that shows that on the whole, SHS students from the selected schools perceived their teachers’ teaching practices to be positive. For example, item 16 was used to find out whether the teacher normally marks students’ exercises and discusses results with them, with mean of 3.48 and standard deviation of 0.50 indicates that teachers enact this practice. An overall mean of means (M=3.45, SD=0.75) of the items suggests that students have positive perception and agrees that their teachers make use of constructivist teaching practices during classroom instruction in mathematics. On the usage of computers and other technological tools in teaching mathematics, responses of the students affirmed the earlier findings indicated by the teachers. The results indicated that 46(51.2%) disagreed and 43(47.8%) of the student respondents strongly disagreed to the item which indicated that their teachers use computers to demonstrate mathematical concepts.

➤ *Research Question Four*

- What is the extent of coverage of content of mathematics syllabus?

The aim of this research question was to determine whether the mathematics teachers are able to cover what they are to expose their students to as indicated in the mathematics syllabus in a semester. Results are illustrated in Table 2.

Percentage of Mathematics syllabus coverage	Percentage of teachers
50%	3.8
60%	73.1
70%	23.1

Table 2:- Coverage of the senior high school Mathematics syllabus

Table 2 indicates that 1(3.8%) of the teachers are able to cover 50% of the mathematics syllabus, with a majority of the teachers, 19(73.1%), being able to cover 60% and the remaining 6(23.1%) of the teachers covering 70% of the entire mathematics syllabus for the Senior High School level. This result shows that teachers are not able to cover more than 70% the content of the Senior High School mathematics syllabus. It can be inferred from this finding that, most of the students may go into their final examinations without completing the entire mathematics syllabus.

➤ *Research Question five*

- What resources are available for the teaching and learning of mathematics at the senior high school level?

The primary purpose of this research question was to elicit response from the teachers about the availability of teaching and learning resources. Results depicted that, all the teachers agreed to having ‘enough’ mathematics syllabus, textbooks, library books, classroom furniture and chalk or marker. Again, from the results, almost all the teachers agreed to ‘Too few or little’ and ‘Not at all’ on the availability of computer resources such as projectors, computer software, computers with internet connectivity

for the teaching and learning of mathematics, as 57.7% and 42.3% of the teachers agreed to 'Too few or little' and 'Not at all' calculators respectively. This suggests that although Senior High School mathematics teachers in the selected schools have access to some teaching materials such as syllabus, textbooks, chalk/markers, they are not endowed with technological resources in order to use them in their mathematics instruction.

B. Discussion of results

In Ghana, there is a nationwide trend of having more teachers who are females than male teachers, particularly in elementary schools (Ampiah et al., 2000). Ironically, only eight (8) out of the 26 mathematics teachers who completed the questionnaire for the teachers were females. Though in the Metropolis there were as many male teachers as female teachers, the number of male mathematics teachers surpassed that of their female colleagues. The findings suggest that students generally concur that their teachers exhibit their teaching practices through student-centred approaches which are congruent with teaching practices reported by the teachers themselves. According to the results from the teachers' survey, for instance, most students agreed that their instructors aim to clearly explain information and keep students from making errors. Additionally, most students suggested that their instructors encourage them to discuss ideas with their classmates, which is also compatible with the teaching practices reported by the instructors. In Ghana's mathematics curriculum, the prescribed method of teaching is the use of cooperative learning through which students may work with their colleagues to build new knowledge and understanding and assume responsibility for their own learning (MoE, 2007). This shows that methodologically, teachers and students are doing what the syllabus entreat them to do. It confirms the argument of Hodson (1993) that the best way to learn mathematics is through constructive engagement with peers and the instructor. In addition, most respondents indicated that they use the recommended books which attempt to enhance the active engagement of students in the process of teaching and learning. Using these prescribed textbooks provides all learners with a level ground and also exists to serve as a source of reference material for both teachers and students (Vincent & Stacey, 2008). Nevertheless, given the value of textbooks, their explanations and tests, Vincent and Stacey (2008) argued that relying solely on textbooks have recognized an impact that they are weak in actual-life applications of mathematics hence, encouraging shallow teaching and learning.

Again, Willis (2010) argued that students' mistakes and misconceptions are regarded as essential, as teachers can always use errors to measure their teaching and students understanding. Agreeing to this finding, the findings suggest that the most of teachers try to give students' positive feedbacks on their errors and correct their mistakes.

In addition, teachers' and students' responses agreed to the poor usage of ICT in the teaching and learning of mathematics in the senior high school. Though the government of Ghana has advocated for the usage of ICT in the teaching and learning of mathematics, students and teachers in the STMA have not had much exposure to that effect. No teacher was found to have covered the mathematics syllabus wholly in a particular semester, and this clearly indicates student's inability to learn what they need to know before they graduate.

The teaching and learning resources were put into three categories; curriculum materials, mathematical tools, and buildings and furniture. The result from the data analysed revealed that majority of the schools had enough access to mathematics syllabus, textbooks and mathematics books in the library. The result indicated that classroom furniture's, were available in all the schools but the only problem was that they were not enough. This has caused students to stand or perch on chairs in the classrooms where you can count as many as eighty or more students in a class which was to contain thirty-five to forty students. Situations like this may not allow teachers to cater for the individual needs of the student since they cannot move round to supervise students' work in mathematics. This is so because the curriculum materials are the basic things a teacher needs to discharge his/her duties even if there are no classrooms because of their importance to education. Slattery and Carlson (2005) affirms the importance of a syllabus by saying that it is a contract between the teacher and the student and spells out what happens if a student fails to meet course expectations. As a contractual document, whatever is in it must be respected by both the teacher and student and for that reason, the Ghana Education Service and the ministry of education have made the syllabus available to all schools. With the available mathematics syllabuses in the schools, mathematics teachers will know what to teach at a particular point in time. It is not surprising to see mathematics textbooks available in all categories of schools because according to Rezat (2009), it is one of the most important teaching and learning resources. This will help students to learn a lot of things on their own and to do enough practice of what they have learnt in the classroom.

Averagely, all the schools in the various categories have enough curriculum materials for use by both teachers and students. Apart from chalk/marker board drawing instruments and mathematical set for students, which are highly available in all school categories, some of the other mathematical tools are simply available in less quantity and others not available at all in all the school categories. With the unavailability of most of the mathematical tools in schools, teachers will not be able to function at their best in terms of lesson delivery. All the students and teachers agreed to the poor state of the usage of ICT in the teaching and learning of mathematics, though it is iterated by Guerrero (2010) who indicated that one area that has seen dramatic growth in the influence and applications of ICT on the development of content and the evolution of instruction is mathematics and the American Association of

Mathematics Teacher Educators (2006) stated that “ICT has become an essential tool for doing mathematics in today’s world, and thus, it is essential for the teaching and learning of mathematics” (p. 1). This finding shows that there is an inadequate usage of ICT in teaching and learning of mathematics. However, the question to be asked in STMA is “How can teachers prepare their students for the world of work in this technological age where there are no computers, internet connection, and mathematics software to use in the teaching and learning of mathematics in our schools?”

VIII. CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS OF THE FINDINGS TO THE TEACHING AND LEARNING MATHEMATICS

Although this study is delimited to a small population, the key findings offer a suitable premise to draw some conclusion. The majority of mathematics teachers of the respective schools have received professional training in mathematics education. Though majority of the teachers involved in the study have background qualification in mathematics education quite a number (42.3%) have no background qualification in mathematics education. The implication of this is that the methodological approach of these 42.3% of teachers may have an impact on students learning as well as performance in the subject. Also majority having background training in mathematics education presupposes that they are more than capable of handling students conceptual and procedural difficulties to enhance teaching and learning. It is recommended based on the find that a study be conducted to find out whether two groups of teachers differ significantly in terms of knowledge and teaching.

Another conclusion from this study is the fact there are more experience teachers teaching mathematics in our schools as against novice teachers. This presupposes that novice teachers have the opportunity of tapping into the knowledge base of these experience ones to inform the way things are done in the mathematics classroom. It also means that at any point in time students can fall on the amalgams of the knowledge possessed by teachers to maneuver their way through any difficulty. It is however recommended that a study be conducted to ascertain whether there is any difference in the knowledge base of these two groups of teachers in teaching mathematics.

Also, the finding of this study show that teachers are adopting constructivist teaching practices in their mathematics instruction in Senior High Schools as enshrined in the Ghanaian mathematics curriculum. This implies that the objective of changing from the use of conventional methods in teaching mathematics to a more student-centred approach (constructivist practices) by curriculum developers is being achieved. It would be ideal however to find out from mathematics teachers their perception towards the constructivist teaching approach.

It can also be concluded that mathematics teachers in the metropolis in question are unable to complete the

content stipulated in the mathematics syllabus. The implication of this is that students would go into their final examination with some knowledge gap. It is recommended that a research is conducted to find out what causes mathematics teachers’ inability to complete the content stipulated in the syllabus vis-à-vis students pass rate in those areas in question.

From the study, it was clear that there are enough resources for the teaching and learning of Mathematics. However, there were little or no ICT resources for the teaching and learning of mathematics. The implication of this finding to the teaching and learning of mathematics is that teachers will not have the opportunity to inculcate technology in their mathematics instruction since the resources are not available. It also means that the issue of innovation in teaching and learning the subject in the metropolis is problematic. It recommended that government, non-governmental organisations as well as school authorities team up to provide the needed ICT resources in the schools to help inject innovation into the teaching and learning of mathematics. It is also recommended that in-service training be organised for mathematics teachers to empower them on the usage of ICT tools. It is suggested that a research should be conducted on the effects of the use of ICT in the teaching and learning of mathematics and its impact on students’ performance.

Generally, it would be ideal to conduct a research into the state of mathematics education across the country to addressing the issues confronting the teaching and learning of the subject.

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