UNIVERSITY OF EDUCATION, WINNEBA

INVESTIGATING DEMAND FOR SENIOR HIGH SCHOOL MATHEMATICS TEACHERS AND THEIR PREPAREDNESS TO IMPLEMENT AN INCLUSIVE EDUCATION MATHEMATICS CURRICULUM

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DOCTOR OF PHILOSOPHY

2022

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A thesis in the Department of Mathematics Education, Faculty of Science Education, submitted to the School of Graduate Studies in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy (Mathematics Education) in the University of Education, Winneba

MAY, 2022

DECLARATION

STUDENTS' DECLARATION

I, Richard Asumadu Oppong, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: ……………………………………

DATE: ……………………………………………

SUPERVISORS' DECLARATION

We hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of dissertation as laid down by the University of Education, Winneba.

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ACKNOWLEDGEMENTS

I am sincerely grateful to God Almighty for how far He has brought me. To God be the glory for the great things He has done and continues to do.

I wish to express my heartfelt appreciation to my supervisors; Prof. Samuel Kwesi Asiedu-Addo, Prof. Damian Kofi Mereku and Prof. Charles Kojo Assuah. I cannot get words enough to describe enough the various contributions you have made in my academic life.

I am at this point today because the entire family of mathematics education department of the university of education, Winneba has always been there for me. I wish I could enumerate individual contribution but space and time would not permit that. Cheer up my brother and my sister, your support has been recognized.

I am particularly grateful to my colleague mathematics teachers in senior high school especially those who were involved in the study. Without your participation and support, this work would never have seen light of day. I would also like to thank the headmasters of school that participated in the study for allowing me to use their schools.

I exclusively express my deepest appreciation to my family both in Buoho and Winneba, particularly my wife, Patricia Buabeng, for everything you have done for me. You actually do not know how much you mean to me. Mother, Nana, Ohemaa and Sweetie have been my greatest inspiration any time I see them with their usual smiles. My dear, I love you all.

The greatest joy of any teacher is to see students prospering and happy. My dear students I am what I am because of you. I am grateful to you and all. God bless you and keep you now and forever.

DEDICATION

To my dear wife, Patricia, and wonderful children, Richardson and Afua Kwartenmaa

TABLE OF CONTENTS

Contents **Page**

LIST OF TABLES

LIST OF FIGURES

Figure **Page**

LIST OF ABREVIATIONS

AC	Active Class
ASAC	Average Size of Active Class
ATCTL	Adjusted Total Current Teaching Load
ATTL	Adjusted Total Teaching Workload
BECE	Basic Education Certificate Examination
CRDD	Curriculum Research Development division
DTS	Double Track System
ETL	Excess Teaching Load
FCUBE	Free Compulsory Universal Basic Education
FSHS	Free Senior High School
GES	Ghana Education Service
GES-SPC	Ghana Education Service School Placement Curriculum
GPS	Global Positioning System
IE	Inclusive Education
IEMC	Inclusive Education Mathematics Curriculum
ITPP/C	Inclusive Teaching Practices from Pedagogical/Classroom Perspective Lens
ITPS	Inclusive Teaching Practices from Social Perspective Lens
JHS	Junior High School
KNUST	Kwame Nkrumah University of Science & Technology
LPPW	Learning Period Per Week
MAG	Mathematics Association of Ghana
MDGs	Millennium Development Goals
MM	Mixed Methods
MoE	Ministry of Education
MTP	Maximum Teaching Period
NABCO	Nation Builders Corps
NAC	Number of Active Class
NaCCA	National Council for Curriculum and Assessment
PTR	Pupil Teacher Ratio
RCS	Required Class Size
RTLW	Required Total Workload
SBA	School-Based Assessment

SEN	Special Education Needs
SEN/D	Special Education Needs and or Disabilities
SENPF	Special Education Needs Policy Framework
SHS	Senior High School
SPSS	Statistical Product for Service Solution
STR	Student Teacher Ratio
TCTL	Total Current Teaching Load
TNMT	Total Number of Mathematics Teachers
UCC	University of Cape Coast
UEW	University of Education, Winneba
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund
WASSCE	West Africa Senior School Certificate Examination

ABSRTACT

The study investigated Senior High School (SHS) mathematics teachers' demand and preparedness to implement an inclusive education mathematics curriculum. The procedure involved a cross sectional survey that used a structured online questionnaire to elicited information on the demand for SHS mathematics teachers and their preparedness to implement an inclusive education mathematics curriculum. A sequential explanatory mixed methods design was employed with a sample of mathematics teachers from 195 senior high schools in then 10 political regions of the country, selected conveniently and purposefully to complete a questionnaire designed using Google Forms (an online survey authoring software). This was followed by interview with 10 mathematics teachers from the 4 GES school placement categories. The study revealed that demand for mathematics teachers in senior high schools exceed supply of mathematics teachers and the existing supply have distributional imbalances because while schools in categories B and C have more mathematics teachers, those in category D have very few mathematics teachers. It was also revealed that mathematics teachers in senior high schools are inadequately prepared to implement inclusive education mathematics curriculum in that most of the teachers' awareness of inclusive education concepts and practices is low. Approximately 59% of the mathematics teachers sparingly use inclusive education strategies in their mathematics classrooms. It is therefore recommended that various stakeholders of education should put measures in place to organize training on inclusive mathematics education to upgrade in-service mathematics teachers' knowledge on inclusivity. Also, mathematics teacher education programmes should be reviewed to include inclusive mathematics education concepts and practices so that mathematics teachers from various institutions would be equipped to practice inclusivity in their mathematics classroom.

CHAPTER 1

INTRODUCTION

1.0 Overview

This chapter presents the background to the study, the statement of the problem, purpose of the study, research objectives, research questions, the significance of the study, limitations, definition of terms, and organization of the study.

1.1 Background to the Study

The vital role of mathematics education in the development of students and its associated linkages to almost all subjects studied in schools cannot be over emphasized. The benefits derived by students who studied mathematics in its application in business, economics, physics and geography are enormous. Mathematics is used in market places, in national income accounting, in construction of bridges, in land scaping, just to mention a few. Due to these benefits and important role of mathematics in students' development, every student must benefit fully from the teaching and learning of mathematics. In spite of student's own self-development with mathematics, Adentunde (2007) argues that all over the world, mathematics is largely used as a requirement for students seeking admission to tertiary and professional institutions. These are some of the reasons for the pivotal position occupied by mathematics in various schools' curricula globally (UNESCO, 2012; Mereku, 1999; Bishop, 1988; Willis, 1990).

It is in this vein that the design, implementation and enforcement of mathematics curriculum are critical in any educational set up. Also, the much attention which has been given to teaching and learning of mathematics at all levels of Ghana education system is as a result of vital role that the subject plays in economic, social and human development, especially in senior high schools where students are required to pass mathematics at their final examination. In this regard, students exiting senior high school can successfully progress from the second cycle to the post-secondary or tertiary institutions only if the students pass core mathematics (National Accreditation Board, 2007). In view of this, it is the interest of almost every student at the senior high school to pass mathematics at the end of the final examination (West Africa Senior School Certificate Examination (WASSCE)). The success of the students at the end of the exit examination in mathematics depends on many factors which include the nature of the mathematics curriculum, the teachers implementing the curriculum and the school community. These factors when put together define the system of mathematics education that would enable the student to succeed at the end of the learning process. It is therefore imperative for mathematics teachers to be conversant with the mathematics education curriculum and be ready to implement it in a school atmosphere that promotes its sustainability.

The effectiveness of mathematics teachers' teaching practices in promoting students understanding of mathematics concepts is supposed to be shaped by the mathematics curriculum in use and that is why mathematics teachers' activities in the school are of great concern, generally to all stakeholders in education especially, government, parents, guardians and mathematics educators (Nsiah-Asante & Mereku, 2012). However, it is unfortunate that, it seems every year, educational stakeholders complain about the performance of senior high school students in mathematics after the release of WASSCE results. Could it then be said that the curriculum is not being used or various stakeholders of education are not performing their roles well?

Eshun (1999), raised concern about Ghanaian students' poor achievement in mathematics and this was reiterated by Flecher (2018). This poor performance in mathematics has been attributed to numerous factors which include gender, age, study time, attitude, motivation, historical background, education levels of student's family, socio-economic status and retrogressive practices (Enu, Agyeman & Nkum, 2015). The poor performance of students of senior high schools in mathematics may also be attributed to students-to-mathematics teachers' ratios, increase in students' enrolment, and shortage of mathematics teachers at the senior high levels. It is important to recognise that, the school and classroom practices towards teaching and learning of mathematics; mathematics education curriculum implementation and its sustainability could also affect performance (Asamoah, Sundeme, Quainoo, Adom-Fynn, Yalley & Afrane, 2020).

Katz and Porath (2011) argue that for all students to learn and understand well, teachers must recognise students as having diverse or different needs, and a classroom created to accommodate all students to learn and develop a sense of belonging. The atmosphere created in the classroom depends on the various practices demonstrated by the teacher. Even though, mathematics teachers are directed by mandated state curriculum on the skills and topics to teach, the teaching and learning practices that are implemented by teachers in classrooms are not restricted (Katz & Porath, 2011). A good mathematics teacher therefore engages all students as active participants of the class and also appreciates all students as good learners (Liu, 2001; Abdullah, Abu Bakar & Mahbob, 2012). However, the major activities of the mathematics teacher in the classroom are defined by the curriculum and for that matter the syllabus. The Ghanaian mathematics curriculum, which was then officially defined by the syllabuses developed on behalf of the MoE by the Curriculum Research and

Development Division (CRDD) of Ghana Education Service (GES) was based largely on the objective model of curriculum development which was used in many developed counties in the last half of the 20th century. With this model, according to Tyler (1949), one of its proponents, the syllabus follows four steps sequence; identifying objectives, selecting the means for the attainment of the objectives, organise the means for the attainment of the objectives, and evaluating the outcomes. The main characteristics of this model of syllabus is its emphasis on the statement of the instructional objectives which should describe desired learning outcomes in terms of specific learner objectives. One fundamental challenge of this objective based of syllabus (curriculum) is its' inadequate emphasis and consideration for inclusivity. This might be the reason for more emphases on inclusive model of syllabus in the current curriculum reform by National Council for Curriculum and Assessment (NaCCA) of GES (MoE, 2020).

A new curriculum must meet the academic needs of students, economic and cultural needs of the society while satisfying the expectation of the various stakeholders of education especially teachers (Alsubaie, 2016). This is why NaCCA had restructured the Objective Base Curriculum to a Standard-Based Curriculum so as to respond to the national priority of shifting the structure and content of the education system from merely passing examination to building character, nurturing values, and raising literate, confident and engaged citizens who can think critically. Teachers are the major implementers of the curriculum because teachers develop lesson plans from the syllabi within the framework of the curriculum (Carl, 2009). The teachers use the lesson plan for the lesson delivery in the classroom and therefore require an indebt knowledge about the curriculum for its successful implementation. Hence, the success of any curriculum implementation to large extent depends on the availability of qualified and competent teachers (Handler, 2010) who are able and willing to accept, implement and sustain the curriculum.

Prior to 2017, the majority of children in Ghana who reach basic stage 6 continue to Junior High School (JHS). For those who enter JHS, most are able to complete. The story is entirely different when it comes to entry into senior high school. The situation was that a significant number of students from junior high schools were not able to make it to senior high school. Before 2017, less than 50% of students from the junior high school were able to make the transition into senior high school (Akyeampong, 2017).

The students exiting junior high school wrote their first external examination, the Basic Education Certificate Examination (BECE). The number of students who were able to meet the selection criterion from the BECE to the next stage of the Ghanaian education, qualified to be enrolled at the Senior High School or the Technical/Vocational school. However, due to the introduction of free senior high school policy by the government of the Republic of Ghana in September 2017, every student who completed the junior high school was expected to get entry to senior high school. Currently, there is about 90% of students who completed JHS are in senior high school (Mereku, 2019).

The rationale behind this policy is to allow every student from the basic level equal opportunity to get access to senior high school education. Now that almost every student from the basic school is enrolling into senior high school, the traditional teaching practices which seem to favour the advantaged students to the detriment of less privileged groups should be the thing of the past especially in mathematics. In the traditional mathematics classroom in Ghana, students are constantly asked to exhibit their ability in solving mathematics problems (Fletcher, 2015). Some of the mathematics questions given to students to solve in the traditional classroom are either taken out of context or put in context understood by only the dominant groups. Mathematics teachers should consider these kinds of differences among students in the entire teaching process to benefit all students. It should therefore be understood that, with current policy of FSHS, different categories of students with different needs in terms of students' socio-cultural background, physical appearance, mental capabilities and varied emotional challenges are together in our SHS classrooms. All these groups of students are sitting in the same mathematics classroom to be taught by the same teacher and on the same topics, with the same teaching strategy. Since mathematics is a core subject at the senior high school, it makes it mandatory subject for every student to study (Fletcher, 2015; Graham, 1975). In order to meet the needs of all these students, the mathematics teacher must involve all the learners to participate fully in the teaching and learning process. The concept of participation in education for every student is inclusion (Roos, 2019).

The essence of inclusive education as provided for by the Ghana's strategic plan and inclusive policy was to ensure quality education to all through appropriate curricula, institutional arrangements, teaching strategies and practices, resource management and usage, and in collaborations with local communities in our education system to achieve the best learning outcomes that improve the total well-being of all learners (MoE, 2015). Teachers of mathematics are therefore required to know and employ inclusivity in their mathematics classroom to aid all categories of students to pass the exit mathematics examination so that they can progress in academic and professional ladder.

The need for teachers to strategize to adopt different teaching practices in mathematics classroom is to involve all students in the teaching, learning and assessment processes. This could be done properly using inclusive teaching methods so that no child is left behind in the mathematics class (Cornell University, 2013). This is because Lewis and Norwich (2001) opine that everybody has needs which must be identified and addressed in one way or the other. These needs could be a need common to all (common), a need that are common to some, but not others (specific) and finally a need that are unique to an individual (unique). The needs of individuals according to Lewis and Norwich (2001) become complex, demanding and difficult to address as they move from common to unique. It is the teacher's main responsibility to ensure that the educational needs that are common to all the students are met through inclusive teaching practices. The needs that are specific to certain students are addressed through differentiation and special attention is given to unique students.

Mereku and Cofie (2008) opined that mathematics teachers' instructional strategies are usually tailored towards one teaching methodology without problem solving skills as if all children in the class are the same and would understand at equal levels. This kind of notion held by some mathematics teachers favours a portion of the students neglecting others which in the long run led to the student's inability to become successful in mathematics. Fletcher (2015) argues that the culture that has always operated in the Ghanaian mathematics classroom perpetuates social segregation because, like mathematics classrooms in many parts of the world, it is also made up of dominant and dominated groups who share, through their perceptions of "knowing" mathematics, the value of maintaining the status-quo and the existing social order in the interactions between the two groups. The instructional strategy or teaching practices that is inclusive and considers the level of cognitive development of the students is more effective (Mereku & Cofie, 2008). Unfortunately, it is impossible to modify teaching practices in mathematics classroom to suit the level of development of all children in the class unless conscious efforts are made to identify the levels at which children are operating (Mereku & Cofie, 2008). The mathematics teacher can therefore include every student in the mathematics classroom if the curriculum makes provisions for inclusivity and that the teacher is also prepared to implement inclusive practices.

1.2 Statement of the Problem

Inclusive education was endorsed and proclaimed as a policy by UNESCO and recognized by 92 countries (including Ghana) and 25 international organizations (Ainscow, 2000; Foreman, 2008). One of the main resolutions of the Salamanca Statement, article 7 calls for the delivery of quality education to all through appropriate curricular, organizational arrangements, teaching strategies, resources and partnerships with communities, and was restated at the World Education Forum in Dakar, Senegal, in the year 2000. The resolution according to Singh (2016) solicits governments to give the highest priority to making education systems inclusive and adopt stated principles of inclusive education as a matter of policy. This idea is further supported by the United Nation's Standard Rules on Equalization of opportunities for Person with Disability Proclaiming Participation and equality for all.

Since Ghana signed to this treaty in 1992, all the studies researchers have conducted seem to focus on the aspect of inclusion regarding infrastructure, physical presence and integration of person with disability into the mainstream school system (Mensah, 2019; Deku & Vanderpuye, 2017; Vanderpuye, 2013). There are limited studies that have been conducted to assess teacher demand by the policy. The mathematics teachers' supply and preparedness for the policy implementation. The level of mathematics teachers' knowledge and use of inclusive education curriculum and its teaching strategies and practices. Specifically in the area of inclusive education mathematics curriculum and the use of inclusive education mathematics curriculum in teaching of mathematics which is learnt by every student from the basic school through to senior high school. With the introduction of inclusive education policy, Free SHS and the demands of the new mathematics curriculum which emphasises inclusivity; students with diversity and different capabilities such as gender, learning difficulties, giftedness, location, and cultural and linguistic diversity relative to mathematics education are enrolled into SHS together with the traditional students who would have proceeded to SHS if Free SHS was not introduced.

The government of Ghana implemented Free SHS policy in September 2017 which resulted in the rise of students' enrolment by 33.2% (Partey, 2018). This situation according to the Ministry of Education is likely to create an estimated 24,880 students who would not be enrolled in senior high school in 2018 (MoE, 2018). The rise in number in 2017 academic year and projections into the future increase in number of enrollments in SHS triggered the government of Ghana through the ministry of education and Ghana education service to introduce a double track system. The implementation of the double track system is to allow government to cater for the excess enrollment, in order to ensure that, the Free SHS is available and accessible to all eligible students (Newton-Offei, 2018). All these students with varied abilities and socio-cultural backgrounds are going to be in the same classrooms and study the same mathematics curriculum, hence the need to establish the extent to which supply meets demand for mathematics teachers and their preparedness to employ teaching strategies and practices that would benefit each student in the class to succeed according to the student's own ability and pace.

1.3 Purpose of the Study

The purpose of this study was to investigate the mathematics teachers' demand and preparedness for the implementation of inclusive education mathematics curriculum (IEMC) in senior high schools in Ghana.

1.4 Objectives of the Research

The study seeks to achieve the following objectives;

1. To assess the extent to which the supply of SHS mathematics teachers meet the demand for mathematics teachers in Ghanaian senior high schools
2. To determine the influence of GES School Placement Categories (GES-SPC) on the levels of demand for mathematics teachers in senior high schools
3. To investigate the extent to which SHS mathematics teachers are prepared for the implementation of an inclusive education mathematics curriculum.
4. To find out the extent to which SHS mathematics teachers are aware of inclusive education concepts and strategies for the implementation of the inclusive education mathematics curriculum
5. To investigate the extent to which SHS mathematics teachers' use inclusive education strategies in the implementation of the inclusive education mathematics curriculum.

1.5 Research Questions

The following research questions guided the study;

1. To what extent does the supply of SHS mathematics teachers meet their demand in Ghanaian senior high schools?
2. What is the influence of GES School Placement Categories (GES-SPC) on the levels of demand for mathematics teachers in senior high schools?
3. To what extent are SHS mathematics teachers prepared for the implementation of the inclusive education mathematics curriculum (IEMC)?
4. What is the level of awareness of SHS mathematics teachers towards the use of inclusive educational concepts and strategies for the implementation of the inclusive education mathematics curriculum (IEMC)?
5. How frequently do SHS mathematics teachers' use inclusive education strategies in the implementation of the inclusive education mathematics curriculum (IEMC)?

1.6 Significance of the Study

The study would make mathematics teachers in senior high school appreciate their levels of preparedness to implement inclusive education concepts and principle in their mathematics classrooms. This would go a long way to assist the teachers to seek the appropriate professional and in service training to equip themselves for their academic and professional development.

The study would bring to bear the discrepancies and inequalities in the demand and supply of mathematics in the various senior high school in Ghana. This would inform policy makers to put in measures to address imbalances in the supply of mathematics teachers to SHS to benefits all schools in the country. It would also serve as bases for stakeholders such GES to conduct a full nation-wide survey to estimate the teacher demand in various subject areas so that areas with inadequate teachers could be addressed.

Every student in senior high school has the desire to pass core mathematics in order to progress in the academic ladder or possibly enter into any professional career training. It is in view of this that teachers of mathematics have to manage their classes in a way that would benefit every student to pass the mathematics. To achieve this, teachers of mathematics are to practice inclusive teaching which will involve all students irrespective of their abilities and socio-cultural backgrounds. To practice inclusive teaching in mathematics classroom, the mathematics teachers are expected to have enough knowledge about the inclusive education as required by the mathematics curriculum hence this study will bring to light the level of teachers' knowledge so as to know what to do that would promote academic growth of students.

Also, the study is significant in that it brings to bear the level of mathematics teachers' inclusive teaching practices in Ghanaian senior high schools. This could inform stakeholders of education on various steps to take in order to get every student involved so that no student is left behind.

The study would also identify the weaknesses of teacher of mathematics in SHS towards inclusive teaching practices so that teacher training institutions could adjust their curriculum to meet the standards of inclusive teaching practices. Even though, mathematics teachers at the senior high schools are expected to have acquired enough knowledge to teach all categories of students, it is perceived that some teachers go to classroom with a mind-set of teaching students of equal abilities which end up benefiting only a portion of the students.

The study would add to the body of literature on inclusivity by bridging the gap between the concept of mathematics teachers' inclusive teaching practices from the social perspective lens (ITPS) and inclusive teaching practices from the pedagogical or classroom perspective lens (ITPP/C). Also, the result and findings from this study are anticipated to add to the existing knowledge on inclusive mathematics education especially in the area of inclusive teaching practices in mathematics classroom. This will create more avenues for other researchers to explore more in the field of inclusive teaching practices in mathematics classroom.

1.7 Limitations to the Study

The emergence of Covid-19 and its impact on research made the current study employ online mode of data collection especially for the quantitative data. This condition raises a lot on concern about multiple responses from participants of the study. To reduce multiple responses, the data was critically assessed and any data that had any form of suspicion to be coming from same respondents were discarded. This situation affected the sample size to be small. However, scenario analysis was performed that gave opportunity for various situations for future considerations.

Some of the items in the questionnaire were recoded after the follow-up interviews and observations to make analysis and interpretations easy. Researchers who may therefore wish to use the questionnaires might need to modify the items to suit their situations.

The issue of sampling biasness could not be ruled out due to the use of convenience sampling method which did not allow for equal chances of all the mathematics teachers on the various platform. However, the responses from the participants showed a fair distribution of respondents across the then 10 regions of Ghana.

1.8 Delimitation of the Study

The inclusive education policy of Ghana is designed to affect students/pupils at all level of the education system. This means that any study relating to inclusion should involve all level of education but this study is limited to some senior high school in Ghana. Also, teaching practices involve all subjects read at the SHS which means that the study could encompass all subjects that are studied at SHS but since mathematics is studied by every student, the study is restricted to inclusive mathematics teaching practices.

Due to knowledge transfer and correlational nature of various subjects thought at the SHS, any teacher teaching any subject could have been sampled for the study, however, the study is limited to mathematics teachers because of the pivotal rule mathematics play in almost all subjects.

Pedagogical knowledge and for that matter teaching practices are fundamental requirement for every teacher. This presupposes that those teaching mathematics at the SHS have acquired adequate skills in teaching practices to effectively teach mathematics at SHS. The study was thoughtfully focused on the knowledge levels of mathematics teachers about inclusive education and inclusive mathematics teaching practices. Although, the object of the study is underpinned on knowledge and teaching practices, the interest is emphasised on Knowledge about inclusive education and inclusive teaching in mathematics classroom.

The other aspect of mathematics knowledge such as content and curriculum are omitted from the study. Also, teaching practices which do not ascribe to inclusiveness are excluded from the study so as to narrow the scope of the research.

1.9 Organization of the Study

This thesis is structured into five major chapters. Chapter one consists of the background of the study which describes the mathematics teachers' inclusive knowledge and teaching practices, the rationale and motivation for the research are briefly highlighted in this chapter. The statement of the problem for this study, the purpose, objectives and research questions as well as the significance, delimitation and organization of the study are presented.

The Chapter two reviews the relevant literature to help in developing knowledge on the theory or social turn and social participatory model. The reviewed literature also aided in deeper understanding of mathematics teacher's inclusive knowledge and teaching practices which helped in shaping the study. Chapter three is about the research methodology. It contains the research approach and design, an account of the population, sample and sampling techniques, instrumentation, and the full procedure for data collection and analysis. The chapter three ends with matters of trustworthiness of the study.

The demographic characteristics of the sample, results and the findings of the analysed data are identified, interpreted and discussed in Chapter four. This highlighted the major findings and the inferences made from the findings based on the related existing knowledge. Chapter five looks at the summary of the research study, summary of major findings, conclusions, recommendations and areas of future study based on the findings of the research.

1.11 Definition of Terminologies and Abbreviations

Curriculum

In education, a curriculum is broadly defined as the totality of student experiences that occur in the educational process. The term often refers specifically to a planned sequence of instruction, or to a view of the student's experiences in terms of the educator's or school's instructional goals.

Mathematics curriculum

The mathematics curriculum aims to help all children to develop a positive attitude toward mathematics and to appreciate its practical applications in life. It's to help them develop *problem solving skills*, their ability to use mathematics in everyday life and use mathematical language effectively and accurately.

Curriculum implementation

Curriculum implementation is the translation of a written curriculum into classroom practices. Regardless of the definition or approach, curriculum can be organized into three major components: objectives, content or subject matter, and learning experiences.

Inclusion

Inclusion is an approach that seeks to transform the regular school system in order to remove the barriers that prevent Children from participating fully in education

Inclusive Education

Inclusive Education is therefore defined as educational system which emphasizes on eliminating all exclusionary pressures and bringing all students on board to benefit from the educational system by making it conducive and flexible enough to accommodate all learners so as to be successful academically.

Inclusive Education Mathematics Curriculum

Inclusive Education Mathematics Curriculum used in the study refers to senior high school mathematics curriculum that which requires and applies the concepts of inclusivity.

Demand for teachers

Demand for teachers as applied in this study refers to the total number of professionally qualified and trained mathematics teachers needed to provide and execute teaching skills that will produce a certain specified output from an educational system.

Supply of teachers

Supply of teachers as applied in this study refers to the total number of professionally trained and qualified mathematics teachers produced and recruited to provide and execute mathematics teaching skills in an educational system (senior high schools).

Active classroom

Active classroom defines classrooms that were actually occupied and used for classes in the 2019/2020 academic year since it is likely to find classrooms that are not used for classes in some of the schools.

Class size

Class size refers to the total number of students in a class being taught by a mathematics teacher for specified periods within the week.

Teacher workload

Teacher workload is the sum of all activities that take the time of a teacher during the contact hours.

Special education

Special education is defined as a system of education in which a range of services are provided to students with emotional, behavioural or cognitive impairment or with intellectual disability

CHAPTER 2

LITERATURE REVIEW

2.0 Overview

This chapter discusses the review of related literature relevant to the study. It includes the concept of inclusive education, the theoretical framework, inclusive education in Ghana, challenges of inclusive education in Ghana, senior high school mathematics curriculum, mathematics teachers' knowledge about inclusive concepts and practices, mathematics teachers' use of inclusive strategies and practices, and demand and supply of mathematics teachers and a chapter summary.

2.1 The Concept of Inclusive Education

Inclusive Education (IE) seems to be a difficult and complicated phenomenon in the entire education community which makes its definition complex and problematic (Mitchell, 2005; Mitchell, 2010). This is because in spite of the great and increasing attention received by the notion of inclusion in educational research and practice in the last few decades, there is no universally accepted definition for the term, either for what it is or what it is needed for. According to Artiles, Kozleski, Dorn, and Christensen (2006), the absence of an agreed definition is based on differences of perspective and context in research on inclusion, which can be seen in the coverage of ethnic, social and special educational issues (Nilholm, 2007). Other challenges militating against the proper conceptualization of inclusive education have arisen from semantic, ideological and political discourses of inclusion (Barton, 1997).

Dyson (1999) for example has propounded that the concept of inclusion is built upon four separate fundamental discourses. These are the rights and ethics discourse, efficacy discourse, political discourse, and pragmatic discourse. First, the 'rights and ethics' discourse is based on the belief of social justice which explains inclusion in relation to the right of all children to an equitable quality education. Inclusion as used in social justice suggests that inclusion should be at the heart of any society that cherishes a liberal political structure and mixed culture – one that celebrates diversity and promotes fraternity and equality of opportunity for all (Thomas, 1997). Secondly, the efficacy discourse provides a serious assessment and analysis of the effectiveness of education in special schools compared with the inclusive education for students with disabilities. Thirdly, the political discourse involves the awareness of individuals to recognize inclusive education and defines the power struggles among professionals with vested interests, such as special education professionals and parents who either assist or resist the transition from a segregated system to an inclusive system. Finally, the pragmatic discourse argues for what inclusive education should look like in practice and how it should be appreciated. This discourse assumes that inclusive schools have definite characteristics that are peculiarly different from those of non-inclusive schools such as systems, structures, practices, ethos, theories of learning and instruction, and strategies that teachers can follow (Nketsia, 2016). It can be deduced from the above arguments that inclusive education is given equal opportunities to every student to benefit from the school system irrespective of one's ability or inability.

However, in many educational contexts, the notion of inclusive education is often used to promote support for diversity and equality, but it can also be used to describe a way of teaching children in special educational needs (SEN) (Ainscow, Booth, Dyson, & Farrell, 2006; Sheehy et al., 2009). The concept of inclusive education in most recent studies seem to be focusing greatly on students with identified special educational needs and/or disabilities (SEN/D) (Messiou, 2017; Nilholm & Göransson, 2017; Ruberg & Porsch, 2017). Most of these studies seem to ignore the fact that every human being has a need in one way or the other, either a common need, specific need or unique need (Lewis & Norwich, 1999). Therefore, inclusive education should no longer be restricted in definition for global social concern which emphasises on human rights (Stubbs, 2008). It should also differ from formerly held philosophy of integration and mainstreaming (Foreman, 2008; Mitchell, 2004) but advocates for promotion of quality education for all learners, in an inclusive and supportive learning system (Mitchell, 2004).

One other way to use the term inclusion is to describe what it means to be included in a society, as well as why it is critical (UNESCO, 2009). The term can also describe a way of teaching, in which all students are taught in a regular classroom. This argument or line of definition for inclusion seems to create a gap between conceptual or theoretical studies that advocate a more diverse learners- and 'for all'-related paradigm and empirical studies that emphasis on an understanding of inclusive education as the placement of students with SEN/D in the mainstream school system (Nilholm & Göransson, 2017). This dual use of the notion raises questions about what happens when the same term is used to describe both a way of taking part in society and a way of teaching in a classroom. This argument might be because; inclusive education could be defined in various ways (Ainscow, Booth & Dyson, 2006; Thomas & Vaughan, 2004; Clough & Corbett, 2000). While some schools of thought conceptualise the inclusive education to mean a process of educating children with special education needs and/or disability (SEN/D) in general education classrooms (Messiou, 2017; Nilholm & Göransson, 2017; Ruberg and Porsch, 2017; Blecker & Boakes, 2010; Idol, 2006), others think that it is a concept of bringing every student on board in the classroom such that all students benefit from the teaching and learning process at their own levels and pace, thus education for all (Hayes & Bulat, 2017).

Inclusion differs from integration in that under the concept of integration, students with SEN/D are physically placed in general education classrooms without any provisions made for the students in terms of teaching practices in the classroom, or mainstreaming where SEN/D students spend part of their school days in the general education programme and other part in a separate special education programme (Idol, 2006). In integration or mainstreaming every student irrespective of one's ability or needs should fits into the general education system and copes with the curriculum. The implication of this is that the student is the one who adapts to the school's situation but not the school system recognizing the needs and abilities of the students and helping him/her to succeed in the education programme (Vanderpuye, 2013).

IE is involved with structural adjustment of schools in order to respond to the abilities and needs of all students no matter their backgrounds (Ainscow, 2000) and regardless of any challenges the students may have, are placed in age-appropriate general education classes of any school they may find themselves to receive high quality instruction, interventions, and supports that enable them to meet success in the core curriculum (Bui, Quirk, Almazan, & Valenti, 2010; Alquraini & Gut, 2012). McLeskey and Waldron (2000) describe successful inclusion to be based on change in every aspect of schooling. Therefore, successful inclusive education happens principally through accepting, understanding, and attending to student differences and diversity, which can include the physical, cognitive, academic, social, and emotional. Confirming this and stressing the need for presence, participation and achievement for all students, Flem, Moen and Gudmunsdotter (2004) conceptualise inclusive education to mean the kind of schooling that is designed to meet the needs of all students. Promotion of equal access to good formal education for all irrespective of individual differences that might exist among children in terms of their physical, intellectual, social, emotional, linguistic or other conditions. These include children with disability, gifted children, street and working children, children from other remote and farming communities or roaming populations, children from language, ethnic or cultural minorities and children from other disadvantaged or marginalised communities, groups or segregated areas (Olukoya, 2019; The Salamanca Statement and Frame work for Action on Special Needs Education, 1994).

Globally, IE is mostly recognised as a reform that supports and welcomes diversity (UNESCO, 2001). Skrtic, Sailor and Gee (1996) therefore conclude that IE involves schools meeting the needs of every student. In order to be successful in inclusive agendum, schools have to pay ‘‘attention to all aspects of schooling – curriculum, assessment, pedagogy, and support'' (Mitchell, 2005, p.4) and remove all barriers to learning. Inclusive education is seen by the Centre for Studies in Inclusive Education (2002) as a continuous process of breaking down barriers to learning and participation for all children. Consequently, Booth and Ainscow (2002) argue that schools, communities, local authorities, government, and all other educational stake holders have to make everything possible to eliminate all barriers to educational participation and learning for all. In essence, one should understand inclusive education concept as different from other educational concepts that are concerned principally with disabilities and special educational needs. Significantly, inclusive education is the right of all categories of students to participate fully in school activities (Olukoya, 2019). Inclusion fails to accept the use of special schools or classrooms to segregate students with disabilities, special needs in education or giftedness. In inclusion, premium is however placed upon full participation and respect for the social, civil and educational rights of all students (Olukoya, 2019). Inclusion is an approach that seeks to transform the regular school system in order to remove the barriers that prevent Children from participating fully in education (Omede, 2016). The ultimate goal of inclusive quality education is to end all forms of discrimination and foster social cohesion (UNESCO 2012). Inclusive Education is therefore defined as educational system which emphasizes on eliminating all exclusionary pressures and bringing all students on board to benefit from the educational system by making it conducive and flexible enough to accommodate all learners so as to be successful academically.

2.2 Theoretical Framework

The study was based on the classical theory of equal opportunities propounded by Sherman and Wood, (1982) cited in Orodho (2009) and aggregate teacher labour market theory following Zabalza, Turnbull, and Williams (1979). The main aspect of the theory of equal opportunities employed in this study is the need to provide equal opportunities for all students and probably all teachers. The theory believes that all persons are born with some level of capabilities and if given the appropriate chances could be successful in education. According to the theory, educational systems are to be designed in a way that all forms of barriers such as socio-economic factors, geographical factors, socio-political factors, socio-cultural factors, school-based factors, which militate against the progress of students with learning disability in any form to take advantage of their inborn talents according to their own abilities.

This theory is in line with advocates in recent decades that, research in mathematics education is gradually shifting to involve what is known as the "social turn" because of the coordination between cognitive and its physical environment (Lerman, 2000). The success of students according to social turn model does not depend on only the cognitive part of the students but also on the atmosphere in which the teaching and learning take place. Many researchers who are interested in numerous issues within mathematics education and social concerns have come to appreciate the association between culture, context and cognition in mathematics education (Morgan, 2014; Gutriérrez, 2013). These researchers believe that the cognitive level of learners can be influenced by their cultural background, classroom situation, teacher's attitude and the learner' s own behaviour, therefore it is important to associate learner's cognition with their social system particularly in an inclusive classroom in order to develop their full academic potential.

Even within the studies that focus basically on cognitive domain of learning and knowledge, the notion of situated learning and distributed knowledge (Lave & Wenger, 1991) are widely used, as well as other theoretical perspectives that emphasise social part of learning, drawing particularly on Vygotskian psychology (Vygotsky, 1978). This study is aligned to social influence on mathematics education because all learning take place in social environment; the school is located in community; students interact in classrooms with colleagues and of course teachers teach students together in classrooms. In fact, the choice of this social theoretical perspective and methodological approach is not by chance because the theory is not only shaped by the objectives of this study but also by the inclusive nature of the study, the interests, knowledge and experience of the researcher. It is also influenced by the traditions and expectations of the environment within which the study and the theories are situated (Lagrange & Kynigos, 2014).

Furthermore, the study adopted the social part of learning because the concern for the individual's mental ability and its related cognitive operations are no more occupying the pivotal position in teaching and learning under the recent theories in mathematics education particularly from sociocultural perspective (Gutierrez, 2013). This has provided room for researchers to study classroom culture, participation, structures, socialization processes, and teachers' knowledge, preparedness and professional development in a more holistic manner. However, the relationship between the choice of social theory and the objectives of this study is dialectical because this particular theoretical perspective do not only allows the current study to address the issues of inclusive education and the use of inclusive education teaching practices in classroom that have been found as being of major concern but also affects the way the problem of mathematics teachers' knowledge and preparedness to implement inclusive education mathematics curriculum and the use of IEMC practices in mathematics classroom are perceived and defined.

It also raises new concerns that are yet not being thought of about inclusivity (Morgan, 2014). In this case, the social theory is necessary in that the study perceives the characteristics, actions and achievements of individual students, teachers' behaviour and teaching practices as phenomena arising within social practices, structures and discourses. Studying these practices, structures and discourses allows us to gain new insights into the experiences of students and teachers (Morgan, 2014) in the implementation of inclusivity in mathematics education curriculum.

It is important to recognize that learning mathematics goes beyond the effort of individual students and teachers because Valero (2010) emphasizes the complexity of the networks of communities, interest groups and practices relevant to mathematics education and to address this multiplicity of social practices and the connections between them, mathematics education researchers adopt the theory of social participation into mathematics education. For example, Dowling (1998), Cooper and Dunne (1998) and Straehler-Pohl and Gellert (2013) apply the theory of social participation to understand how access to successful participation in mathematics schooling is distributed across different social groups. It is therefore critical to study the various communities and practices in which students and teachers participate in the classroom, in the school and even outside the walls of the school in order to identify the contributions of these factors toward the total academic growth and development of all mathematics students.

In particular, there has been numerous attempts to locate the reasons for failure in the characteristics of the individual mathematics students concerned or of their school communities towards seeking to understand how the practices and structures of the education system itself, as well as the broader society and its dominant discourses, serve to construct and sustain the disadvantaged student (Herbel-Eisenmann, Choppin, Wagner & Pimm, 2012). At the same time, the study goes beyond the focus on the conventional educational outcomes as indicators of success or failure but as a social recognition and participation as equally important dimensions of social justice (Black, Mendick & Solomon, 2009). Social justice is a significant concern to this study because every student has the legal right to education and should be assisted to attain the optimal level of education according to the student's own potentials and abilities.

The theoretical framework of this study rests on two fundamental social paradigms, the social participatory model which is in line with Wenger (1998) communities of practice model and a social inclusive model (Asp-Onsjö, 2006). The general principle of participatory model in social paradigm is that learning is social interaction among learners, teacher and the environment. That is, learning is seen as a function of participation (Wenger, 2011; Wenger, 1998). Participation is considered as getting involved in the teaching and learning process (Wenger, 2011). Participation is therefore an active process which involves the whole person and combines "doing, talking, thinking, feeling and belonging" (Wenger, 1998, p. 56). Participation "goes beyond direct engagement in specific activities with specific people" (Wenger, 1998, p. 57). It embraces the aspect of freedom of will, desire and interest of doing and doing it at one's own pace according to one's own ability. As one participates then one is practicing as states by Wenger (2011) that practice "exists because people are engaged in actions whose meaning they negotiate with one another" (Wenger, 1998, p. 73) and the practice reside in a community of individuals with mutual engagement. Members of a community of practice are practitioners who develop a shared repertoire, such as experiences, tools, artifacts, stories, concepts, knowledge, interest, etc.

The spirit of belongingness, shared responsibility and joint enterprise keep the community of practice together. It is a collective process of negotiation by the participants in the process of pursuing a common goal. From a participatory social perspective, inclusion in mathematics education means not only to be present in the classroom physically; it also means to be included in the mathematical practice of the classroom. In this case inclusive mathematics education is concerned with issues regarding mathematics in the society and matters of mathematics in the classroom.

Asp-Onsjö (2006) puts inclusion into three dimensions as spatial inclusion, social inclusion and didactical inclusion. Spatial inclusion according to Asp-Onsjö (2006) refers to how much time a student spends in the same room as compared with other classmates. The social dimension of inclusion is concerned with the way in which students participate in the social, interactive play with the others in the school. Didactical inclusion talks about the ways in which student classroom involvement relates to the teacher's teaching approach and the way in which the students engage with the teaching material, the explanations and the content that the teachers may supply for supporting the student's learning.

The major consequence of adopting this social and participatory model is to recognize that success and failure in school mathematics do not rest solely on individual students' academic abilities or weaknesses but could be linked to the social opportunities and social disadvantages. This study is about mathematics teachers' demand and supply, mathematics teachers' knowledge about inclusive education and their inclusive teaching practices in mathematics classroom in the Ghanaian senior high schools. It is expected that if every student is allowed to participate in what goes on during mathematics lesson according to his or her own ability taken cognizance of the presents of other students, interact with other students in the class freely, manipulate and play with different kinds of teaching learning materials and receives the necessary support from the teacher, the student would be successful in mathematics.

The aggregate teacher labour market theory following Zabalza, Turnbull, and Williams (1979), states that, the labour market for teachers could be seen as part of the usual demand and supply system but, with extra complication that the government is practically the sole hirer of labour. The mathematics teachers demand in senior high schools in Ghana can be determined by the number of SHS students in the country's senior high school, and the GES desired students-to-teacher ratio (In this case, 40 students to 1 teacher according to Ananga and Tamanja, 2017). In this situation, the demand for SHS mathematics teachers is fixed based on the government desire and capability to hire. Let us represent this demand by Q as shown in Figure 2.1. This happens under the reasonable assumption that the supply of teachers with professional education is a positive function of average teacher earnings (based on governments fundings/budget education) is an upward-sloping labour supply schedule S illustrated in Figure 2.1.

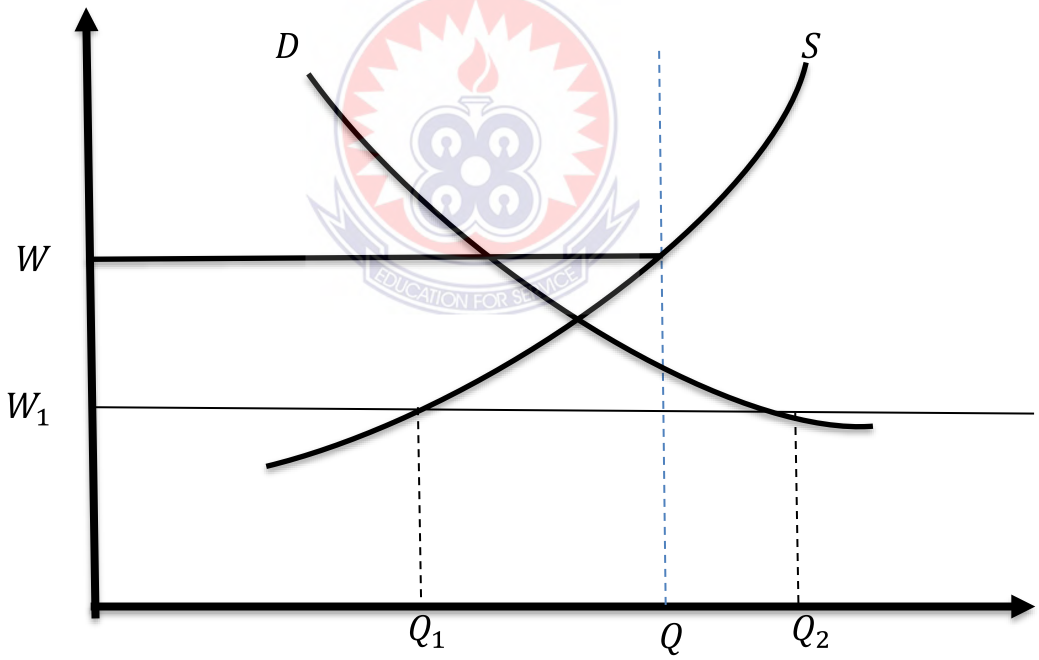


Figure 2.1: The labour market for demand and supply of teachers

Adapted from Chen (2009)

Therefore, in a perfectly competitive market, a teacher wage W would clear this labour market. However, in the economics of teachers' labour market, the market is not competitive, because the government, in its role as exclusive purchaser of teaching labor for public senior high schools, has other considerations, prime among which is the level of expenditure on teachers' salaries in total. For a given level of such expenditure, an inverse relationship can be plotted between teachers' earnings and the number of teachers hired, labeled *D* in Figure 2.1. If the government wants to raise the salaries of teachers, it can afford to hire fewer number of teachers, given a fixed budget for education (Chen, 2009).

Another complication added to the model is that teacher salaries do not adjust freely, since almost all the teachers are civil servants, and therefore have their salaries following the country's civil servant remuneration system. Figure 2 illustrates a general situation of how the economics of aggregated teacher labor market operates. The government in most cases with a fixed wage rate W, which can be afforded to hire the number of teachers Q_2 at this fixed salary level. However, the market supply of teachers with professional education at this salary level could be only Q_1 at this fixed level of government expenditure on education (at that salary level). According to Chen (2009), government can therefore at this level of demand for teacher hire $(Q_2 - Q_1)$ either non-professional or low qualification teachers to fill the vacancy. On the other hand, Q_2 can be higher than what is the actual demand for teachers Q, in this case, there is over-supply of total number of teachers needed, measured as $(Q_2 - Q)$. The teacher shortage in such situation, usually occur if supply of professional teachers is not meeting the demand as in $(Q - Q_1)$ or government is not hiring more teacher due to budget for education constraints or professional or qualified teachers are not willing to take the teaching job (Ingersoll, 2001).

2.3 Inclusive Education in Ghana

The constitution of Ghana enshrines education as is a right for all citizens (The Constitution of the Republic of Ghana, 1992). A critical assessment of this provision in the Ghanaian constitution indicates that the notion of inclusion in education was long known the people of Ghana before its inception formally. In view of this Ghana has been part of many international treaties on the right of all citizens to education; the United Nations Convention on the Rights of the Child (1990); the World Declaration on Education for All - Jomtien (1990); the Standard Rules on the Equalization of Opportunities of Persons with Disabilities (UN,1993); the Salamanca Statement and Framework for Action (UNESCO, 1994); the Millennium Development Goals(MDGs) (2000); The Dakar Framework for Action (2000); and the UN Convention on the Rights of Persons with Disabilities (2006) (Inclusive Education Policy, MoE, 2015).

Apart from the international commitments by Ghana to include all children in education irrespective of the person's background, the country has demonstrated a lot in the local scene towards inclusivity in education. The 1961 Education Act which mandates Free Compulsory Universal Basic Education (FCUBE), the Persons with Disability Act (Republic of Ghana, 2006), Act 715, further legitimizes IE placement, the punishment by law attached to denying placement based on student with special education needs and/or disability, policy documents such as the Education Strategic Plan (MOESS, 2010, 2003), Special Educational Needs Policy Framework (SENPF) (GES, 2005), inclusive education policy (MoE, 2015; Vanderpuye, 2013) and the new curriculum reform (MoE, 2020) emphasize on the use of inclusive education principles to the Ghanaian education system.

Although Ghana has tried to provide education for particularly basic education for as required by the 1992 constitution, the implementation of free and compulsory basic education for all Ghanaians of school going age could not be achieved by the year 2005. For example, learners with disabilities who form a significant proportion of the out-of-school population were not catered for (MoE, 2015). It is in this light that the Ghana Government's Education Strategic Plan 2010-20 made provisions for people with physical and mental impairments, orphans, and those who are slow or fast learners, to be included in and within the mainstream formal system except probably in extreme cases where the individual may need an additional assistance (MOESS, 2010). The essence of inclusive education as provided for by the strategic plan was ensuring quality education to all through appropriate curricula, institutional arrangements, teaching strategies and practices, resource management and usage, and in collaborations with local communities in our education system to achieve the best learning outcomes that improve the total well-being of all learners (MoE, 2015). This is backed by the new curriculum which "emphasizes on creative and inclusive pedagogies that are anchored on authentic and enquiry-based learning, collaborative and cooperative learning, differentiated learning, holistic learning, and cross disciplinary learning" (MoE, 2020 p. 10)

The introduction of the concept of inclusive education has been gradual in its implementation through pilot projects. The first phase of the piloting involved ten districts and thirty schools (Vanderpuye, 2013). By the end of 2011, the Government of Ghana through the Special Education Division of Ghana Education Service had implemented Inclusive Education on pilot projects in 529 schools in 34 districts. The various communities and key government officials were sensitized, school children were screened, teachers were trained on the identification of children with special educational needs (SEN) including those with disability, and how to manage children with SEN with emphasis on children with different abilities in the classrooms (MoE, 2015; Vanderpuye, 2013).

It is obvious that Ghana is doing well in her quest of getting quality education for all and this is demonstrated in the introduction of the free senior high school (FSHS), an indication of inclusivity since it addresses the issues of discrimination and exclusion. The FSHS has giving the opportunity to every child from the basic level the right to high school education; thus, all children leaving junior high school have equal opportunity to access education. The policy has it that all graduates from JHS can benefit from SHS education and no child should be excluded from or discriminated against on the grounds of race, colour, sex, language, age, class or social group, religion, political or other opinion, national, ethnic origin, poverty, disability, birth or any other status (MoE, 2015). It can therefore be argued that Ghana is truly practicing inclusive education at the SHS if not in all level of education.

2.3.1 Challenges of inclusive education in Ghana

Despite the introduction of inclusive education policy in Ghana in 2015, just as it happens in the implementation of IE in developed countries, challenges are inevitable and Ghana is no exception. The first challenge to inclusive education all over the world not only in Ghana is the meaning and definition of the term inclusivity as applied in educational context. Due to different contextualization of the term, it makes it difficult for one to know exactly what researchers talk about any time the term inclusive education is used in a study. While some educational researchers used it to mean students with special educational need (SEN) (Vanderpuye, 2013; Adera & Asimeng-Boahene, 2011; Vanderpuye, Gyimah & Deku, 2009), others prefer using to mean involving every student irrespective of the students' ability and or background to be successful in school (Olukoya, 2019; MoE, 2015).

Secondly, some Ghanaians' negative attitude towards people with SEN/D and expectations from students in terms performance. This is fueled by Ghanaian cultural views about disabilities and giftedness. Adera and Asimeng-Boahene (2011) report that people with disabilities sometimes face ridicule through folklore and songs due to deep rooted beliefs that they are curses from God or the result of witchcraft. Agbenyega (2003) and Oliver- Commey (2001), referring to the derogatory labels used in the society to refer to people with SEN/D, report that the use of these labels filter into the school system, resulting in ostracism and stigmatisation either by teachers or peers.

Also, it has been identified that teachers lack the skill to effectively educate children with SEN/D and giftedness (Agbenyega, 2007; Obeng, 2007). In this regard, teachers tend to ignore gifted students with the view that for such student would surely understand the lesson which prevent such students from reaching their full potentials.

Additionally, there seems to be inadequate commitment from government to provide enough educational resources for the benefit of all students. This part of the world also lacks the appropriate assistive technology to support different category of students based on their unique abilities. Other challenges may be large class sizes due to inadequate and inappropriate infrastructure that would benefit every student. The issue of enough qualified teachers to teach students with different ability groupings cannot be ruled out as one of the factors militating against inclusive education in Ghana (Vanderpuye, 2013).

Finally, educationists in Ghana use the term SEN to refer to children who have significant learning difficulties and therefore need special educational provisions by way of adaptations to the curriculum and/or the physical environment in order for them to achieve their academic and career potential (Vanderpuye, 2013). This is therefore no different from how SEN is used by the Special Educational Needs Code of Practice (2001). Professionals in education also assigned labels to specific categories of children with SEN (Gyimah, 2006). For instance, the term disability is used by professionals in Ghana to refer to people who have physical or mental impairment which affects the person's ability to perform normal routine activities (VAnderpuye, 2013). With the introduction of the inclusive education policy and its subsequent curriculum reform which emphasizes on inclusivity, there is the need for the educational professionals to start thinking of redefining certain terms in a broader perspective so as to avoid segregation and exclusion in our educational system since every child could do well irrespective his/her nature, ability, background and temperament if given the right tuition.

2.4 Senior High School Mathematics Curriculum

All public schools in Ghana follow one national curriculum, which was centrally developed at the Curriculum Research and Development Division (CRDD). The teaching syllabuses of which both public and private senior high schools use are produced by the CRDD. The existing mathematics curriculum was introduced and implemented in the year 2007 and the aim of that curriculum was based on the twin premises that all can learn mathematics and that all need to learn mathematics with a view to achieving a curriculum that reflects individual students' needs (Ministry of Education, Science and Sports; MoESS, 2007).

The ultimate goal of the 2007 curriculum was to enabled all students acquire the mathematical skills, insight, attitudes and values needed to be successful in their chosen careers and daily lives by increasing the students' self-oriented learning abilities to the highest peripheral. The 2007 curriculum therefore encouraged the acquisition of more skills and use of varied teaching methods and resources to help students to develop the mathematical skills that they would need in their daily activities (MoESS, 2007).

It also aimed at bringing a shift from a teacher-centered approach of teaching and learning to a more participatory teaching and learning methods to help students develop their skills through the application and experimentation of different problem-solving skills (MoESS, 2007).

The syllabus is used as a guide for the day to day instructional and assessment activities. As a guide, the curriculum provides a framework through which private publishing houses produce other curriculum materials in mathematics including students' book and teachers' guide. All the teacher's guidebooks describe step-by-step what teachers are supposed to do in a lesson (Croft, Coggshall, Dolan, Powers &Killion, 2010).

Aside the framework that the curriculum provides to private publishing houses to produce textbooks, the CRDD also assesses all textbooks and consequently reserves the right to amend, delete or and reject a part or the whole of any textbook. In view of such control, the contents of textbooks are more or less the same in all the regions though this may have been published by different private publishing houses. The National Council for Curriculum and Assessment (NaCCA) established in 2007 following the educational reforms that year as an advisory board to the CRDD.

NaCCA is responsible for the development and determination of its advice on matters relating to curriculum and assessment with Ghana Education Service (GES) serves as the implementation body of the national curriculum (Oduro, 2015).

There are many contributing factors to high quality education, but teacher performance is perhaps the central factor (Susuwele-Banda 2005). It must be emphasized that each subject partly contributes to the achievement of the collective aspirations of the nation. As a result, each subject studied at the senior high school has its rationale and aims. The rationale for the mathematics curriculum at the senior high school includes the development in students' numeracy competence to be able to function effectively in society and be well equipped to enter into further study and associated vocations in mathematics, science, commerce, industry and a variety of other professions (CRDD, 2010).

The mathematics curriculum also seeks to help the students use mathematics in daily life by recognizing and applying appropriate mathematical problem-solving strategies. Ghana intends to emphasize on the acquisition of these qualities and the important quality of functional mathematics in the teaching and learning programmes in the school system. The syllabus hence puts a great deal of emphasis on the development and use of basic mathematical knowledge and skills (Ministry of Education, Science and Sports, 2007). It can be said that the goal of the mathematics curriculum, is to make every student see the study of mathematics to be meaningful and value beyond school life of students. This requires an assessment procedure that requires problem solving and critical thinking rather than mere recall of facts (Nabie, Akayuure & Sofo, 2013).

The senior high school curriculum describes and explains assessment requirements for all content areas. The curriculum also describes levels of learning, termed 'profile dimensions', whereby outcomes can be determined from a lower level to higher order learning (Bloom, 1969). The Ghana's 2007 mathematics curriculum was designed in terms of profile dimensions (Ministry of Education, 2007). The profile dimensions could be seen as the cumulative psychological units used for describing the underlying behaviours for teaching, learning and assessment. These psychological units consist of a set of quite general and specific categories that encompass all possible learning outcomes that might be expected from instruction. Consistent with the national policy, the curriculum is aligned with behavioural cognitive framework that outlines the cognitive levels to be covered. These levels follow Bloom's (1969) taxonomy of fact recall, application of knowledge and understanding, analysis, synthesis, and evaluation.

Stobart (2010) explains that profile dimension serves as a useful framework for analysis of test items. Teachers are able to identify the number of items belonging to recall of facts, comprehension, application, analysis and synthesis to evaluation. Teachers are expected to teach using a progression from one stage to the next, starting from the recall of facts to higher levels of their application, that is, synthesis and evaluation. As to the reasons that influence teachers not assessing the higher order thinking skills is unknown (Stobart, 2008).

Meanwhile, Oduro (2015) posits that it is these higher order skills that lead towards learning process skills that have been highlighted as relevant to 21st century education. The implication of this phenomenon is that, performance of students in the classroom may seem to be above average but when students are examined in the higher order thinking skills within the concept(s) by an independent body, students' performance are likely to be low. Another implication is that students will not be able to apply their mathematical knowledge in real life situations thereby defeating the purpose of the mathematics curriculum.

In the same vein, if mathematics teachers' teaching and assessment practices elicit higher order thinking skills from students, it has the potential improving their performance in external examinations as well. It is in line with this that any good mathematics curriculum should encourage teachers to provide opportunities for all students to work co-operatively in small groups to carry out activities and projects both during class time and out-of-school time when necessary (Nabie, Akayuure & Sofo, 2013) and this would allow every student to participate in the teaching, learning and assessment process in his or her own pace in order to be successful.

2.5 Mathematics Teachers' use of Inclusive Strategies and Practices in Classroom

A teacher having diverse perspectives can enrich student learning by exposing them to stimulating discussion, expanding approaches to traditional and contemporary issues, and situating learning within students' own contexts while exploring those contexts. According to Ambrose (2004) students are more encouraged to take care of their own learning needs in classroom environment which recognizes them, draw appropriate associations with their everyday lives, and respond to students' unique concerns. To expound on this, it is imperative to say that inclusive teaching in mathematics builds upon the teacher's basic instincts to ensure that all voices are heard and all students have a chance to participate fully in the learning process, by digging a little deeper into why participation imbalances exist. To develop this complex climate, the teacher must practice a mixture of interpersonal and intrapersonal awareness, regular curriculum review, and knowledge of inclusive practices.

Inclusive education cannot be successful without the conscious contributions from several stakeholders which need to work together to make inclusion a reality. One critical agent among these stakeholders and probably the most important one for the success of inclusivity in mathematics classroom is the regular mathematics classroom teacher (Maheshwari & Shapurkar, 2015). A major portion of the responsibility for the realization of an inclusive system in mathematics classroom where excellence and equality work in perfect harmony therefore rests in the hands of the mathematics teacher (McFarlane & Wolfson, 2013). According to Das, Kuyuni and Desai (2013) teachers are the agent of change who are responsible for the successful implementation of inclusive education programs in all levels of education. Thus, if inclusive education mathematics curriculum would work successfully, then the onus lies on the teachers who are the final implementers of the curriculum. Mathematics teachers' beliefs to a great extent shape the format of instructions and learning that all students especially those with learning needs receive in a regular mathematics classroom (Das, Kuyuni & Desai, 2013). Costello and Boyle (2013), opined mathematics teachers play a fundamental role in implementing an open and inclusive environment for all students (both less privilege and regular students) in the classroom. Survey of various studies conducted on inclusive education helps to understand more about inclusion and its importance. It clearly emphasises how important the role of school and teacher is, in dealing with inclusion, and making it successful (Belapurkar & Phatak, 2012).

In spite of this provision, it has been found that some teacher factors have influence on teachers' use of inclusive education programmes, effect of which could lead to students with learning needs in mathematics still being excluded from regular mathematics classrooms. The reasons for this exclusion are multiple globally as inadequate resources for inclusive education, inadequate mathematics teachers, and mathematics teaches' inability to handle inclusive mathematics classrooms (Maheshwari & Shapurkar, 2015). Studies on inclusive education have also identified some problems facing mathematics teachers in the practices of inclusive education such as limited attention devoted to planning and preparing general mathematics education teachers for inclusivity (Simpson & Myles,1990), where majority of schools are poorly designed and few are equipped to meet the unique needs of students with special learning needs in mathematics (Singh, 2016). While numerous studies have found that regular education teachers perceive themselves to be unprepared to teach students with learning needs in mathematics (Peterson, 2011). Jelas (2000) and Gafoor and Asaraf (2009) stated that the success of inclusive education is dependent in part on the mainstream teachers' perceptions of special need students and educability of these students and on the extent of their willingness to make adaptations to accommodate individual differences. If mathematics teachers responsible for inclusive teaching practices have unclear perceptions of their role, it may seriously undermine the efforts in maintaining and restructuring of the mathematics teaching towards inclusion.

Das, et al (2013) identified large class sizes as another factor which affects mathematics teachers' implementation of inclusive education practices in the mathematics classroom. Reiff, Evans and Cass (1991), Peterson (2011) identified lack of teachers' ability to use variety of instructional strategies/activities for teaching students with learning needs in mathematics while Scruggs and Mastropieri (2000) attributed this to general mathematics education teachers' awareness of inclusive education teaching practices and strategies. Being aware about the special needs of students with learning difficulties, the necessary modifications in class curriculum, and the awareness about the need for the utilization of instructional activities are all significantly essential for mathematics teachers to be able to truly include all students in any type of mathematics education they impart. When mathematics teachers are aware and well informed about the concept of inclusion, they feel more confident about the roles they need to play in the classroom.

In a study carried out by Maheshwari and Shapurkar (2015) on awareness of the teachers about inclusive education, found that 46 teachers were unaware of inclusive education, out of which, 21 teachers said that they were cognizant of the fact that students with special needs need to be placed in regular classrooms, however they were unaware that such a concept was known as inclusive education. A lack of awareness of instructional activities to include and support students with learning needs along with other students in a regular classroom however can prove to be a major barrier in teaching and learning process (Bhatnagar & Das, 2013). This does not only affect the implementation of inclusive education in the classroom, but also has an impact on mathematics teacher' self-efficacy and disposition towards inclusive mathematics education (Maheshwari & Shapurkar, 2015). Teacher awareness has been found to significantly influence the learning environment they create for the students and the application of appropriate practices in the inclusive mathematics classroom (Bhatnagar & Das, 2013).

The awareness of teacher in the utilization of instructional activities in inclusive education by gender plays a crucial role in the implementation of inclusive mathematics education. It is important that mathematics teachers' categorization either as male or female may affect their ability to utilized instructional activities which can make a great difference in the education of their students with learning needs in mathematics. Teacher's gender not only determines the level of acceptance they show towards inclusive practices, but also affect their commitment towards the implementation of such policies (Avramidis & Norwich, 2002). It is the mathematics teacher who works most closely with the mathematics student. The knowledge that the teacher acquires and the awareness he/she holds, greatly influence the ability of students to adapt to their environment as well as their performance in the classroom. The awareness, knowledge and attitudes of the mathematics teacher also impact the effectiveness, with which inclusive practices are implemented (Maheshwari & Shapurkar, 2015).

In the inclusive environment, the educational system is designed based on students' individual needs, as this facilitates the academic and social improvement of each learner. Therefore, the adaptation of curriculum, including appropriate instructional strategies is central to the creation of a more inclusive educational environment (Eriks-Brophy & Whittingham, 2013). These instructional strategies bring life to learning by stimulating students to learn. The use of instructional strategies in the classroom has the potential to help the mathematics teachers to explain new concepts clearly, resulting in better student understanding of the concepts by constructing their own knowledge (Kadzera, 2006). It is held that good instructional strategies can never replace the teacher but make teachers as facilitator of teaching and learning processes. Even though, there has been an increase in the number of students who are less privilege in inclusive settings, not all educational environments are properly equipped to meet these students' special needs in mathematics (Berndsen & Luckner, 2012). A classroom may include different types of students; therefore, mathematics teachers should consider students' diverse needs when developing their means of instruction. This is significant to ensure that all students' learning needs are met through instruction, and it can be achieved when educators employ instructional methods that permit them to teach content in a number of different ways (Cross, Salazar, Dopson-Campuzano, & Batcheldar, 2009).

In a study by Ayantoye and Luckner (2016) on successful students, who are with special needs, their teachers who were interviewed reported that both vocabulary support and additional teaching strategies have a great impact on students' achievements. In addition, teachers in the aforementioned study most frequently stressed differentiated learning, repetition of information, and visual support as the most significant facilitators. While Florian and Black-Haewkins (2011) in their study found that the teaching approaches and strategies themselves were not sufficiently differentiated from those that are used to teach students to justify categorization as specialist pedagogy. This view, notwithstanding, Florian (2008) recognizes that what works for most students does not work with some. It means therefore that if we want all students to access the school curriculum and succeed academically, some form of differentiation is required. In order to get around the difficulty in meeting the diverse needs of students in regular education mathematics classroom, the United Kingdom Special Education Needs Code of Practice (DfES, 2001) in Gyimah (2006) suggests three main strategies. These are: setting suitable learning challenges; responding to students' diverse needs, and overcoming potential barriers to learning and assessment for individuals and groups of students. By implication, inclusion is not intended to frustrate teachers, but to identify ways to make all students succeed in the mathematics lessons. Mathematics teachers can achieve this by adapting both the physical environment and the curriculum to ensure that every student benefit from the learning experience. This calls for prior planning to enable organization of learning materials that are appropriate for enabling all students to follow the mathematics lesson.

2.6 Inclusive Education and Teacher Knowledge about IEMC

The whole idea of inclusive education is built on the concerns of getting all kinds of students from diverse backgrounds to have the best equitable education for all. The efforts toward an inclusive education in our societies have significantly changed the nature of the provision of special education which hitherto was seen as a place for certain category of student. The struggles for inclusive education have had a tremendous impact on the role of regular classroom teachers, who must provide, nurture, support and cater for the needs of the growing number of different categories of students with diverse needs to benefit from the teaching and learning process in the classroom (Engelbrecht et al., 2016; Mitchell, 2010). This inclusion according to some researchers such as Casely-Hayford, Seidu, Campbells, Quansah, Gyabaah and Adam (2013) has both social and academic dimensions.

The social dimension of inclusive education involves social interactions and social exchanges of students such as eating, playing, and engaging in out-of-classroom activities together between and among students with diverse characteristics and conditions (Mónico, Mensah, Grünke, Garcia, Fernández & Rodríguez, 2018). The academic part of inclusive education comprises with the ability of the students to participate in teaching and learning activities in the classroom which requires more training for and participation from teachers (Mónico et al., 2018). The true realization and ultimate success of inclusive education depends largely on the regular classroom teachers (Mitchell, 2010), and teachers' knowledge about inclusive education is one of the most important elements in the actualization and successful implementation of inclusive education (Mónico et al., 2018).

However, most teachers do not have enough knowledge in diversity and inclusion which make it difficult for such teacher to accept responsibility for students with diversified backgrounds. In some instances, the teachers may not have the skills required to assist students with different learning abilities in the same classroom (Gök & Erbaş, 2011; Batu, 2010). Studies have shown that there is a relationship between teacher's knowledge about inclusive education and the kind inclusive practices demonstrated by the teacher in the classroom and this is seen in several researches which have established the link between teachers' training in SEN/D, their attitudes towards inclusion, and their inclusion practices (Beacham & Rouse, 2012; Florian & Black-Hawkins, 2011; Sharma, Forlin & Loreman, 2008).

The situation now for the current study is whether teachers of senior high schools really have enough knowledge and required skills about inclusive education since the success of any form of inclusion demands the teacher to modify the instructional arrangement and classroom setting, use effective instructional methods and strategies such as differentiated pedagogy and scaffolding, adapt instruction, and provide equal learning opportunities for all children (Bricker, 2000). They are also expected to assess children's development, prepare an effective learning environment, engage all children in learning activities, use different instructional methods and strategies, and work with families for the benefits all learners (Bruns & Mogharberran, 2009). The lack of knowledge, skills, and experiences to fulfil these roles is one of the most important barriers to effective inclusion (Pivic, McComas, & La Flamme, 2002; Soodak, Erwin, Winton, Brotherson, Turnbull & Hanson, 2002).

It is emphasized in literature by scholars that teachers lack the requisite knowledge necessary for the teaching of children with special needs and that majority of the teachers in the mainstream school system do not have what it takes to implement inclusive education curriculum in their classrooms (Agbenyega & Deku, 2011; Ocloo & Subbey, 2008; Agbenyega, 2007; Odom & Bailey, 2001). According to scholars such as (Dinnebeil, McInnerey, Fox, and Juchardz-Pendry, 1998; Wesley, Buysse, & Tyndall, 1997) as emphasized by Sucuoglu, Bakkaloglu, Iscen Karau, Demir and Akalin (2014), regular school teachers themselves admit that the most critical hurdle to the admission of students with special needs into their classrooms is their own inadequate knowledge and experience in inclusive system of education and its related practices. In fact, in many instances, the regular school teachers believe that they do not have adequate training sufficient enough to manage diversity in their classrooms (Amr, Al-Natour, Al-Abdallatb & Alkhamra, 2016; Agbenyega & Deku, 2011; Sharma, Forlin, & Loreman, 2008).

Indeed, most teachers have the feeling that there is the need for knowledge acquisition and experience with inclusive education (Sadler, 2005), especially in the areas of mechanisms and strategies to support and promote interactions among students of diverse needs in general classroom for effective teaching and learning that benefits all students (Bruns & Mogharberran, 2009; Küçüker, Acarlar, & Kapçi, 2006; Varlier & Vuran, 2006). When teachers of mathematics in SHS are well verse with the knowledge of inclusivity, most of them would understand the differences that exist among students and prepare their lesson in such a way that all the students would be in mind when delivering the lesson. If teachers have every learner at the back of his/her mind teaching would be done to benefit every learner to understand the lesson in the students on way since all the learners would be actively involved the lesson and are likely to be successful based on their own abilities. Additionally, mainstream teachers also need the support of various educational stakeholders such as institutional heads and parents, seek experts' advice in activity planning in the teacher's schedules, and get access to necessary resources (Odom, 2002; Werts, Wolery, Snyder, & Caldwell, 1996). This is important because, according to Agbenyega (2007), as teachers gain the extensive professional knowledge needed about inclusive education; they change their attitudes and do well in the use of inclusive education curriculum practices. In addition, experience and contact with SEM students improves regular teachers' knowledge and confidence in working with inclusive principles and the teachers eventually cater for every student in the class. According to Beacham and Rouse (2012), the balance among knowledge, skills, and attitudes is critical in inclusive education since it is accepted that increasing the teachers' knowledge and experience improve the quality of inclusion in the classroom (Bredekamp & Copple, 1997; Werts et al., 1996).

2.7 Teacher's Strategies for Inclusive Teaching in IEMC

Teaching and learning under inclusive education mathematics curriculum refers to modes of teaching and learning that are planned in a collaborative manner to actively engage, involve and challenge all students to participate in the teaching and learning process according to individual students' abilities so as to be successful. The development of mathematical proficiency and competency is known to be highly dependent on effective and proper teaching practices. This is why Corwin (2018) suggests that there is significant evidence pointing towards teaching practices that support the development of mathematical proficiency and these practices include;

1. Establish mathematical groups to focus learning: the mathematics teacher in an inclusive classroom establishes clear goals for the mathematics that students are learning, situates the goals within learning progressions and uses the goals to guide instructional decision. In this case every student in the classroom is brought on board to actively participate in the teaching and learning process.
2. Implement tasks that promote reasoning and problem-solving: inclusive education mathematics teacher engages students in solving and discussing tasks that promote mathematical reasoning and problem-solving and allow multiple entry points and varied solutions strategies. This brings about the ability levels of learners which guide the teachers to employ scaffolding and differentiation teaching methods.
3. Use and connect mathematical representations: mathematics teachers engage students in making connections among mathematical representations to deepen students understanding of mathematics concepts and procedures and apply these concepts and procedures as tools for problem solving.
4. Facilitate meaningful mathematical discourses: mathematics teachers in inclusive system facilitate discourse among students to build shared understanding of mathematical ideas by analyzing and comparing students' approaches and arguments about mathematical issues.
5. Pose purposeful questions: mathematics teachers in inclusive classrooms use purposeful questions to access and advanced students reasoning and sense making about important mathematical ideas and relationships in order to advance the mathematical development of all students.

6. Build procedural fluency from conceptual understanding: mathematics teachers build fluency with procedures on a foundation of conceptual understanding so that students over time become skillful in using contextual and mathematical procedures.
7. Support productive struggle in learning mathematics: in the inclusive education mathematics classroom, mathematics teachers consistently provide all students, individually and collectively with opportunities and support to engage in productive struggle as they grapple with mathematical ideas and relationships.
8. Elicit and use evidence of student thinking: mathematics teachers use evidence of students thinking to assess progress towards mathematical understanding and to adjust instruction continually in ways that support and extend learning for all students.

2.8 Demand and Supply of Mathematics Teachers

The teacher is anyone who has undergone complete professional education training and is regarded as a moral instructor, moral educator and a moral model for his students (Akinpelu, 2003). S/He is someone who teaches and imparts knowledge and skill, guard and guides the pupil, student or learner through worthwhile experiences resulting in knowledge, attitude or behaviourial change in the learner. However, it is only when the behavioural and attitudinal change in the pupil or student is positive that, one can assert that the teacher and probably the learner are the most important factors in any education system. The teacher determines to a great extent the success or failure of any teaching learning relationship and a proper implementation of the curriculum. It follows therefore that the quantity and quality of teachers in any educational system determine its strength and effectiveness (Chukwu 2011).

The demand for and supply of teachers especially mathematics and its related subject areas as physics, chemistry and biology have been in ascendency. This could be attributed to factors such as low production of mathematics and science teachers. Increasing teacher retirements and increasing student enrolment in many countries such as free senior high school in Ghana. The assessment and analysis of demand and supply of teachers in a country have to consider the dynamics of teacher labour market which operate within. In spite of this, it is extremely difficult to involve all the economic, social and psychological factors which may have bearing on demand and supply of teachers in the equation. According to SACE (2010) most people tend to restrict issues concerning teacher demand and supply to classical economic analysis leaving these sociological and psychological aspects that could play major role in the analysis of teacher demand and supply. The sociological aspects include social perception of the teaching profession while the psychological part deals with the choices individuals make with regards to the teaching profession.

The labour market for teachers in many parts of the world especially in the sub-Saharan Africa does not operate in a free market per se not even in Ghana. Instead the market operates within a monopoly market with a dominant purchaser of the services, in most case the government than multiple purchasers as in a free market. In view of this the purchase of teacher services does not necessarily obey the pricing principles that respond to demand and supply. It rather indicates the desire of the monopoly to pay leaving teachers with limited options to willingly supply their skills. As such there is always a danger that teachers are underpaid or overpaid, relative to other professions or relative to the scarcity of their service. However, the choices teachers make as free agents, also affect demand and supply within the monopoly system. This means the study of demand and supply should always consider government actions and the choices individuals make relative to teaching. It is reported that for over two decades in the United States, educational stake holders and governments have forced many school systems to lower standards to fill teaching openings, leading to high levels of under qualified teachers and, in turn, to lower student performance (Ingersoll & May 2010).

The remedy to the shortage of mathematics and science teachers is not far from fetch: the prevailing policy now and in many instances in the past has been to increase teacher supply (Rice, Roellke, Sparks & Kolbe, 2009; Fowler, 2008; Darling-Hammond, 2007). For instance, about two decades of implementing the 1987 reform in Ghana, a national study was conducted as part of efforts to address "the problem of making available an adequate number of trained teachers for instruction in schools" (Quansah, 2003, p.1). The study revealed that an estimated teacher shortage of 40,000 trained teachers in the country's public basic school system, with untrained teachers filling 24,000 of the vacancies. In response to this, Government's introduced a quick teacher preparation programme by distance which was dubbed "Untrained Teachers Diploma in Basic Education" (UTDBE), the programme targeted untrained basic school teachers who studied by distance using modules, with periodic face-to-face interactions with tutors to earn professional qualification for teaching in basic schools. Also, many measures have been implemented to recruit fresh graduates and candidates to teaching. These include career shift programs, such as Nation Builders Corps (NABCO) in Ghana and the American "troops-to-teachers" programme which was designed to entice professional into mid-career switches into teaching, and the teach for America programme which was made to lure academically talented graduates and candidates into under staffed school to go and teach. Further, many states have established different certification programmes, that allow college graduates to defer some or all of their formal education training and begin teaching immediately. Some school districts have resorted to recruiting teaching candidates from overseas. Financial incentives, such as signing bonuses, student loan forgiveness, housing assistance, and tuition reimbursement, have all been instituted to aid recruitment into teaching different states (Hirsch et al., 2001; Liu et al. 2008; Rice et al., 2008; Feistritzer 1997). These initiatives in most instances targeted the mathematics and science fields.

However, some researchers believe that the reasons for these staffing problems are more complex and varied than simply an insufficient production of new teachers and mere recruitment of graduates to fill the understaffed schools (Ingersoll & Perda 2010; Ingersoll & May 2010). These researchers opined that beginning in the mid-1980s and continuing to the present, elementary and secondary student enrolments in the United States for instance have grown steadily. Over the same period, high school graduation course requirements increased in the core academic subjects, especially in mathematics and science. This led, in turn, to a dramatic rise in the number of students taking mathematics and science courses over the past two decades. Mathematics course enrolments grew by 69%, and science course enrolments grew by 60%. In addition, during this period, the number of teacher retirements increased by a striking 141%. All of these factors led to a large jump in the demand for new mathematics and science teachers, and it is expected that there could be worsening shortages if the trend continuous.

2.8.1 Dynamics of teacher demand

Demand for teachers, as explained by Zabalza, Turnbull and Williams (1979), cited by Mireku (2000) is complex to define easily and adequately because of the numerous usage of the term ‘Demand’ in other types of labour as required in different industries. However, the term ‘demand for teachers’ as applied in this study refers to the total number of professionally qualified and trained teachers needed to provide and execute teaching skills that will produce a certain specified output from an educational system. In other words, without teachers of a certain number and description, the output targets of an educational system cannot be achieved (Mireku, 2000). Donitsa-Schmidt and Zuzovsky (2014), analysed the definition of demand based on demand theory and stated that demand is the number of available job positions offered for certain compensation.

Supply on the other hand refers the number of qualified individuals both able and willing to offer their services in a particular line of work, depending on compensation. Compensation includes wages, bonuses, future earning possibilities and other types of rewards that can be encompassed under the heading of 'working conditions' and incentives, including status in society. Teacher shortage in the labor market occurs, therefore, when demand exceeds supply and is the result of an increase in demand, a decrease in supply or both occurring simultaneously. However, the operational definition of teacher shortages is not consistent. Some define it according to an observable quantitative measure. Since it is hard to rely on this measure as usually most positions are filled at the beginning of the school year and no class is left without a teacher, another measure is a 'hidden shortage', i.e. the number of under-qualified teachers hired to fill the empty positions. These include both unqualified teachers as well as teachers who were trained to teach other school subjects or class levels

Demand for teachers come as a result of inadequate teachers available to equate the number of teachers needed to meet teaching requirement of the education system at a given educational level (SACE, 2010). This implies that there are not enough teachers to teach the enrolled students in schools at that particular moment. For instance, Mereku (2019) argues that even though there have been remarkable increases in pupils' enrollment rate over the past decade, there have not been a commensurate increase in teachers because there is very little increase in the rate at which teachers were produced. That is, though pupils enrollment at the basic level increased by over 60% in the last decade, the increase in the rate of teachers at post during the same period was very low leading to an excess of demand over supply of teachers. Also, when Ghana introduces the free SHS policy in September, 2017, the students' enrolment almost doubled leading to the creation of double track system. This resulted in an urgent need of teachers particularly mathematics teachers to fill the vacancies that were created by the rise in enrolment. But one of the biggest challenges in estimating demand is navigating the difference between ideal demand and actual demand. Ideal demand requires defining the desired pupil-teacher ratio, geographic teacher distributions, and course requirements to determine the perfect number of teacher's necessary each year (Samadi, 2020). The actual demand represents reality, the need for teachers based on the number of teachers actually hired and employed. In this case, actual demand dropped, but ideal demand did not. In an ideal sense, schools would like, at a minimum, to be able to maintain the number of teachers and return to the class sizes and course offerings they had in place before the recession (Leib et al, 2016).

There are many factors which contribute to demand for teachers in a given educational system. These factors include the number of teachers on duty, teacher quality, student enrolment, Pupil Teacher Ratio (PTR), class size, number of classes, number of streams, teacher workload, number of teachers employed and Government policy. These factors were considered representative of the critical driving forces behind trained teacher availability and decisions as well as Government policies on secondary school teacher employment (Boe, 2006; MOEST, 2005b).

2.8.1.1 Number of teachers on duty

The number of mathematics teachers employed at a given time or period to teach in high schools is more of a policy arrangement by governments to meet the demand for teachers. The main approach to increase the number of mathematics teachers involves employing both monetary and non-monetary incentives to make teaching more attractive and more flexible to enter. One strategy to increase mathematics teachers' supply to meet demand is to lower mathematics teacher qualification standards by employing less qualified mathematics teachers without full certification or asking certified teachers from related field to teach mathematics subjects in which they have no standard qualification, usually referred to as out-of-license and out-of-field teaching respectively (Cobbod, 2015).

2.8.1.2 Teacher quality

According to Intisar and Ya-Fei (2019) teacher quality is a complex phenomenon for which no general and absolute agreement exists concerning an appropriate and comprehensive definition. Two areas typically have been considered by researchers and policymakers as candidates for describing teacher quality: (a) teacher inputs including teacher characteristics, professional preparation, and license and (b) classroom effectiveness which are frequently measured in line with student performance on standardized tests. In spite of huge emphasis placed on teacher quality, educators and policymakers mostly disagree over the definition of teacher quality, how it should be evaluated and how it should be interpreted and used. It is therefore imperative to put the quality of the mathematics teacher in perspective of professional competence, academic prowess and teaching or job commitment. If the mathematics teacher has the right academic training, good professional training and the teacher is willing to teach, then there is that likelihood of becoming quality mathematics teacher.

The concern for quality education in the developing nations in particular is critical because of the interdependence between education and productivity, between education and human capital development and between education and the demands of the labour market. Any serious discussion on quality education cannot ignore the need to maintain sustainable and efficient teacher training, since at the heart of the education debate is the teacher. It is in this light that national policies are vital especially in the developing nations on such issues as teacher supply and demand, quality of training, funding, and curriculum development and implementation (Ntim, 2013).

According to Michelle (2018), the quality of mathematics education in schools particularly high schools depends on the quality of the teachers because since the teacher is the main implementer of the curriculum and whether students would be successful or not in the syllabus depends much on the implementer. To be able to fulfill the requirements for STEM education in Ghana, the education of Ghanaian students should critical be provided by motivated teachers with content and pedagogical proficiency in Mathematics.

2.8.1.3 Student enrolment

Student enrollment directly influences teacher demand. An increase in the school age population corresponds with an increase in the number of teachers needed in the education system, as long as pupil-teacher ratios remain constant. Future public school enrollment numbers can be estimated by looking at birth rates, public school attendance rates, and immigration and migration patterns. These indicate how many school age children will enter school. Once the number of students entering school is estimated, historical data can be used to model how many students will stay in school and for how long.

2.8.1.4 Pupil Teacher Ratio (PTR)

Opanug, Okagbue, Oguntunde and Amina (2019) explain that the pupil-teacher ratio (PTR) is the total number of pupils in a particular school divided by the total number of qualified teachers. PTR is often confused with "class size" even though; they are different but similar metrics in educational evaluation. PTR is a key indicator in measuring quality and equity in public schools especially in public primary education. Other indicators may include, but not limited to: educational qualification of the teacher, health condition and intellectual quotient of the pupil, psychological variables such as externalizing or internalizing behaviour, motivation of the teachers, the quality of teaching and teaching aids, school-home distance, quality of curriculum and educational policies, social and environmental factors (Abiodun, 2017).

In schools with smaller student teacher ratio, teachers can have more time to spend with each student and check the progress of every student they are responsible and can provide a more individualized teaching that is more suitable to each student. There are lots of studies about class size but not that much about student teacher ratio although student teacher ratio is at least as important as the class size (Nizamettin & Celika, 2014).

Idowu and Oluwole (2014) believe that the ratio of students to teaching staff compares the number of students (in full-time equivalent) to the number of teachers (in full-time equivalent) at a given level of Education and similar types of institutions. However, this ratio does not take into account the amount of instruction time for student compared to the length of a teacher's working day, nor how much time spend teaching. It therefore cannot be interpreted in terms of class size. Also, this kind of comparison of students to staff ratio fails to address area specific of the teachers in the school which sometimes makes it difficult for teachers who teach core or general subjects such as English and mathematics.

2.8.1.5 Class size and Number of classes

Bahanshal (2013) claims that finding a definition to an idealistic class size which could be applicable in almost all teaching and learning environment tends to be difficult. Interestingly, teachers in sciences, English and mathematics in particular, always favour small classes and believe that students in small classes learn better than their counterparts in large classes as more practice and activities are employed. In larger classes, more time is needed for non-academic activities related to administrative and organizational procedures and to the management and control of discipline. Reductions in the quantity of learning opportunities constrain teachers from achieving the necessary pace, depth and breadth of curriculum coverage as class size increases (Bahanshal, 2013).

Numerous studies have investigated the influence of class size on student attitudes, behaviors, and outcomes (Mulryan-Kyne, 2010; Cuseo, 2007; Carpenter, 2006). The conventional wisdom among parents, teachers, school administrators, and policy makers is that smaller class sizes translate to improvements in student learning and outcomes. The difficulties in assessing the causal influence of class size on student outcomes, such as achievement, are class size itself is often not directly observed but rather proxies by pupil-teacher ratios at the state, district, or school level (Monks & Schmidt, 2010).

According to Lloyd-Strovas (2015) teaching large classes can be challenging. Logistical concerns, such as taking attendance, grading, and providing frequent and detailed feedback, can quickly become unmanageable. A lecture-based, large classroom leads to very little interaction between instructor and student, causing the student to feel anonymous and isolated especially in an inclusive education mathematics classroom.

2.8.1.6 Number of streams

The free SHS policy which was introduced by Ghana government has successfully enhanced the Free Compulsory Universal Basic Education (FCUBE) agenda of Ghana. This has gone a long way to assured the people of Ghana, a general access to schooling for all children (Mensah, 2019). In fact, in the first term of the 2017/2018 academic year, enrolment into first year of Senior High School was 424,092 students, representing approximately 63% increase in first-year enrolment over that of 2014/2015 academic year which was 260,210 students (Ministry of Education's

EMIS, 2015). The government's successful implementation of Free SHS policy to meet increasing demand for secondary education significantly raised the enrolment levels in SHS which caused the Ministry of education (MOE) to introduce double-track system (DTS) in senior high schools as a temporal measure in about 400 senior high schools to accommodate more students and ease congestion in senior high schools (MOE, 2019).

Mensah (2019) establishes that it can be estimated that, secondary education is going to be the primary tool for enriching human capital in the country in the next few years. The study further asserts that due to an overwhelming increase in enrolment in Senior High School owing to the implementation of the Free SHS policy, pragmatic measures should be put in place address issues relating to the rising numbers. These include double track system which divides the total student population and staff into two tracks, whiles one of the tracks attends school, and the other is on vacation and vice versa. Botchway (2019) argues that DTS lives us with many unanswered questions. The DTS has introduced the shift system into the senior high schools hence graduates of Junior High School go to school in batches. While one track is at home, on vacation the other goes to school. The reformation has been seen through curricular and attendance. Some few years back the Ghana education service adopted a system called the shift system, this was introduced to cater for all children of school-going age due to the inadequate school infrastructure such as classrooms in the country (Botchway, 2019). Many have praised the government for rolling out the Double Track System which gives many BECE graduates the chance to have access to secondary education but, what is the quality of such a system?

2.8.1.7 Teacher workload

Workload according to Amalu (2014) is the sum of all activities that take the time of an employee. Workload can at times be heavily overload or light (under load). Role overload is a situation in which employees feel they are being asked to do more than time or ability permits. It is further stated that working under time pressure can be stressful because people are anxious when they have a lot to do before some deadline, as time runs out a feeling of impending disaster increases (Amalu, 2014)

Cobbod (2015) argues that authorities would always ensure that teachers are present to staff almost all classrooms, even if that requires the lowering of standards. Governments usually respond to inadequate supply of teachers by using one of two broad options: increasing the workload of the available teachers or adding to their number. Increasing the workload of teachers involves increasing class sizes and/or the average number of classes assigned to each teacher and lengthening teachers' working hours in return for salary increase sometimes (Cobbod, 2015). An alternate to this policy is the "double-shift" scheme where schools run classes for one group of pupils in the mornings and another group in the afternoons. This kind of system results in reduced investment in equipment and fewer teachers, and has an additional advantage of coping with the inadequate infrastructure and teaching-learning materials. In a study by ILO (1991b) the act of employing overloading tactics usually by developing countries can "eventually drive qualified teachers into other professions, particularly as general working conditions and real salary rates continue to deteriorate" (ILO, 1991b p.17).

2.8.1.8 Number of teachers employed

The number of mathematics teachers employed at a given time or period to teach in high schools is more of a policy (National Employment Policy, 2014) arrangement by governments to meet the demand for teachers. The main approach to increase the number of mathematics teachers involves employing both monetary and non-monetary incentives to make teaching more attractive and more flexible to enter. One measure is to lower mathematics teacher qualification standards by employing less qualified people without full certification or asking certified teachers to teach subjects in which they have no qualification, usually referred to as out-of-license and out-of-field teaching respectively (Cobbod, 2015).

2.8.1.9 Government policy

Osman (2002) defines policy as a detailed statement that determines the vision and aspirations, and provides procedures for carrying out the vision. It is viewed as a standard decision rule, a regulation, or a set of instructions that apply in all similar situations. Osman (2002) further sees policy as the outcome of political influence, which determines and sets limits to what the state does. Policies roiled out by governments of nations to deliver social goods to the populace are termed public policies. Rutkowski (2007) defines policy knowledge as 'the body of knowledge available to assist policy-makers in their understanding of the causes and consequences of the outputs of government and the subsequent society impact. Policy in this regard could mean a set of tested rules and principles prescribed especially by government for members of the society to define the levels that one can go in that field so as to influence the activities of the society positively. Education policy is therefore the principles and government policy-making in educational spheres together with the collection of laws and rules that govern the operation of educational systems (Asamoah & Abarichie, 2017). Education policy also refers to government decision rules regarding education, schools, colleges and universities and/or their related matters. For instance, government rules regarding school attendance, graduation, college entry, content for study, teachers recruitment and retention, payment, etc. Government, sector Minister, Governors or Regional Ministers, Mayors, Municipal and District Chief Executives executive's orders as well as statutes and ordinances enacted by legislative bodies and judicial decisions issued by courts are some of the means by which educational policies emerge (Asamoah & Abarichie, 2017). The free Education Policy demands that states build assessment systems that track the achievement of all students against a common set of high instructional standards. In addition, government of Ghana capitation grant policy was meant to contribute to an increased access and participation in primary education and the recent free senior high school policy are all measure to get every child on board to attain secondary education.

Viennet and Pont (2017) Pressures on education systems grow to deliver high-quality education and the number of reforms increase, policy makers do not necessarily grant much attention to their implementation. Education policy implementation is a complex, evolving process that involves many stakeholders and can result in failure if not well targeted. It is therefore crucial to understand it, clarify its determinants and explore ways in which it can be more transparent and effective. There is indeed a difference between passing a policy bill or a strategy and turning it into daily practices for teachers, school administrators and local communities. Implementation details may be left for administrations and educators to figure out, effectively leaving the reform process half-way through. Challenges to implementing education policy include co-ordination issues, inadequacy of organizational resources, actors' capacity or reactions against reforms. But as the education sector has become more complex, the challenges of putting change into practice have also evolved. Education stakeholders are increasingly diverse and growing more vocal and ambitious about what education systems should look like.

Other factors are attrition rate, economic situation of the country and cost of education. It is also worth mentioning that teacher demand can also be attributed to some minor issue such as teachers teaching outside their specialized area, or teachers moving to other schools, even though such teachers might not have left the teaching profession entirely (Eide & Goldharber, 2005; Stinebrickner, 1998).

The economists believe that teacher demand is a function of prices for the purchasing of teacher services relative to the number of teachers the government and few private sponsors are willing to purchase at a particular price. This economic interpretation reveals that there could be potentially qualified teachers who may intentionally avoid the teaching appointment if the current prices the government is willing to pay are below teachers' reservation price leading to increasing demand (SACE, 2010). It is therefore important and critical for government, private employees and policy makers to do some cost benefit analysis on the price they are willing to pay for employing teachers.

2.8.2 Dynamics in Teacher Supply

Adeyemi (2008) Supply, an economic concept had been described as the quantity of a commodity that is called into the market over a particular period of time at specific prices. An increase in supply tends to lower the price and increase the quantity demanded. Conversely, a decrease in supply causes a rise in price and consequently reduction in the quantity demanded. Relating the supply situation to education, prices such as salaries (the price of labour) are determined in the same way as the prices of goods. The major determinants of the supply of science and non-science teachers are the salaries or wages. Teachers' salaries are good determinants when considering the economics of teacher supply. This is because the educational system competes with other occupation in the labour market in a market economy. In view of the fact that the period for training of teachers takes considerable time, it becomes difficult, for market forces to provide immediate solution to the supply of teachers. The second component of the teacher labor market is teacher supply. States and districts need accurate information about production and availability of future teachers to assess and plan for their workforce needs. To evaluate the current condition of teacher supply, we first identify indicators of teacher preparation program enrollments and completions (Leib et al, 2016). Like teacher demand, there are several different ways to think about teacher supply. One way to analyze supply-side dynamics is total teacher supply. Total activated teacher supply could be conceptualized as the entire teacher workforce. Examining the pool of teachers who will potentially be available to fill empty classrooms is a second way of looking at teacher supply and is most relevant to labor force analysis. This teacher supply can be thought of as the number of potential teacher entrants who were not teaching in the previous year, who are either new entrants to the profession or re-entrants who have stepped out from teaching for a period of time.

Michelle (2018) opines that to be able to fulfill the demand for qualified mathematics teachers by attracting the best candidates, specific recruitment strategies must be developed. When one knows what factors attracted or influenced students who have already chosen mathematics as their specializing subject at university level, to choose teaching as a career, those strategies can be geared to accomplish the goal of increasing the numbers of high quality, professional and committed mathematics teachers. Student teachers' motivation to choose teaching as a career also correlates with their job satisfaction, which contributes to the retention of these teachers in education.

The supply of teachers at any level of education and in every part of the globe cannot occur in isolation. The decision of individuals to opt for teaching as a career after schooling is a critical point that needs serious consideration when assessing whether there is adequate supply of teachers; it also affects the quality of people who choose to enter the teaching profession. It is one thing deciding to enter the teaching profession after graduation, really entering and then staying in the profession till retirement.

Supply of teachers can also be contributed by the inflows of people who are professionally qualified to teach but not teaching. This source of teacher supply could be complex in that with the introduction of unemployment interventional policies to get most graduate employed, there are individuals who are not trained teachers but still represent a pool of teachers in the system.

Another factor that needs serious consideration when it comes to sources of teacher supply is the nature and policies of the country on teacher licensing issues. The conceptual confusion compounds when we turn to the more important term, 'qualified teacher,' because of the different standards used. In a country like the USA, every state defines a qualified teacher quite differently, with varying requirements for knowledge of subject matter, pedagogy, curriculum, assessment, learners and learning (Darling-Hammond, Berry, Haselkorn & Fiedler, 1999). The America 'No Child Left Behind' Act defines a qualified teacher as one who has full state certification or a pass score on state teacher examination and who receives professional development which enhances subject matter knowledge, aligns with standards, and improves instructional strategies based on scientifically based research (Cochran-Smith, 2003). Such a teacher would demonstrate competence in each subject area he/she teaches. At the same time, the Act grants states discretion in determining what a 'highly qualified' teacher is.

However, in some counties such as was the situation in Ghana, qualified teaching standards are embodied or assumed to be embodied in the pre-service education curriculum; they are therefore not separately assessed outside the formal assessment of the pre-service course. A teacher is regarded as professionals just on the basis of their success in the examinations conducted by their training institutions such as the colleges of education and the teacher education universities (Cobbold, 2015). But the Education Act, 2008 (Act 778) makes provision for the implementation of Teacher Licensure in Ghana. According to Act 778, the National Teaching Council (NTC) is to "register teachers after they have satisfied the appropriate conditions for initial licensing and issue the appropriate license" (Kofie, 2017). Interestingly, the first licensure examination took place in 2018, a decade after the passing of the act. Graduate from various institutions willing to teach have since been writing the teacher licensure examination every year to become professional teachers.

Finally, foreign qualified teachers who may be willing to work in the country's teaching field through various educational agencies like the UNICEFF, DANIDA, US Aid, etc could also be a source of teacher supply but this source of supply seems to be negligible in this contest.

It has always been barely possible to predict the number of people who will choose teaching as a profession. Even those who study education in school, it is not a done deal for them that after graduation they will enter the teaching profession instantly or ever. There is no guarantee that such individuals will become teachers or opt for different jobs. Even those who take teaching appointments do not provide full assurance that they will continue working as teachers for the rest of their working life, or work in a particular school or location. United State for example, produced 8,021 new mathematics teachers at the end of the 1999-2000 academic year which was over twice the number of mathematics teachers who retired (3,915), but was smaller than the number of mathematics teachers who left teaching that year (13,750) (Ingersoll & Perda, 2009).

In view of these, many researchers of demand for and supply of teachers relate the supply of teachers to human capital, choice of labour and compensation theories (Boyed, Lankford & Wyckoff, 2004; Bobbit, et.al 1991, Kirby & Grissmer, 1991). These theories assume that as normal and rational human beings, people seek to maximize the benefit and satisfaction they derive from the work they do (Gilford & Tenenbaum, 1990). This means that the utility derived from one's work affects the individual's choice regarding the job, the human capital one would wish to invest in and geographic location of where an individual would like to work (Dolton, 2004; Murnane, Singer, John, 1989). It is therefore imperative for every nation that wishes to get more people into a particular field of job (profession) including teaching to consider the utility likely to be derived from the profession (teaching), not only in terms of pecuniary rewards (earnings, monetary incentives) of teaching but also its non-pecuniary rewards (opportunity costs, status of the profession, opportunities for self, academic and professional development, probability of being employed, more holidays). `

It is also important for policy makers and various stakeholders of education to recognize that even after an individual has chosen teaching as a profession, the one has the right to make a choice of a geographic location to work in or not to enter the teaching profession altogether (Falch & Strom, 2005; Shield et. al, 2004, Podgusky & Monroe, 2004). The decision regarding the location or area to teach is affected by many factors which may be financial, road network, social amenities, and other resources. It is evident that certain limited non-financial rewards associated with certain areas (semi-urban and rural areas) with limited resources, impede on the satisfaction derived from teaching in such areas as compared to teachers who are in areas with abundant resources that are valued by all. This is critical, because teacher salary in Ghana and many other African countries (such as Nigeria and South Africa) is equal at equal levels and ranks regardless of the school location and or available resources.

In terms of utility derived from the teaching profession those teachers who find themselves in rural school, derived lower utility than those who are in urban schools that are resource endowed. Teachers who experience reduced utility will either exit the teaching profession in any least opportunity or move to schools that increase their utility by increasing the non-financial part of the utility. This would explain some of the assertions that indicate shortages in rural schools because teachers do not supply labour in these areas, more especially science, mathematics and language teachers. For example, the Ministerial Committee on Rural Education in South Africa (2005) found out that rural areas were experiencing shortages of competent and qualified teachers. Also, Australia has difficulty in recruiting teachers for positions outside the metropolitan and larger urban centres, specifically, in all states and territories, vacancies for mathematics, science and information technology secondary school teachers have been hard to fill in rural and remote areas (MCEETYA, 2001, 2003). Murphy, DeArmond and Guin (2003) revealed that the much publicised teacher shortage in the USA was not a national crisis but a regional challenge: urban schools and those with relatively high populations of minority and low-income students bore the impact of the shortage; and southern and western states were much hit than other regions. There was also trouble in recruiting well-qualified teachers for inner cities and rural communities, where working conditions were poor and pedagogical demands were far greater (Darling-Hammond & Sclan, 1996). Similarly, Dolton, Tremayne and Tsung-Pine (2003) reported of a geographical mismatch of those seeking teaching jobs in UK and where teachers were needed. According to them, there were more teachers needed in London and the Southeast, although many more qualified teachers sought jobs in the North of England. In developing countries such as Ghana, teacher shortages have historically been critical in rural and farming communities (Colclough & Lewin, 1993; Lockheed & Verspoor, 1991).

2.9 Chapter Summary

The related literature relevant to the study which were reviewed included the concept of inclusive education. It was found that the concept of inclusivity is a complex phenomenon making it difficult to have generally accepted. The concept was contextualized to mean any form of education that supports every student in terms of diversity and equity (Mitchell, 2005; UNESCO, 2001; Skrtic et al, 1996).

The theoretical framework for the study was based on the theory of equal opportunities propounded by Sharman and Wood (1982). This theory is in line with the advocates in mathematics education known as the "social turn" which coordinate cognitive and physical environment (Lerman, 2000).

Studies about inclusive education in Ghana were reviewed and was found that inclusive studies have been restricted to special education needs. The studies do not deal with general diversity and equity in terms of students' abilities in mathematics classroom (Vanderpuye, 2013).

The challenges of inclusive education in Ghana in relation to senior high school mathematics curriculum were reviewed with the implementation of the inclusive policy, mathematics teachers are expected to exhibit inclusive education concepts and practices in their mathematics classroom for the benefit of all students.

The dynamics of demand for and supply of mathematics teachers were reviewed under the following; teacher quality; number of teachers on duty; students' enrollment; pupil teacher ratio; class size; number of classes; number of streams; teacher workload; number of teachers employed and government policy (SACE, 2010; Ingersoll & May, 2010; Darling-Hammond, 2007).

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Overview

This chapter covers the research methodology used for the study. It discusses the research paradigm, the design, population, sample and sampling procedure, instrumentation, piloting of the instruments, data collection procedure and data analysis procedure.

3.1 The Research Paradigm

Research paradigm defines the worldview, the thinking, the belief or the school of thought ascribed by a researcher (Kivunja & Kuyini, 2017). It describes the philosophical underpinning which guides the study. There are four main research paradigms, namely; positivism (i.e., modernism), interpretivism (i.e., constructivism or post-modernism), critical or transformative and pragmatism. The Positivist paradigm describes a worldview to research, which is grounded in using scientific method of investigation. It is used to search for cause-and-effect relationships in nature and tries to interpret observations in terms of facts or measurable entities (Fadhel, 2002).

The Critical paradigm defines the worldview of research which is grounded in issues of social justice. It seeks to address the political, social and economic issues, which lead to social oppression, conflict, struggle, and power structures in the society. It also seeks to change the politics so as to confront social oppression and improve the social justice leading to transformation in the socio-political system (Kivunja & Kuyini, 2017). The Interpretivist paradigm is the worldview of researchers that is grounded in understanding the subjective world of human behaviour and experience (Guba &

Lincoln, 1989 cited in Kivunja & Kuyini, 2017). This approach tries to understand and interpret what the subject is thinking or the meaning one is making of the context. The main tenet of the Interpretivist paradigm is that reality is socially constructed (Bogdan & Biklen, 1998). The pragmatist paradigm defines the worldview which provides methods of research that are seen to be more practical and pluralistic in nature. It allows a combination of methods that in conjunction could shed light on the actual behaviour of participants, the beliefs that stand behind those behaviours and the consequences that are likely to follow from different behaviours. To the pragmatist, there is no single reality and all individuals have their own and unique interpretations of reality (Alise & Teddlie, 2010; Biesta, 2010; Tashakkori & Teddlie, 2003).

The study employed the pragmatist paradigm because the researcher believes that no single scientific method is adequate enough to explain the social reality of the world at a particular instance (Alise & Teddie, 2010). The current study sort to investigate relationship among some social variables (demand and supply of mathematics teachers) which needs an interpretivist approach to understand how the context influence these variables (Creswell & Plano Clark, 2018). The other aspect involves the understanding of human behaviour, awareness of inclusive education, use of inclusive teaching strategies and practices which require the constructivist methods (Creswell & Plano Clark, 2018).

The study therefore requires the combination of some ideologies from both positivist and constructivist and hence the use of pragmatist paradigm. The nature of this study requires multiple methodological approaches. The research methodology is a key component in any study because it un-earths the central strategy and rationale behind the study. It provides the methods employed in the study, the principles behind the use of the methods that make it an accurate tool for studying the topic under consideration. It is also an essential component which maps out the research design and provides an overview of the approaches adopted in the conduct of the study based on the research paradigm (Saunders, Lewis & Thomhill, 2009).

3.2 Research Approach

Creswell (2015) identified three research approaches to be considered by educational researchers. These approaches are the quantitative (which is usually associated with the positivism), qualitative (normally for interpretivism) and mixed methods research approaches (which aligned with the pragmatism).

Mixed methods research design involves the theories which underpin the direction of data collection and analysis and the mixture of quantitative and qualitative approaches in many phases of this research process. As a method, it focuses on collecting, analysing, and mixing both quantitative and qualitative data. The fundamental premise is that the integration of both quantitative and qualitative approaches in a single study provides a better understanding of research problems than either approach alone (Creswell, 2015).

The choice of mixed methods was informed by the goal of the study to generalize findings while ensuring an in-depth understanding of the nature of mathematics teachers' inclusive teaching practices in senior high schools. With mixed methods research, it is possible to provide a better and in-depth understanding of the use of teacher demand and preparedness to implement inclusive education mathematics curriculum and inclusive teaching than employing either quantitative or qualitative approach alone. Another benefit for adopting mixed methods research is that it offsets the weaknesses of using solely either quantitative or qualitative data (Denzin &

Lincoln, 2018).

The study also adopted mixed methods because of historical argument (Jick, 1979). One school of thought argues that quantitative research is limited in understanding the context in which people express themselves. Also, the voices of respondents would not be heard directly in quantitative research. Besides, quantitative researchers are always in the background, and their own personal biases and interpretations are insufficiently discussed. Qualitative research makes up for these weaknesses.

On another school of thought, qualitative research is seen as deficient because of the personal interpretations made by the researcher, the ensuing bias created and the difficulty in generalizing findings to a large group because of the limited number of participants studied. Quantitative research, arguably, would not have these weaknesses. Clearly, the combination of both approaches could offset the weaknesses of either approach used alone (Creswell & Plano Clark, 2018).

Furthermore, mixed methods research provides more comprehensive evidence for studying a research problem than either quantitative or qualitative research alone. Researchers are given permission to use multiple tools of data collection available in a single study rather than being restricted to the types of data collection typically associated with qualitative research or quantitative research (Leavy, 2017).

Mixed methods research helps answer questions that cannot be answered by qualitative or quantitative approaches considered alone. Mixed methods encourage researchers to collaborate across the sometimes-adversarial relationship between quantitative and qualitative researchers. Teacher demand and preparedness to implement Inclusive education mathematics curriculum and inclusive teaching practices deal with diversity and equity which are social in nature, human driving and behavioural in perspectives; therefore, employing Mixed Methods Research by sharing between quantitative and qualitative methods in a study like this would help to narrow the approaches and collaboration to inquiry. For instance, quantitative data alone may inhibit the feelings of teachers in the selected senior high schools about their preparedness to implement inclusive education mathematics curriculum and inclusive teaching practices while the qualitative data alone may prevent generalisation on the mathematics teacher demand. The mixed methods approach would help guard against bias and subjectivity in the study.

Mixed methods research is "practical" in the sense that the researcher is free to use all methods possible to address a research problem. It is also "practical" because individuals tend to solve problems using both numbers and words, they combine inductive and deductive thinking, and they employ skills in interviewing people as well as recording behaviour. It is natural, then, for individuals to employ mixed methods research as the preferred mode of understanding a phenomenon.

In spite of the above merits of employing mixed methods approach to research, conducting mixed methods research can be time consuming and could also require lots of resources to collect and analyze both the quantitative and qualitative data (Creswell, 2015). It complicates the procedures of research and requires clear presentation if the reader would be able to sort out the different procedures. With this in mind, clear procedures are employed in conducting the study to overcome the weaknesses highlighted. Although mixed methods research demands resources in terms of time and funds, it is more appropriate for this study as a result of its inclusiveness in nature (Marshall & Rossman, 2010). The mixed method approach enables the researcher to gather both quantitative and qualitative data in a form of numbers and in words as well as interacting with subjects for clarification and explanation of various behaviours exhibited by respondents (Creswell, 2015; Marshall & Rossman, 2010; Cohen).

3.3 Research Design

The study employed the explanatory sequential mixed methods design. This design is in two phases to explain the level of mathematics teachers' knowledge on inclusive education and their use of inclusive teaching practices in senior high school mathematics classrooms. The first phase of the study employed cross sectional descriptive survey to obtain two forms of data. One was students' enrolment information as well as teachers and school characteristics, and the other was teachers' knowledge about inclusive teaching and use of inclusive teaching practices in mathematics classrooms. In the second phase, interviews and observations were used to obtain data to triangulate and substantiate the data obtained from the survey in the first phase (Creswell, 2015). The data from the first phase was used to determine and report on mathematics teachers' demand and supply, knowledge levels about inclusive education and the nature of teaching practices in mathematics classroom. A descriptive survey method was useful for assessing a group of people's practices, attitudes, preferences, concerns, interests and perceptions (Gay, Mills & Airasian, 2011; Best & Kahn, 2005). A cross-sectional survey is mostly quantitative and usually collects descriptive data through questionnaires (Creswell, 2012; Robson, 2011).

The data from phase two were used to answer research questions concerning the current status of mathematics teachers and their knowledge about inclusive education and inclusive teaching practices in mathematics classrooms. The interviews and the observational data were collected to reveal the true nature of mathematics teachers' inclusive teaching practices and bring to light an in-depth understanding of these teachers practice teaching in inclusive senior high school classrooms. In Figure 3.1, the two phases can be seen linked together as a sequential explanatory mixed methods design in flow chart.

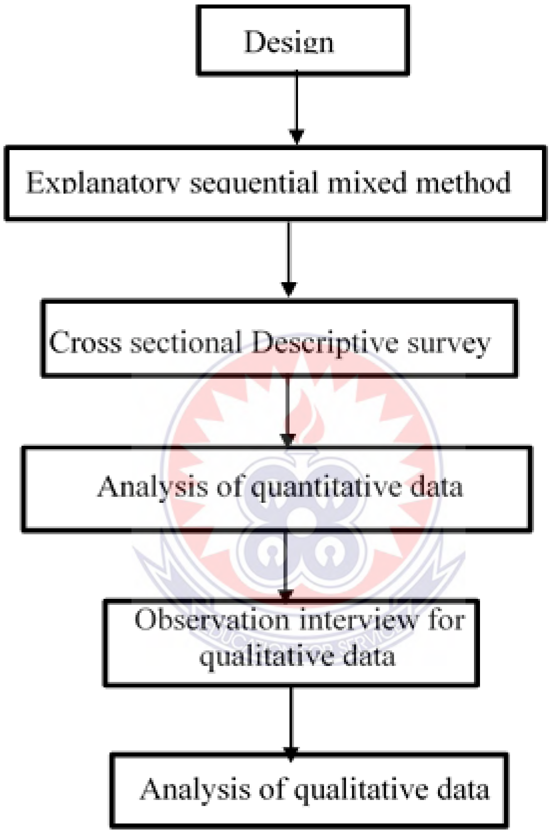


Figure 3. 1: The structure and framework of the methodological design of the study

The Figure 3.1 shows how the various stages of the research methodology were linked to address the research objectives so as to answer the research questions. The first step used questionnaire to gather information or data from the participants about their preparedness to implement inclusive teaching practices in mathematics classrooms. The demographic characteristics of the mathematics teachers (participants) were also taken at this stage of the study. The questionnaire also assisted the researcher to obtain data on students' enrolment information required to determine whether or not supply of mathematics teachers (or number of mathematics teachers at post) meets the demand (i.e., number of mathematics teachers required) for the implementation of the inclusive mathematics education curriculum currently in SHS. The data obtained at this stage were analysed and follow ups were made through phone calls and visits to the schools to correct errors where necessary.

In the second phase of the study, interviews were conducted and observation was made in 10 selected SHS. These interviews and observations aided the researcher to gather enough data on how the senior high schools' mathematics teachers implement inclusive teaching practices in mathematics classrooms. The third stage of the study was used to analysed the qualitative data after the quantitative data analysis. The results and findings from the data were interpreted and conclusions were then drawn from the interpretations made.

3.4 Study Population

Population is simply all well-defined collection of members or objects known to have similar characteristics in which a researcher is interested. The study population is a subset of the target population from which the sample is actually selected for which the researcher can generalize the study findings (Banerjee, 2010). That is, the all-inclusive set of cases from which a researcher sample is drawn is called the target population.

The researcher made frantic efforts to obtain the size of the population or the total number of senior high schools in the nation from relevant agencies of the Ministry of Education (i.e., Ghana Education Service Secondary Education Division, Education

Management Information System (EMIS) and National Teaching Council (NTC)) but all proved futile. However, information available at the myshsrank.com website created in 2020 indicate there were a total of 644 public senior high schools, 317 private senior high schools and 47 technical and vocational institutions (see Table 3.1). It must be noted that at the time that the proposal for this study was approved, there were only 10 regions in Ghana.

Table 3. 1

Number of senior high schools in Ghana by Regions

Region	Public	Private	Tech/Voc	Total
Ashanti	122	66	4	192
Brong-Ahafo	75	29	3	107
Central	67	42	3	112
Eastern	90	23	8	121
Greater Accra	44	99	6	149
Northern	47	19	5	71
Upper East	31	11	3	45
Upper West	28	4	3	35
Volta	88	15	10	113
Western	52	9	2	63
Total	644	317	47	1008

Source: myshsrank.com (2020).

In this study, the target population is defined to comprise all senior high schools in Ghana whose mathematics teachers could be accessed and contacted via the following professional social media platforms: Mathematical Association of Ghana (MAG) national and regional groups WhatsApp platforms, Patriotic Educators' Network (PEN) WhatsApp platform, UEW Mathematics Interns' Groups (2016, 2017 2018, & 2019) WhatsApp platforms. Table 3.2 shows the total number mathematics teachers on the various platforms which constituted the target population for the survey.

Table 3.2:

Number of mathematics teachers on various professional social media platforms constituting the target population for the study

Social media platforms	**Mathematics teachers registered on platform**	
	Number	**Percentages (%)**
Mathematical Association of Ghana (MAG) Groups	78	18
Patriotic Educators' Network (PEN)	97	22
Mathematics Interns' Class of 2016	104	24
Mathematics Interns' Class of 2017	95	22
Mathematics Interns' Class of 2018	26	6
Mathematics Interns' Class of 2019	37	8
Total	**432**	**100**

It was estimated that the mathematics teachers on these platforms would be spread across at least 60% of the 644[1] senior high schools across the country. Hence the estimated target population was 386 senior high schools across the country. However, the accessible population was estimated from the various platforms and contacts of the mathematics teachers available to the researcher. In Table 3.2, the total number of mathematics teachers on the various platforms was 432, and was used as the actual accessible population for the study.

3.5 Sample and Sampling Technique

Sample is defined as the subset of a targeted population selected to represent the entire population for a study. Selecting a sample is very necessary for this study because senior high schools and their mathematics teachers are spread all over the country. It is, therefore, impossible to study the entire population of senior high school mathematics teachers across the country because of financial and time constraints. Also, since conclusions drawn from samples are intended to be generalized to the population, and sometimes to the future as well, the sample must be representative of the population (Banerjee, 2010).

Representative samples are important because they ensure that the sample has all the relevant characteristics of the target population (which are of interest to the researcher) to ensure the right mix of subjects/objects are surveyed. This helps ensure your results are not tainted by bias. It also helps guard against overrepresenting certain groups of the population. Acquiring a representative sample requires the use of random sampling techniques that avoid bias in the sample. Bias occurs when the researcher is more likely to sample members of the population with certain characteristics than other members of the population, causing one group to be over represented. The size of the sample and the method used in its selection depends on the population size.

In this study, the researcher employed the two steps approach of using Cochran's sample size determination formula to determine the sample size. The first step was using Cochran's sample size determination formula for infinite population which is given by the formula

$$n = \frac{z^2 p(1-P)}{d^2}$$

Where:

n = total sample size

Z at 95% confidence interval = 1.96

P = is the estimated proportion of attributes that are present in population (at 50%)

d = the desired margin of error or precision=0.05

The formula with the given values yielded an estimated sample size of:

$$n = \frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2}$$

$$= 385.$$

The target population defined by all senior high schools whose mathematics teachers could be accessible via social media platforms, was estimated to be 60% of the entire population of 644, that is, approximately 385 schools, which was also the value obtained by the first part of the formula. This figure is actually the number of members of the target population needed to participate in the survey in order to achieve the required sample size based on the estimated proportion of attributes that are present in the population.

That is, if the population were large or infinite, the required sample size should have been about 385. But in the current study the target and accessible population was estimated to be 432, hence the need to adjust the sample size using the adjustment formula referred to as the Cochran sample size determination formula for finite population given as

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

Where n is the required sample size

n_0 is the sample size obtained in the first step (385)

N is the estimated population (432)

The adjustment formula with $n_o = 385$ and $N = 432$ yielded an estimated sample size of:

$$n = \frac{385}{1 + \frac{385 - 1}{432}}$$

$$= 204$$

The sample size obtained for the study was therefore 204. In spite of this, all the 432 teachers were invited via online Google Form questionnaire shared on the social media platforms (see Table3.2) and the responses exceeded the estimated sample size, the researcher terminated the process and retrieved responses. A total of 270 responses were retrieved which were more than either of sample sizes (204). After sorting out the best responses from each school, 195 questionnaires were selected for the study. This 195 respondents gave 95.6% response rate which then constituted the study sample. Though there were schools that had more than one teacher completed the instrument, the researcher randomly picked one questionnaire for each school to reduce possible data duplication. The number and proportion of schools in each region involved in the study is presented in Table 3.3 and Figure 3.3.

Table 3.3:

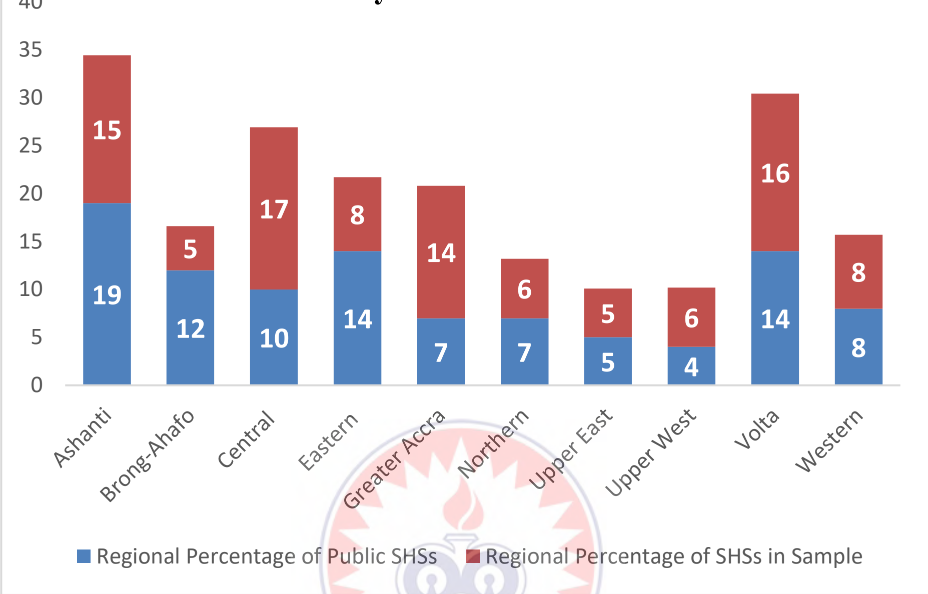
Number of Public SHSs in Ghana and SHSs in Sample by Regions

Region	**Public SHSs in Ghana**		**SHSs in Sample**	
Region	Number	Regional Percentage	Number	Regional Percentage
Ashanti	122	19	30	15
Greater Accra	44	7	27	14
Eastern	90	14	15	8
Central	67	10	33	17
Upper West	28	4	12	6
Upper East	31	5	10	5
Northern	47	7	12	6
Western	52	8	15	8
Brong-Ahafo	75	12	9	5
Volta	88	14	32	16
Total	644	100	195	100

Source: myshsrank.com, 2020; Fieldwork)

Figure 3.3 illustrates the distribution of the proportion of SHSs in the sample compared to public SHSs in the country. It is clear from the figure that the study sample covered senior high school across all the regions. Apart from schools in two Metropolis (Greater Accra and Central), where the proportion of schools in sample was about double the proportion of schools in the region, the graph in Figure 2 shows a good balance in the proportion of schools selected from the regions across the country.

Figure 3.2: Comparison of Regional Proportion of SHSs in Sample to Public SHSs in the Country



The researcher, therefore, randomly selected one mathematics teacher each from 195 schools where teachers responded to the online Google Form questionnaire shared by the researcher on various social media platforms. The issue of sampling biases was minimised considerably with the use of online self-sampling method which allowed equal chances for all mathematics teachers in the target population.

The data obtained by questionnaires from 195 respondents were used for the quantitative part of the study while 10 respondents within the sample were identified for the qualitative phase of the study. The 10 respondents were selected purposefully to be involved in the qualitative data collection part of the study. They were purposefully selected to be representative of the GES school placement categories and also because they were willing to be interviewed and observed in teaching. Two respondents were purposefully selected from Category A, 3 respondents from Category B, 4 respondents from Category C and 1 respondent from Category D.

3.6 Data Collection Instruments

In this section, how the data were collected for the study is described. It describes the instruments used in the study (that of the questionnaires and the interview schedule). The procedures of using the instruments are briefly discussed and how the instruments were tested and validated via the pilot study is also presented.

As indicated above, the study employed the sequential explanatory mixed method design which requires the use of instruments that have the potential to satisfy the two strands of the design, namely, the quantitative strand and the qualitative strand. There are three main instruments that were used in this study for data collection. These instruments are

i. questionnaire,
ii. interview guide, and
iii. observation guide.

3.6.1 Questionnaire

In this study, a questionnaire was used to collect the quantitative data. It was employed to gather quantitative data because it provides uniformity in the presentation of questionnaire items to the respondents. It also guarantees anonymity for the respondents and require less time to be administered especially in this time bound study (Fraenkel & Wallen, 2000). Further, questionnaire is known to be one the widely used instrument for educational research because of its familiarity to respondents. The questionnaire used in the study was adapted from Nketsia (2016) and El-Ashry (2009). Most of the items in the questionnaire were tested, validated and used by Nketsia (2016) and El-Ashry (2009) in their Ph.D. Dissertations in University of Jyväskylä, Finland and University of Florida respectively. The questionnaires were adapted from Nketia and El-Ashry because it was realised that the items in these questionnaires could help the researcher to answer the research questions set up for the study. The items adapted from Nketsia (2016) and El-Ashry (2009) were mainly on receiving responses from respondents on mathematics teacher's preparedness to implement inclusive education mathematics curriculum, mathematics teachers used of inclusive education strategies and practices, mathematics teacher's familiarity and awareness of inclusive education concepts. It should however be noted that these studies that questionnaire was adapted from were done from special education perspective which led to major modification to some of the items used in the current study.

The questionnaire for this study consists of five sections (A, B, C, D and E) carefully adapted to collect the required data to answer the research questions (see Appendix B). The first section, A is designed to get demographic details of respondents such as respondents age, educational and professional background, the data about the schools from which respondents teach is found in this section. Finally, the data on the mathematics teachers demand for the implementation of the inclusive education mathematics curriculum is found in section A and the rest of the sections have series of items focused on themes relating to the dimensions of mathematics teachers' preparedness for the implementation of IEMC.

Section B of the questionnaire contains 3 five-points Likert scale type questions to assess the overall preparedness of mathematics teachers to implement IEMC. Respondents responded to these questions by indicating their levels of preparedness to implement IEMC by selecting one of the following options associated with the question;

1. Not at all, 2. A little, 3. Not sure, 4. Well and 5. Very well;

A respondent who choses very means that such respondent believes that s/he has acquired enough knowledge about inclusivity such that s/he would implement it excellently. A well response means respondents believes in having a good amount of inclusive knowledge and could implement IEMC. Not sure means the respondent cannot tell whether s/he has knowledge of inclusivity or not so as to be able to implement IEMC. A little means that the respondent knows inclusivity but believes that s/he is not prepared to implement IEMC. Not at all means that the respondent is not aware of inclusivity and therefore cannot implement IEMC. The other questions (20 to 30) in section B of the questionnaire were designed to obtain data on mathematics teachers' frequency in the use of inclusive education strategies and practices in their mathematics classrooms. The questions are 11 five-point Likert scale with the following options;

1. Never, 2. Almost never, 3. Occasionally, 4. Most of the time and 5. Almost always

The response Never means that the respondent does not use inclusive education concepts and practices or the respondent does not even know inclusive education concept and therefore could not use it. Almost never means that the respondent uses the inclusive education concepts but in a very parsimoniously. Occasionally means that the respondent employs inclusive concepts and inclusive practices once a while in the mathematics classroom. Most of the time means that the respondent uses inclusive education concept and practices in the mathematics classroom. Almost always means that the respondent uses inclusive education concept and practices often in the mathematics classroom.

The questions to identify mathematics teachers' familiarity with inclusive education are found in Section C of the questionnaire. There are 9 five-points Likert scale questions seeking the level of mathematics teachers' agreement or disagreement with the statements/questions as follows;

1. Strongly disagree. 2. Disagree, 3. Undecided, 4. Agree and 5. Strongly disagree.

The final section is D which consists of 16 five-point Likert scale questions requesting respondents to indicate their level of agreement or disagreement with statements about mathematics teachers' awareness with the inclusive education concepts and practices as applied in mathematics curriculum. The options in section D are the same as that of section C. The option labelled undecided means the respondent is neutral which means a disagreement to the statement in large extent.

3.6.2 Interview Guide and Observation Checklist

An interview guide was designed to follow up and triangulate some of the responses elicited by the questionnaire. A semi-structured interview guide was designed which contained eight questions (see Appendix C). This guided the researcher to offer the interviewees the opportunity to express their views, feelings and experiences freely and allowed the interviewer the freedom to sometimes divert from the items in the interview schedule (Kusi, 2012).

The interview took the form of face-to-face interview where questions were asked directly to the respondent by the researcher. Kankam and Weiler (2010) opined that the approach is beneficial to enable the researcher ensure probing and clarification.

Responses that were not clear on the questionnaire were made clear with the face-to-face interview approach. The items in the guide sort the opinion of the interviewees on the number of students in their schools, number of mathematics teachers in their school and whether they were adequate, number of periods taught per week, interviewees knowledge about inclusivity and inclusive education practices in mathematics classrooms. The researcher used two weeks to conduct the interview. Despite each interview schedule lasted between 15 and 30 minutes, the researcher devoted the whole day for each school so as to allow the interviewee that free will and convenience for the interview. This also reduced pressure and rush during the interview on both the interviewer and the interviewee. All the interviews were done in the participants school since all the interviewees preferred having the interview in their schools.

The researchers also visited 4 classes, one from each GES school placement category to observe using an observation checklist (see Appendix D). Observation as used in qualitative research could be defined as the systematic description of an events, behaviors, and/or artifacts of a given situation (Marshall & Rossman, 1989). Observation is mostly used in the social sciences as a method for collecting data about people, processes, and cultures. It is used usually to collect data by teacher researchers in their classrooms, by social workers in community settings, and by psychologists recording human behavior (Kawulich, 2014).

In this study, ten schools of the participants were visited to observe and verify some of the information provided by the participants in the questionnaire and the interviews using observation checklist which contained thirteen items (Appendix D). The researcher observed physical infrastructure of the schools such as classrooms facilities, the set-up of the classrooms and number of students in a class. Some of the students' time table, test books, exercises and projects the time tables of some mathematics teachers were also observed.

3.7 Piloting the Research Instrument

Piloting was very important aspects of this study. It provided vital information about the nature of items, structure and content of the instruments used for the study. It also provided information on the nature of the possible data from the study, feasibility of data collection strategy and accessibility of participants. The ultimate aim of a pilot study is to provide evidence on validity and reliability of the data collection instruments (Mohajan, 2017). Research findings are usually accepted by stakeholders and applied in real life contexts when such findings are deemed to be reliable, consistent, dependable, replicable and trustworthy (Mohajan, 2017).

The questionnaire was pilot tested with 41 mathematics teachers from 4 senior high schools. Mathematics teachers from two senior high schools in Effutu municipality of the Central Region and two schools in Afigya Kwabre South District of the Ashanti region were involved in the pilot study. The teachers who were involved in the pilot study were advised not to participate in the main study which is confirmed they complied. The piloting of the instrument was done before the covid-19 pandemic so the researcher visited the schools and administered the questionnaires for the pilot study himself. The data obtained were analysed to test the validity and reliability of the instrument. The results of the pilot study guided the researcher in the construction of the interview guide and the observation checklist which was piloted with two teachers from one school in Effutu Municipality. The Piloting of the interview guide and observation check list helped the researcher to estimate the time it would take to conduct the interviews and the type of questions respondents might ask for clarification.

3.7.1 Validity of instruments

Validity refers to the suitability of the interpretations, inferences, and actions that one makes based on the outcome of questionnaire items responses or test scores (Johnson & Christensen, 2004). It is important to note that in ensuring validity of an instrument, it must be guaranteed that the questionnaire items or the test measures what it is intended to measure, for the particular group of people and for the particular context. Also, the interpretations and inferences that are made based on the responses from the questionnaire items or the test scores are correct. Hair et al. (2005) argues that validity describes how well the concept is defined by the instrument of measure. Thus, validity of an instrument defines how best the instrument would help the researchers to obtain the required or needed information from the respondents.

To establish the validity of the instruments, the questionnaire, the semi-structured interview guide and observation check list were given to my supervisors, colleagues Ph.D. candidates and experts (lecturers from special education department, UEW), experts of economics of teacher demand analysis and inclusive education professional for review. This was done because face and content validity can be determined by expert judgment (Gay, Mills & Airasian, 2009). The inputs and suggestions made by the experts and professionals were used to restructure the items in the questionnaire and interview guide. For example, all the questions with the dichotomous responses were changed for multiple categorical responses. It is critical to mention that in spite of validity assessment of an instrument, what was important was the soundness of the interpretations and inferences made from the responses and test scores from the instrument that were validated but not just the instrument (Amedahe, 2001). If the instrument measures what it intends to measure and the results are used for the intended purpose, then the instrument can be said to be truly valid. The pilot-test helped to refine the research instruments. The questionnaire was refined based on the comments made during the pilot study.

3.7.2 Reliability of the quantitative instrument

Reliability of data collection instrument is described as the extent to which the instrument is consistent and can provide similar result when used in similar situations or among a similar sample frame. Although, the general concern of piloting a study is to examine and improve the design of the study, it should be emphasized that the piloting of the study was to assess validity and reliability of the instruments used in measuring mathematics teachers' preparedness to implement IEMC. It is important to also emphasized that the instruments used for the study were not necessarily adopted or adapted from one specific literature but pieces from different materials, experts' advice and supervisors' guidance were all put together for the construction of the instrument, hence the need for preliminary study to check feasibility, appropriateness and likely errors which may occur during the main study (Mohajan, 2017).

This means that the research instrument would result in similar, same or almost the same responses any time it is administered to the similar, same or almost the same sample. The Reliability of a questionnaire could be assessed with several approaches which include; the split half, test retest, alternative form methods and the internal consistency approach. Cronbach's alpha which uses the comparison between individual items and the overall items is employed in this study. Data from the pilot study were analyzed using Statistical Product and Service Solutions (SPSS) Version

20.0 and Microsoft Excel (2010). Analysis of the pilot data began with reliability test for the scales through Cronbach's Alpha. The Cronbach's Alpha testing was used as it is the most well-accepted reliability test tools applied by social researchers especially when questionnaires are used as the instrument.

Cronbach's approach was adopted because it uses the individual items and respondents together with all the items and all the respondent. Cronbach's alpha is thus a function of the number of items in a test, the average covariance between pairs of items, and the variance of the total score (Goforth, 2015). Also, Crobach's alpha is estimated to be the most widely used method in estimating the internal consistency of questionnaire instruments (Kimberlin & Winterstein, 2008). Kimberlin and Winterstein (2008) opine that it is used for summated scales or Likert scale items. Since the questionnaires were predominantly Likert scale, to estimate the internal consistency of the instruments, the Crobach's alpha is deemed the best method to estimate the reliability of the instrument.

Gliem and Gliem (2003) pointed out that under the use of Cronbach's Alpha test, a reliability coefficient close to 1.0 measures the appropriateness of the use of the questionnaire to measure the variable concerned. However, the reliabilities less than 0.60 are considered poor generally, and those in the range of 0.70 to 0.80 are considered as acceptable or good (Gay et al., 2009; Gliem & Gliem, 2003).

The Crombach's Alpha is highly considered in the study to test the instrument's internal reliability. Bryman (2008) opined that internal reliability applies well to multiple-indicator measures and a typical example is the Likert scale used in the study. The respondents' responses to each of the statements are aggregated to form the overall score.

Cronbach's alpha is computed by correlating the score for each scale item with the total score for each individual survey respondents, and then comparing that score to the variance for all individual item scores. The reliability coefficient for this study was computed using the Cronbach alpha determination formula:

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum_{i=1}^{k}\sigma_{y_i}^2}{\sigma_x^2}\right)$$

Where: k defines the number of scale items

$\sigma_{y_i}^2$ defines the variance associated with item i

σ_x^2 defines the variance associated with the observed total score.

In this study, there were 39 items in the questionnaire with Cronbach's Alpha reliability coefficient of 0.904 (see Appendix E) which is very close to 1.0. This means that the instrument is good to be used to investigate the study variables (including mathematics teachers' (i) preparedness to implement IEMC (ii) preparedness to use inclusive strategies/practices, and (iii) familiarity and awareness of inclusive education). The third variable about mathematics teachers' use of inclusive strategies/practices in the mathematics classroom had 15 items and after the analysis, a reliability coefficient of 0.578 was obtained which is less than 0.600, meaning that the reliability of the instrument to measure teachers' use of inclusive strategies was bad. The correlation and multicollinearity analysis of the items were performed to reduce the items to 11 and the reliability test was performed which produced a coefficient of 0.645. The coefficient is not very strong but according to Ghazali (2016) coefficient above 0.6 can be used. The items in this dimension dichotomous in nature but after the pilot analysis the items were changed to categorical items with Likert scale responses.

The second variable about teachers' familiarity with inclusive had 8 items and after the pilot analysis, a reliability coefficient of 0.875 was obtained which is good enough to use in the study. The final variable about teachers' awareness of inclusive education mathematics curriculum had 15 items and the analysis resulted in a reliability coefficient of 0.768 which is good to produce consistent results in the study so the items were used for the study.

3.7.3 Trustworthiness of the research study's findings.

Trustworthiness is referred to as validity and reliability. However, in qualitative studies, this concept is more obscure because it is put in different terms. To ensure the trustworthiness and dependability of the interviews, the interview structure, sequence of words and questions were the same for all respondents (Silverman, 1993). Furthermore, in line with Gibbs (2007) concerning the trustworthiness and dependability of qualitative research, all the transcripts were crosschecked to ensure there were no apparent mistakes. The interviewees fully understood all the questions asked and answered to the best of their knowledge.

Prior to the pilot testing, the instruments, they were given to experts in the field of mathematics education curriculum and inclusive education for their suggestions. My supervisors also went through each item in the instrument for necessary correction and all their inputs were keenly considered. The result from the pilot analysis were discussed thoroughly with colleagues, research fellows and my supervisors and their critiques and suggestions were used to shape the instrument making it authentic, valid and reliable. For instance, some instruments which were dichotomous in nature were changed to multiple choice questions which made easy to measure the need variable.

Qualitative studies do not use instruments with established metrics about validity and reliability, it is pertinent to address how qualitative study establishes that the study's findings are credible, transferable, confirmable, dependable and authentic. Trustworthiness is all about establishing these five things, which are described in more detail below.

3.6.3.1 Credibility of the research study's findings

Credibility is the how confident the qualitative researcher is in the truth of research study's findings. This boils down to the question of "How do you know that your findings are true and accurate?" In order to ensure true credibility of the current study's findings, participants (interviewees) were briefed on the purpose and objectives of the study. The significance of the study was explained to the interviewees which motivated them to provide sincere and credible information.

Also, the questions asked in the interview were made clear as much possible for easy understanding to interviewees. Interviewees were made to feel at home and assured that the information provided would be used for only the purpose for which the information was provided and their identities were going to be confidential at all cost. Interviewees were also not restricted to any time duration in the interview and ensured they had enough time to think and express themselves freely until the interviewer realized interviewees had exhausted all they knew about the subjects under study.

Other means of ensuring credibility was persistent observations based on the information gathered for study and examined the information several times to analyse negative cases for better understanding of the situation under consideration. Also, the true nature of the supply of mathematics teachers in senior high schools in the participating schools as were reported was presented. Additionally, the responses from the questionnaire, the responses from the interviews and the data obtained from the observations were triangulated to ensure credibility of the results.

3.6.3.2 Transferability of the research study's findings

Transferability is how the qualitative researcher demonstrates that the research study's findings are applicable to other contexts. In this case, "other contexts" can mean similar situations, similar populations, and similar phenomena. To ensure transferability of the current study, interviewees were selected from the four GES school placement categories. This was done schools which belong to the same categories are more likely to have similar characteristics.

Additionally, the 10 classes from the 10 schools whose lessons were observed cut across the four GES school placement categories which was believed to have provided some amount of detailed account of the processes involved in the study from the data collection, context of the study and even up to the production of the final report (Anney, 2014). Also, the respondent for the qualitative data were purposively selected based on the outcome of the quantitative data so as to get detailed account of the situation (DeVault, 2017).

3.6.3.3 Dependability of the research study's findings

Dependability is the extent that the study could be repeated by other researchers and the findings would be consistent. In other words, if a person wanted to replicate your study, they should have enough information from your research report to do so and obtain similar findings as your study did. To ensure dependability in this study detailed and comprehensive documentation of the research process were made and every methodological decision was completely recorded. These were done to aid future researchers to be able to replicate the study in similar situations (Shenton, 2004). Also, the views of supervisors, advisors and experts in the field of qualitative research were sought to ensure the right research procedures were followed to enhance dependability of the study.

3.6.3.4 Confirmability of the research study's findings

Confirmability is the degree of neutrality in the research study's findings. In other words, this means that the findings are based on participants' responses and not any potential bias or personal motivations of the researcher. To achieve confirmability of the study the qualitative data analysis, its interpretations, and finding were based on participants points of view and situations devoid of researcher own imaginations. These were achieved by continuous listening to the tape recording and severally reading the transcribed.

Also, all the transcribed data were sent back to the interviewees for confirmation as whether what were recorded and transcribed were what they really wanted to mean. This ensured that the qualitative data and the interpretations of the findings were not fabrications of the researcher's mind, but were actually resulted from the qualitative data. Furthermore, qualitative data triangulation using interviews, questionnaires and observations was used as confirmability procedure to reduce the effect of biasedness. Finally, regular consultations with advisors during data collection and processing controlled and reduced biasedness on the part of the enquirer.

3.6.3.5 Authenticity of the study

Authenticity is an aspect of trustworthiness which shows the degree to which researchers honestly and completely show a range of different realities and realistically convey participants' lives (Polit & Beck, 2014). To portray fully the deep picture of how mathematics teachers supply meet the demand for mathematics teachers to implement inclusive education mathematics curriculum only experienced mathematics teachers were selected for the interview. The researcher also provided rich and detailed description of all the processes and situations in the study.

3.8 Data Collection Procedure

In this section, how the data were collected for the study is described. It describes the processes that were involved in the distribution of the questionnaires and how the interviews were scheduled and undertaken using the interview schedule. The method of observation and the selected schools were visited to observe the situations in the schools is provided in this section.

3.8.1 Ethical Considerations

Data collection from human participants must adopt strategies that conform to ethical standards and legal regulations to protect the participants from possible harm. This certain therefore describes the procedures followed to obtain permission for the study and to gain cooperation from the participants which are important ethical requirements for every study (UEW, 2018; Nnebue, 2010).

3.8.1.1 Permission and Consent

The participants were made to sign a consent formed by responding to an agreement form on line for the online respondents (see Appendix A). Consent was taken from the headmasters of the participated schools for the qualitative data collection before observations were made in the school and interviews conducted. Detailed explanations were given to interviewees before the interviews and all the participants were assured of their outmost confidentiality. Due to this neither the names of the participated schools nor the identity of any respondent is revealed anywhere in the study. Participants were given enough time to think through and complete the questionnaire at their own convenience. This avoided any undue pressure on the participants.

Permission to carry out the study was obtained via a letter from the Department of Mathematics Education, University of Education, Winneba to use both the online platform and face-to-face to collect the data from participants for the study. The major challenges of using the questionnaire as the procedure for data collection were the time and cost of travelling and the cost of phone calls to the participants. The issue of time and cost of travelling were reduced because of the use of online platform for the data collection. However, most of the qualitative data were obtained via face-to-face with the respondents which resulted in inquiring some cost for transportation. This was worsened because of the COVID-19 pandemic. In order to reduce contacts and follow the necessary protocols a digital data collection approach was employed in this study where data were collected through electronic devices (e.g., phones, laptops and tablets) rather than the paper-and pen/pencil forms. The selected technology combined several device functions into one: global positioning system (GPS) locator, photo capture and data capture. The questionnaire was collected electronically and transferred automatically into a single database in real time. The questions in the questionnaire were input in Google form and a link was created which was sent to participants via e-mail and WhatsApp platforms to participants (see Appendix B). Necessary steps and measures were put in place to check duplication and double submission by respondents and these include cross checking and double checking of participants' demographic data.

3.8.2 Quantitative Data Collection Procedure

In the mist of covid-19, time and financial constraints, the researchers employed Google Forms to collect data (an online survey authoring software). The online method of data collection made it easy and possible for data to be collected with less contact with paper to reduce the risk the spread of COVID 19.

The online questionnaire allowed participants to complete the questionnaire at their own convenience. Also, completing the questionnaire online was completely anonymous, respondents felt more at ease to do so. The data collected online was easy to capture which made the organisation of the data more flexible for quantitative data analysis. Finally, it was cost efficient. However, the researcher could not ascertain whether all those who answered the questionnaire online were truly mathematics teachers.

3.8.3 Qualitative Data Collection Procedure

All interviewees were given copies of the interview schedule (Appendix C) to study before the interview was conducted. This was to facilitate interaction between the interviewer and the interviewees. The interviewees were given the opportunity to choose the time, date and venue in order not to disrupt their normal schedules. Additionally, they were assured of confidentiality and also that at no point in time would their identities be revealed. No participant was coerced, pressured or forced to participate in the study. The principles of informed consent and voluntarism were strictly adhered to (Denscombe, 2017; Cohen et al., 2018; Sarantakos, 2005). All though the interviewees were given the option to choose where the interview should be conducted some of them opted to be interviewed in their school and others via zoom.

To ensure that the data were accurately recorded, permission was sought from the interviewee to tape-record the session in addition to the pencil/pen and paper recordings. Also, after the interviews, the tape was played back to each interviewee. This was to enable participants to edit their comments, provide additional information and to validate the information provided in the interview. Further, the transcribed data from the interview was sent back to the respondents (interviewees) for confirmation of the information provided in the interview before usage.

3.9 Data Analysis Procedure

A variable in mathematics and statistics is a quantity that can assume different values. For instance, mark obtained by students in a test is a variable because that marks could assume any value depending of the range of the scores. A variable is used in research to represent items, quantities or objects of interest in the study that could possess different characteristics. In this study there are many variables of interest which include

- the supply of SHS mathematics teachers to meet the demand for the implementation of an IEMC
- SHS mathematics teachers' preparedness for the implementation of an IEMC
- SHS mathematics teachers' use of inclusive education strategies in the implementation of the mathematics curriculum
- differences among *SHS mathematics teachers' preparedness* based on factors
- differences among *SHS mathematics teachers' use of inclusive education strategies based* on factors:

Variables can be classified in several ways depending on the nature of the study. Many studies define variables based on cause-and-effect manner and categorise the variables into response and predictor variables. This categorization is highly useful because of its general applicability, simplicity and special importance in conceptualizing and designing research and in communicating the result of the study (Osuala, 2001). The demand for SHS mathematics teachers for the implementation

IEMC could be influenced by many factors such as the supply of teachers from institutions who train mathematics teachers. The level of enrolment at the various senior high schools, mathematics teacher's professional qualification and working conditions in the schools could all influence the demand for teachers to teach mathematics at the SHS (Ingersoll & Perda 2010; Ingersoll & May 2010). The demand for mathematics teachers could therefore be described as the dependent or response variable while the other variables as institutional supply, enrolment, attrition and retirement are the independent or predictor variables. The other variables of interest in this study are the mathematics teachers' preparedness to implement IEMC, demographic factors such as age, educational background, and gender, school type, location of the school and category of the school. These factors are treated as either response or predictor variable depending on what that factor is used for in the study. For example, mathematics teacher preparedness is measured under three dimensions, namely; use of inclusive strategies/practices, familiarity with inclusive education and awareness of inclusive education mathematics curriculum. In this case mathematics teachers' preparedness to implement IEMC is justified by the three dimensions of preparedness.

All the responses obtained from the Google form questionnaire, interviews and observations made during the data collection were seriously screened and edited to avoid duplications, multiple submission and misrepresentation. The questionnaire data in particular was severally checked to ensure that they were fully completed and consistent with the requirements of the study. The responses from the questionnaires were transferred into Microsoft Excel and Statistical Package for Service Solution (SPSS) version 20 and analysed. Descriptive statistics such as averages and percentages were generated from the data to enable the researcher present the findings. In addition, frequency tables, graphs and charts were also used for graphical representation of the demographic data. The inferential statistical analysis of the demand for and supply of mathematics teachers was done with demand model for scenarios and test of association with chi-square. Mathematics teachers' preparedness to implement Inclusive education mathematics curriculum were done using frequencies, means and standard deviation.

Demand and supply model

The 'demand and supply' model is based on three fundamental variables in a given school system at a particular moment in time. These quantities are average class size, average number of teacher contact periods required by a class over a complete teaching cycle and average teaching load per teacher expressed in number of class contacts period per week (Williams, 1979). The standard average class size at the senior high school is assumed to be 40 students per class based on the GES recommended number of 40 students in a class (Ananga & Tamanja, 2017). The average number of teacher contact period per week for SHS is assumed as 22 period per week based on GES recommended periods for mathematics teachers in senior high schools. The average teaching load per teacher per week is defined as the number of classes the teacher is teaching per week and number of actual periods the teacher is teaching per week. These three quantities could be used individually to determine number of teachers needed in a particular moment in the school. For instance, if the class size is found to be more than 40 students then new classes should be created to accommodate the excess students which demands additional teachers to occupy the new classes created. Similarly, if the teachers work load exceeds the required 22 periods, then the excess are taken and given to new teachers. However, this way of analysing teacher demand is too simplistic and does not reflect exactly what happens in senior high school. This study therefore combines these quantities to create possible scenarios that reflects what happens in senior high school for possible demand and supply analysis in chapter 4. For example, in a senior high school of 1200 students, the number of mathematics teachers required could be computed as follows;

$$Math\ teachers\ required$$

$$= \frac{Enrolment}{class\ size} \times \frac{learnig\ period\ per\ classper\ week}{teaching\ period\ per\ teacher\ per\ week}$$

So, for our hypothetical 1200 students, class size is 40, learning period per class per week is 6 and teaching period per teacher per week is 22 (GES)

$$Math\ teachers\ required = \frac{1200}{40} \times \frac{6}{22}$$

$$= 8.18$$

This means that for a senior high school of 1200 students requires approximately 8 mathematics teachers.

The qualitative data were gathered mainly through the interviews and observations which were transcribed and narrated in words to supplement the information gathered through the questionnaires. Thematic analysis was employed to analyse the qualitative data based on the research questions. It should however be noted that after the preliminary analysis of the questionnaire data juxtaposing it with the responses obtained from the interview and observation, the responses of the questionnaire were recoded for easy analysis and interpretation.

CHAPTER 4

ANALYSIS OF RESULTS AND DISCUSSIONS

4.0 Overview

In this chapter, the results of the data analysis, major findings as well as discussions made on the findings are presented. The significant findings are particularly identified and interpreted within the context of the existing literature. Quantitative and qualitative data were collected and analysed in line with the research questions to provide vivid answers in order to achieve the objectives of the study. The results obtained from the analysis are clearly presented in tables and charts with concise but unambiguous interpretations.

4.1 Demographic characteristics of respondents

In this section, the background information of the mathematics teachers who responded to the questionnaires are presented. Table 4.1 presents the demographic information on the respondents' gender, age, highest general qualification in mathematics, highest professional certificate, institution where professional certificate was obtained and years of teaching experience.

4.1.1 Gender of respondents

There were more males who responded to the questionnaires than females. Out of 195 respondents who were involved in the study, 171 of them representing 87.7% are males while 24 of them representing 12.3% are females (see Table 4.1). This is a true reflection of the proportion of male mathematics teachers in senior high schools in Ghana to females.

Table 4.1

Demographic information on the respondents

	Teachers	**Percent**		**Teachers**	Percent
Gender			Highest qualification in mathematics		
Male	171	87.7	Master's Degree	66	33.8
Female	24	12.3	Bachelor's Degree	129	66.2
Total	**195**	**100**	**Total**	**195**	**100**
Age			Highest professional qualification		
20-29 years	57	29.2	M.Ed. (Mathematics)	48	24.6
30-39 years	108	55.4	B.Sc. (Math. Education)	63	32.3
40-49 years	24	12.3	B.Ed. (Mathematics)	75	38.5
50-59 years	6	3.1	Diploma (Math. Edu.)	9	4.6
Total	**195**	**100**	**Total**	**195**	**100**
Teaching Experience			Institution professional certificate obtained		
1 – 5 years	132	67.7	UEW	117	60.0
6 – 10 years	45	23.1	UCC	57	29.2
11 – 15 years	9	4.6	VVU	21	10.8
16+ years	9	4.6	**Total**	**195**	**100**
Total	**195**	**100**			

4.1.2 Age

The age distribution in Table 4.1 shows that 57 (29.2%) of the mathematics teachers in senior high schools who were involved in the study were in the age bracket of 20-29 years, 108 (55.4%) were in the age bracket of 30-39 years, 24 of them representing 12.3% were in the ages of 40-49 years while 6 (3.1%) of the were between 50 and 59 years. It is clear from Table 4.1that over 96.9% of the respondents are below the age of 50 years which indicates that there are a lot of young mathematics teachers in senior high schools in Ghana. This is a good sign for the sector since most of the teachers have a lot of years before compulsory retirement.

4.1.3 Teaching Experience

The result from Table 4.1 shows that most of the mathematics teachers who responded to the questionnaire have been in the teaching profession for just last five years. It is observed from the Table 4.1 that 132(67.7%) respondents have taught for at most five years. Respondents who have taught for 6-10 years were found to be 45 which represents 23.1% of the respondents while 18 (9.2%) of the respondents were identified to have taught for more than 10 years.

4.1.4 The academic and professional qualification of respondents

The respondents were found to possess only two types of academic qualifications, either the person is holding bachelor's degree or master's degree. It is observed from Table 4.1 that, 29 respondents representing 66.2% have bachelor's degree as their highest academic qualification while the remaining 66 (33.8%) hold master's degree as their highest academic qualification. The professional qualifications of the respondents are also presented in Table 4.1. From the table, it is observed that the most common professional qualification of mathematics teachers is the B.Ed. mathematics education with 75 respondents. This was followed by B.Sc. mathematics education with 63 respondents. There were 48 respondents who possessed M.Ed. In mathematics education wile 9 respondents hold diploma in mathematics education.

4.1.5 Institutions which Awarded professional certificates to respondents

The data on institutions that awarded the professional certificates to the mathematics teachers who participated in the study was analysed and the results presented in Table 4.1

From Table 4.1 60% of the respondents obtained their professional certificates from UEW. This was followed by the UCC which awarded professional certificates to approximately 29% of respondents and about 11% of the respondents obtained their professional certificates from VVU.

4.2 Demographic characteristics of respondents' schools

The section also gives background information of the senior high schools where the mathematics teachers are teaching. These comprise the region and districts in which the schools are located, management of the school, school placement category and enrolment levels.

4.2.1 School type and GES school placement category

The study involved 195 participants from SHS in Ghana. These participants came from over 65 senior high schools in the 10 regions across the country. There were two main types of schools that were involved in the study which were public senior high school and public senior high/technical school. There were 156 public senior high school mathematics teachers and 39 public senior high/technical school mathematics teachers who participated in the study. The Categories of the school in which participants teach were also analysed and the results illustrated in Figure 4.1

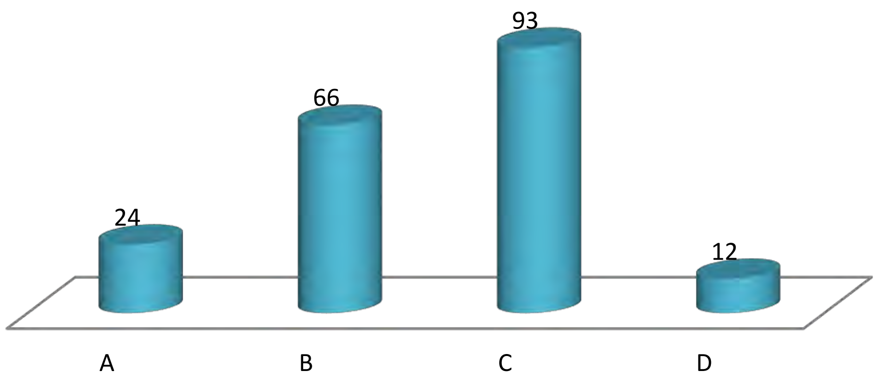


Figure 4.1: GES SHS placement categories of schools in the study

The result as shown in Figure 4.2, indicates most of the participants teach in Category C schools. It is observed that 93 respondents teach in Category C schools, 66 are teaching in Category B schools, 24 are teaching in Category A schools while 12 respondents are teaching in Category D schools.

4.2.2 Number of active classrooms in schools involved in the study

The classrooms that were actually occupied and used for classes in the 2019/2020 academic year were designated "*active classes*" since it is likely to find classrooms that are not used for classes in some of the schools. The numbers of active classes of the schools were explored and it was found that the minimum active classes of the participants' schools were 6 and maximum was 84. The mean active class in SHS was found to be approximately 37. The numbers of active classes in the schools were grouped due the rage in order to get a clearer picture of the nature of active classes and the results presented in Figure 4.2

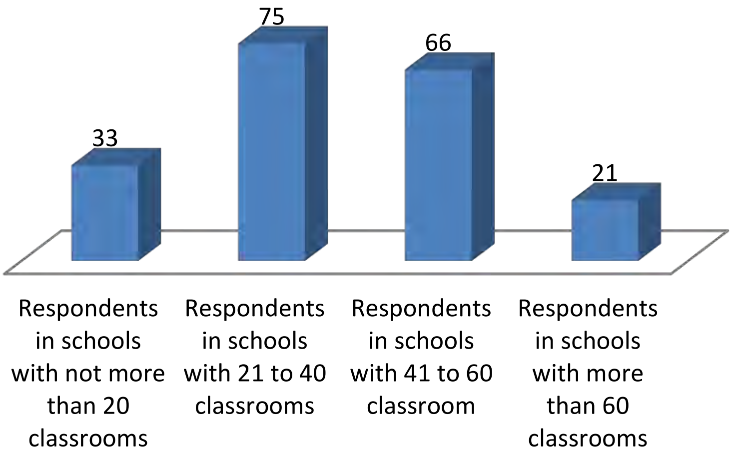


Figure 4.2: Categories of number of active classes in respondent's school

Figure 4.3 shows clearly that most of the schools involved in the study had between 21 and 40 active classes. Respondents in schools with 21 to 40 active classrooms were 75 (38%) while those with 41 to 60 active classrooms were 66 (34%). The number of students in each of the active classes was found and the results revealed that the minimum number of students in an SHS core mathematics class is 21 and the maximum is 65. The average class size at the SHS was found to be 43.

4.2.3 Number of mathematics teachers involved in the study

The number of mathematics teachers in schools which participated in the study range from 2 to 24 and the average was found to be approximately ($M = 12, SD = 5$). The mean of 22 with 5 standard deviation expresses how spread the data were and shows how individual data points were far away from the central tendency. No wonder the range of the data was 22. The range, 22, was observed to be too big for ungrouped data analysis hence the grouping of the number of teachers into categories. Table 4.2 shows the study respondents who indicated they were teaching in schools that had the stated ranges of numbers of mathematics teachers.

Table 4. 2

Distribution of respondents indicating the number of core mathematics teachers in their schools

Category or stated ranges of teachers in schools with:	Respondents	Percent
not more than 9 mathematics teachers	63	32.3
10 to 14 mathematics teachers	66	33.8
15 to 19 mathematics teachers	48	24.6
more than 20 mathematics teachers	18	9.2
Total	195	100

The Table 4.2 shows that most of the participants 66 (33.8%) who were involved in the study indicated they were teaching in schools that have from 10 to 14 mathematics teachers. It is observed from the Table 4.2 that schools that have more than 20 mathematics teachers constitute 18 (9.2%) and schools that have less than 10 mathematics teachers constitute 63 (32.3%). Interestingly, the data distribution shows great disparity amount mathematics teachers in the respondents' schools. Critical assessment of the data show that as some senior high schools have as low as 2 mathematics teachers, other schools have as much as 24 mathematics teachers (Appendix F). Also, the data reveal that there are imbalances in the distribution of mathematics teachers across the various GES school placement categories. While few teachers are found in the category D schools, more mathematics teachers are found in the categories B and C schools (Appendix F). The results confirm what was found by MCEETYA (2003) in Australia where it was difficult to find mathematics and science teachers to fill teaching positions in the remote areas. Also, Murphy et al (2003) revealed that much shortages in mathematics teachers in United State was not national crisis but peculiar to some regions. Further, Dolton et al (2003) stated that there was geographical mismatch teaching job in United Kingdom. It therefore not surprising that there are differences in the number of math teachers in different categories of school since the schools are located in different geographical areas.

4.2.4 Average class size of the active classrooms in the schools

Table 4.3 shows the average class sizes for core and elective mathematics stated by the respondents. The results displayed for core mathematics indicate a maximum class size of 65 students while minimum class size was found to be 21. The average class size was found to be 43. Similarly, for elective mathematics, the maximum class size is 60 students while minimum class size was found to be 9 with an average class size of 35 students.

Table 4.3

Descriptive statistics of average class sizes for core and elective mathematics stated by the respondents

	Total respondents	Min.	Max.	Mean	Std. Dev.
Core mathematics	195	21	65	42.5	10.14
Elective mathematics	195	9	60	34.8	11.32

Table 4.4

Distribution of average class sizes for core and elective mathematics stated by the respondents

STR category	Respondents	Percent
Core Average Maths class size categories		
Class size less than 40	90	46.2
Class size between 40 -50	72	36.9
Class size more than 50	33	16.9
Total	**195**	**100**
Elective Maths Average class size categories		
Class size less than 40	132	67.7
Class size between 40 -50	54	27.7
Class size more than 50	9	4.6
Total	**195**	**100**

The data on class sizes were categorized into groups to help the analysis and comparison to national students per teacher ratio (STR). Table 4.4 illustrates the distribution of average class sizes for core and elective mathematics stated by the respondents within three STR categories. Besides the observation that nearly all teachers taught core mathematics in the schools, it is clear from the class size categories in the table (see Table 4.4) less students took the elective mathematics and therefore the analysis was based largely on core mathematics teacher supply and demand.

4.3 To what extent does the supply meet demand for mathematics teachers in Ghanaian senior high schools for IEMC? (Research Question 1)

This section looks at the extent to which the supply of mathematics teachers in Ghanaian senior high schools meets the demand in the implementation of the inclusive education mathematics curriculum (IEMC). As pointed out in Chapter 2, during the inception stage of the implementation of the government's free SHS initiative, there was public outcry for more educational resources and inputs in the face of inadequate classrooms capacity to contain large class sizes, urban-rural inequalities in mathematics teacher supply leading to large students to teacher ratio in rural schools (Konstantopoulos & Chung, 2009). These, together with other inefficiencies, led to the creation of double track system in some senior high school in the country. It was observed that 74% of the respondents of the study were in school running the double track system before the COVID-19 lockdown.

The first research question is intended to explore the current situation of mathematics teacher supply to find out whether or not it meets the demand for mathematics teachers who are expected to be the implementers of the inclusive education mathematics curriculum introduced with the free SHS.

4.3.1 Mathematics teacher supply and demand based on enrollment and GES STR requirements

The supply of mathematics teachers defines the number of teachers currently teaching mathematics in senior high school while the demand for mathematics teachers refers to the required number of teachers currently needed to teach mathematics in the schools (Mereku, 2000). To determine whether or not the supply of teachers adequately meets the demand of teachers in school, region or country depends largely on the country's policy on students to teacher ratio (STR).

Student-teacher ratio (STR) is the number of students in a school divided by the number of teachers in the institution. For example, a student-teacher ratio of 20:1 indicates that there are 20 students for every one teacher. The term can also be reversed to create a teacher–student ratio. Smaller classes benefit all students because of individual attention from teachers, but low-attaining pupils' benefit more at the secondary school level. Students in large classes drift off task because of too much instruction from the teacher to the whole class instead of individual attention, and low-attaining students are most affected. Research has shown that longer periods in small classes resulted in more increases in achievement in later grades for all students (Konstantopoulos & Chung, 2009). In mathematics, low achievers benefit more from being in small classes since all students are able to have individual attention from teachers.

It would therefore, be prudent to begin examining teacher demand in Ghanaian senior high schools by taking a look at the national policy on STR. The teacher to students' ratio recommended by the Ghana Education Service (GES) is 1:40 at the senior high school. This STR has been used in research studies that involved representatives of the Ministry of Education. In their study on Managing the Effects of Large Class Sizes on Quality Education in Ghana, Ananga and Tamanja (2017) contend that the class size in Ghanaian senior high school stands at 40 students officially.

Table 4.4 shows the distribution of average class sizes for core mathematics stated by the respondents. Using Benbow et al. (2007) argument that a class may be termed large when the pupil to teacher ratio (PTR) exceeds 40 students to 1 teacher, one can see from the table that 46% (i.e., nearly half) of the respondents indicated the average class sizes of their core mathematics classes met the GES STR requirement of 40:1 (see Table 4.4). This suggests the remaining 54% of the respondents are teaching in school that are operating with class sizes beyond the GES STR requirement of 40:1 and, therefore, are schools where demand exceeds supply. Also, the fact that the number of mathematics teachers in the schools range from as low as 2 to 24 and the estimated average enrollment of schools which participated in the study was about 1500, suggests many schools may have problems with ensuring a balance in teacher demand and supply.

These initial observations made the researcher to subject the data to further analysis using three scenarios to gauge how the demand for core mathematics teachers in the participating schools exceed supply. The analysis was limited largely to core mathematics teacher supply and demand because the data (see Table 4.4) revealed nearly all teachers taught core mathematics but fewer taught elective mathematics.

4.3.2 Mathematics teacher supply based on school enrollment and STR

From the definitions of demand and supply discussed above, it is easy to be drawn into an erroneous argument of using class size and STR interchangeably. The analysis of demand and supply of teachers go beyond class size and STR despite the two could be contributory factors. Table 4.5 shows the participants' responses on their schools' number of active classes and the average class-size of a core mathematics classes.

Table 4.5

Descriptive statistics of school's average class-size stated by respondents

	Min	Max	Mean	Std. Dev.
Number of Active Classes in school (AC)	6	84	37	17
Average Size of Active Classes (ASAC)	21	65	43	10

The results displayed in Table 4.5 indicate a maximum number of active classes of 84 while the minimum number was 6 in a school. The mean number of active classes was found to be 37. The table also shows that the least average size of active classes is 21 while the largest average size of active classes is 65 with a mean of 43. This situation suggests most schools are operating STRs which are close to the official one of 40:1, but this is not the reality. So, the demand (or the number of teachers required), indicated by the responses provided, were further analyzed based on the following

(i) the silent official STR and the actual STR that prevails in most school,

(ii) estimated total school enrollment,

(iii) the education system norms on number of core mathematics periods per week, and

(iv) GES quota on teaching periods per week.

The demand or number of teachers required to teach core mathematics in a school with a given number of active classes and average active classes' size were computed using mathematics model (1) below:

$$\text{Demand (or number of teachers required)} = \frac{Estimated\ Enrollment}{STR} \times \frac{LPPW}{MTP}$$

or

$$= \frac{NAC \times ASAC}{STR} \times \frac{LPPW}{MTP} \quad (1)$$

Where

NAC → Number of Active Classes

ASAC → Average Size of Active Classes

STR → Different SHS STRs – official 40:1 and actual 50:1

LPPW → GES quota on number of Learning Periods Per Week learners are meet to be taught by the teacher, which is 6 at the SHS

MTP → GES quota on Maximum Teaching Periods per week per teacher, which is 22 at the SHS

The demand summaries obtained with formula (1) were categorized as:

- teachers in schools whose demand is not more than 10
- teachers in schools whose demand is between 11 and 20
- teachers in schools whose demand is between 21 and 30
- teachers in schools whose demand is more than 30.

Figure 4.3 shows the categories obtained with the mathematics model (1) and distribution of mathematics teachers (or schools) in demand categories obtained using the two STR scenarios – 40:1 and 50:1.

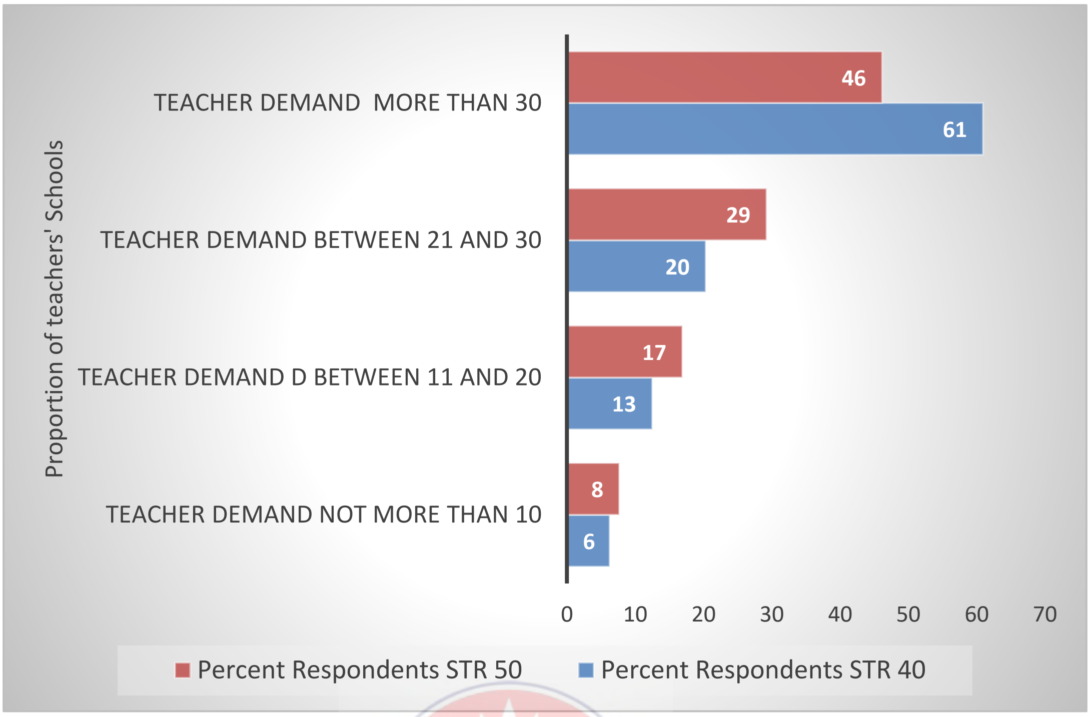


Figure 4.3: Distribution of mathematics teachers (or schools) in demand categories with the two STR scenarios

Figure 4.3 shows that there is not much difference in the proportion of schools whose teacher demand is not more than 10 or is between 11 and 20. Interestingly, where demand is 21 to 30 teachers, there is a 9% increase in proportion of schools with STR of 50:1, but when it comes to where the demand is over 30 teachers, the proportion of schools with STR of 40:1 have higher demand with a difference of 15%. These show that neither the official STR of 40:1 or the realistic STR 50:1 ensures a good balance in teacher demand and supply in Ghanaian senior high schools.

Actual number of teachers at post were subtracted from the teacher demand figures computed with the formula (1) and the results recorded as the excess number of teachers required and were categorized as:

- supply is more than demand by less than10
- demand is more than supply by less than10
- demand is more than supply by between 11 and 20
- demand is more than supply by between 21 and 30
- demand is more than supply by more than 30.

Figure 4.4 shows the categories excess demand over supply obtained with mathematics model (1) and distribution of mathematics teachers (or schools) in these categories using the two STR scenarios – 40:1 and 50:1.

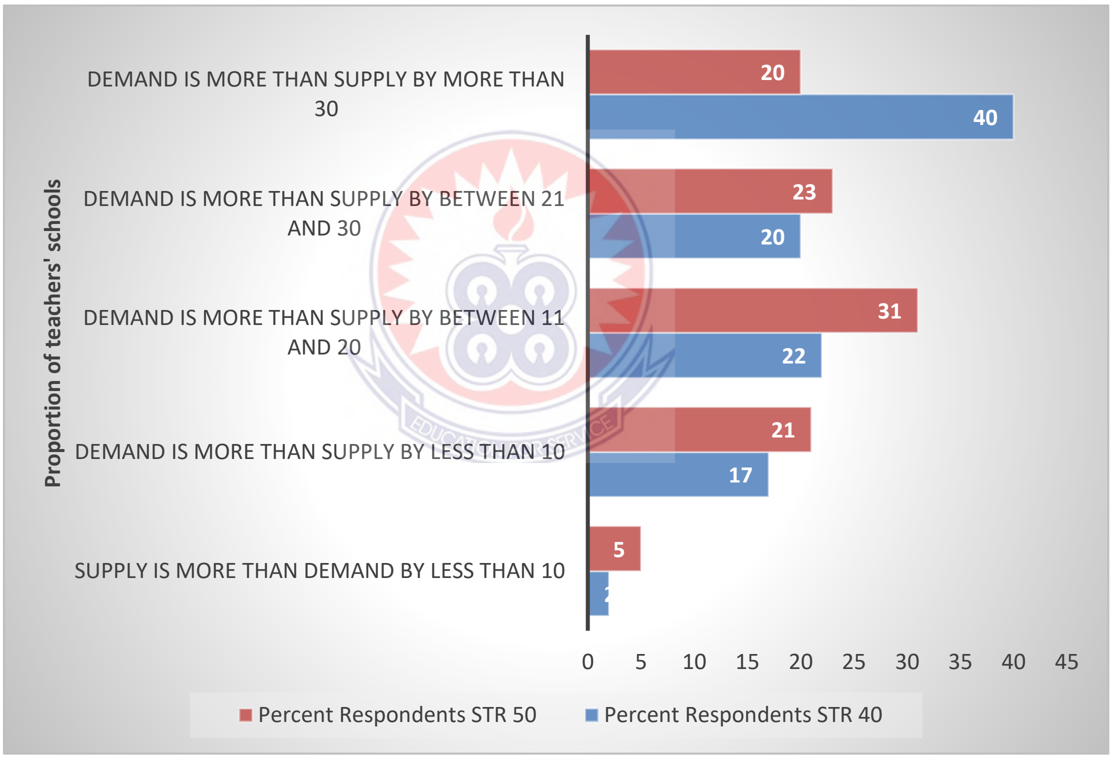


Figure 4. 4 Distribution of mathematics teachers (or schools) in excess demand categories with the two STR scenarios

Figure 4.4 shows that if the STR is 50, there will be more schools with excess mathematics teachers than where the STR is 40 but these will happen in 5% or less schools. Also, if the STR is 50, there will be 9% more schools with 11 to 20 excess mathematics teachers than where the STR is 40. But where the demand is over 30 teachers, proportion of schools with STR of 40:1 will require double the number of teachers in schools with schools with STR of 50:1. Since the number of mathematics teachers available in schools of the respondents in this study range from as low as 2 to 24, that is, because there are no schools with more than 30 teachers in the study, the hypothetical scenario using formula (1) does not provide a good illustration of the situation. However, the results are in line with theory of aggregate demand and supply of teacher labour market by Zabalza et al (1979) and Chen (2009) who argue that in teacher economic market where the government seems to be the sole purchaser of the market with fixed funds for spending, the demand for teacher usually does not meet supply of teachers.

4.3.3 Mathematics teacher demand and supply based on teacher's workload

The research therefore explored a second scenario in which the demand for mathematics teachers in a school was associated with the workload of the mathematics teachers at post (i.e., the supply of teachers at the time of the study). The study estimated the workload of the mathematics teacher based on the following parameters:

- GES quota on number of periods per week learners meet to be taught by the teacher, which is 6 at the SHS (LPPW)
- Number of Active Classes (NAC)
- Total Number of Mathematics Teachers (TNMT) in the respondent's school.

The demand or number of teachers required to teach core mathematics in a school with a given number of teachers were computed using the mathematics model (2) below:

School's total number of core mathematics periods per week = $AC \times LPPW$

Average core mathematics teachers required = $\frac{NAC \times LPPW}{TNMT}$ (2)

Where

NAC → Number of Active Classes

LPPW → GES quota on number of periods per week learners are meet to be taught by the teacher, which is 6 at the SHS (

TNMT → Total Number of Mathematics Teachers in the respondent's school

The demand summaries obtained with the mathematics model (2) were categorized as weekly workload of schools with:

- less than 19 periods per week
- 20 - 22 periods per week
- over22 periods per week.

Figure 4.5 shows the proportion of schools whose workloads are below the GES workload requirement per week (i.e., less than 20 periods); within the GES workload requirement (i.e., from 20 to 22 periods per week) and above the requirement (i.e., over 22 periods per week).

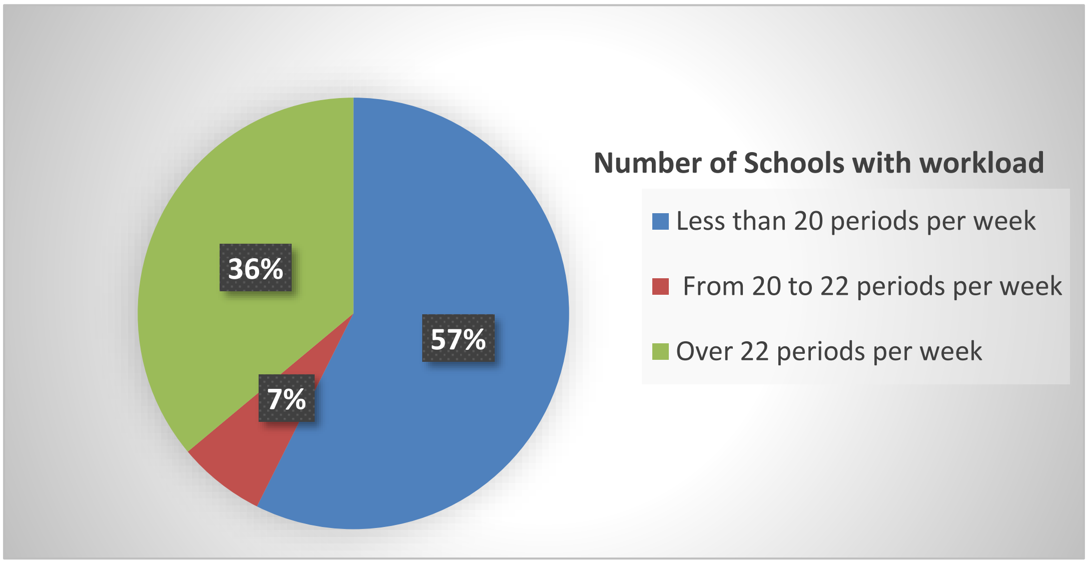


Figure 4. 5: Proportion of respondents indicating their school's workload is below, within or above the GES workload requirement per week

It is obvious from this scenario in Figure 4.5 that the majority of the respondents (57%) are in schools which are doing less than the GES workload requirement per week (i.e., 22 periods) with only 7% doing this prescribed workload. It is clear from Figure 4.5 that most of the core mathematics teachers in SHS who participated in the study are in schools which are doing more periods per week compared with the GES required periods. There are 66 out of the 195 of the teachers (i.e., 34%) teaching over the GES workload requirement per week.

4.3.4 Mathematics teacher demand and supply based on adjusted teacher's workload

The analysis of teaching obtained with the mathematics model (2) in the second scenario uses only the number active classes and the number of mathematics periods per week per class which do not make room for class size and for that reason tend either to overestimate or underestimate the actual teaching workload. An improved mathematical model was as a result evolved by the researcher applying an approach that assigned weights based on the official GES STR of 40:1 to the number of students in each class or class size. The weighted class sizes were used as a base line for the adjusted teaching workload for teachers of core mathematics. The adjusted total teaching workload (ATTL) required by teachers of core mathematics in a school with a given number of teachers were computed using the mathematics model (3) below:

$$\text{Adjusted Total Teaching Workload (ATTL)} = \left(1 + \frac{ASAC - RCS}{RCS}\right) \times MTP \qquad (3)$$

Where

ASAC →Average Size of Active Classes
RCS → Required Class Size based on official GES STR of 40:1
MTP → GES quota on Maximum Teaching Periods per week per teacher, (i.e., 22 at the SHS)

Figure 4.6 shows the proportion of schools, using the ATTL model, whose workloads are below the GES workload requirement per week (i.e., less than 20 periods); within the GES workload requirement (i.e., from 20 to 22 periods per week) and above the requirement (i.e., over 22 periods per week).

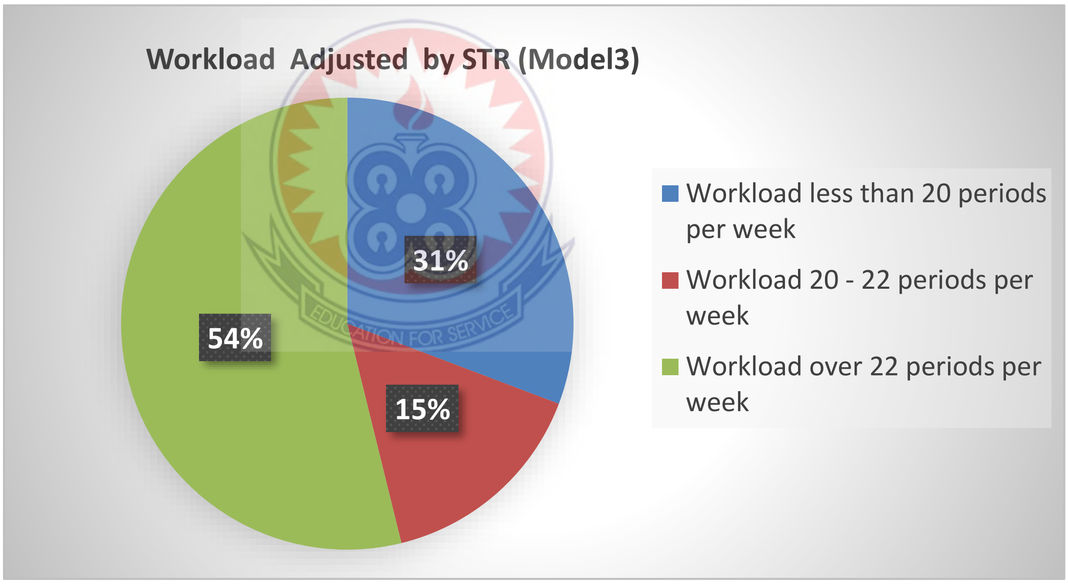


Figure 4. 6: Proportion of respondents (using the ATTL model) indicating their school's workload is below, within or above the GES workload requirement per week

It can be seen from the Model 3 scenario in Figure 4.6 that though the majority of respondents (54%) are in schools which are doing less than the GES workload requirement per week (i.e., 22 periods) the proportion of teachers doing the prescribed workload doubled in the adjusted model from 7% to 15%. But those doing over the prescribed workload decreased in the adjusted model to 31% compared to 36% in the unadjusted model.

The ATTL model seems to be a better predictor of teacher workload and can be useful for determining whether or not supply of teachers in a senior high school meets the demand. One can also compute the excess teaching load (ETL) by using; ETL= $TCTL - RTL_w$ $(22\ periods)$ and adjusted excess teaching load (AETL) by; AETL= $ATCTL - RTL_w$ $(22periods)$. It should be noted that negative values of ETL and AETL means that the teachers in the school are teaching below the required 22 periods per week while positive values indicate that the teachers in such schools are teaching more than the required 22 periods per week.

The results have consistently shown that many mathematics teachers in senior high schools are teaching less than the prescribe workload or periods and many teach in classes whose class size are below the official GES STR of 40:1. But a substantial proportion of the teachers are above the official GES STR suggesting they devote nearly all their school time to teaching and, therefore, have more little time to deal with their numerous non-teaching tasks and responsibilities which are not usually considered in the contact hours for teaching workload including

- lesson planning
- marking classwork and homework
- recording pupil data for school-based assessment (SBA) and
- reporting to parents
- supervising pupils outside lesson times and marking classwork
- school trips and other general administrative duties.

But the fact that most of the schools have large class-sizes that are about double the GES required STR and that teachers in such schools need a lot more time to deal with the non-teaching tasks and responsibilities of their job, which are not usually considered in the workload contact hours decisions, raise questions that has to be considered by the Ghana Education Service.

4.4 Analysis of the qualitative data

The previous sections of this chapter were dedicated to the analysis of the quantitative data and the presentation of the results obtained from the extent to which supply meets demand for mathematics teachers for the implementation of IEMC. In this section the data obtained from the follow up based on the findings from the quantitative data analysis. The data obtained from the follow up are mainly qualitative in nature. The data were gathered from the various observations made at some senior high schools and interviews with some mathematics teachers who answered the questionnaires and some who did not take part in answering the questionnaires. The analyses of the qualitative data are presented on themes and poster discussions from some of the photographs from the schools visited. The presentation is based on the research questions 1 to 3.

4.4.1 How does supply meet demand for SHS mathematics teachers for the implementation of IEMC?

The results from the quantitative analysis revealed that in general the supply of mathematics teachers does not meet the demand for the implementation of IEMC in that schools have high students to mathematics teacher ratio, mathematics teachers have high workload and other activities which do not actually contribute to the teachers' workload. Interviews with the teachers revealed the following themes as the reason why mathematics teachers think more mathematics teachers are needed in their schools. The themes are increasing enrollment due to free SHS, double truck, large number of classes, number of periods of mathematics teacher per week and other extra curricula activities.

Increased enrolment of students due to free SHS

All the six mathematics teachers who were interviewed pointed out that students' enrolment at the senior high school have increased so much due the introduction of the free SHS. To the teachers the rise in number in some cases do not necessarily increased the periods taught by the teacher but increased the teachers' workload such as marking and supervision.

One teacher puts it this way; *The population of students has increased due to the free SHS policy and some of the students are mathematically week so it takes a lot of effort to get some of the students to understand anything you teach them within the same time. Sir you know the syllabus must also be completed so we are really suffering with this huge numbers.*

Another teacher also said; *the increase in the enrolment as a result of the government free SHS policy did not only increase the class size but the difficult and worrying part of it is marking. It's when you assess students after lesson and you see the heap of exercise books to be marked, then you appreciate the problem of teaching core mathematics.*

Some classes were visited showed that increase in enrolment has caused the creation of increased class sizes. The number of students in each of the classes in most of the classes were between 45 and 65. These large class sizes may require more than a single teacher of mathematics at a particular point in time for effective class management and control. This may also reduce some activities such as marking of exercises and tests by a single mathematics teacher.

Double truck system

The increase in number of students due to the introduction of free SHS without immediate increase in the facilities of the senior high schools necessitated the introduction of the double truck. The mathematics teachers who were interviewed indicated that most of the teachers teach both tracks as result of inadequate mathematics teachers and also, every student reads core mathematics and most of the subject areas are reading elective mathematics in recent times. It was observed that most of the school that are running the double track system have fewer number of students in a class as compared to the school that are running only the single track. This is evident in some of the photographs taken from some of the double track schools.

It was observed from some of the school that were running double tract system that the number of students in the classes were between 20 and 35. However, some of the teachers interviewed express some worries about the fact that some teachers have to teach in both tracks. The time tables of some of the teachers were assessed to ascertain the number of periods they take in the week in the various tracks and the samples are provided in Figure 4.7

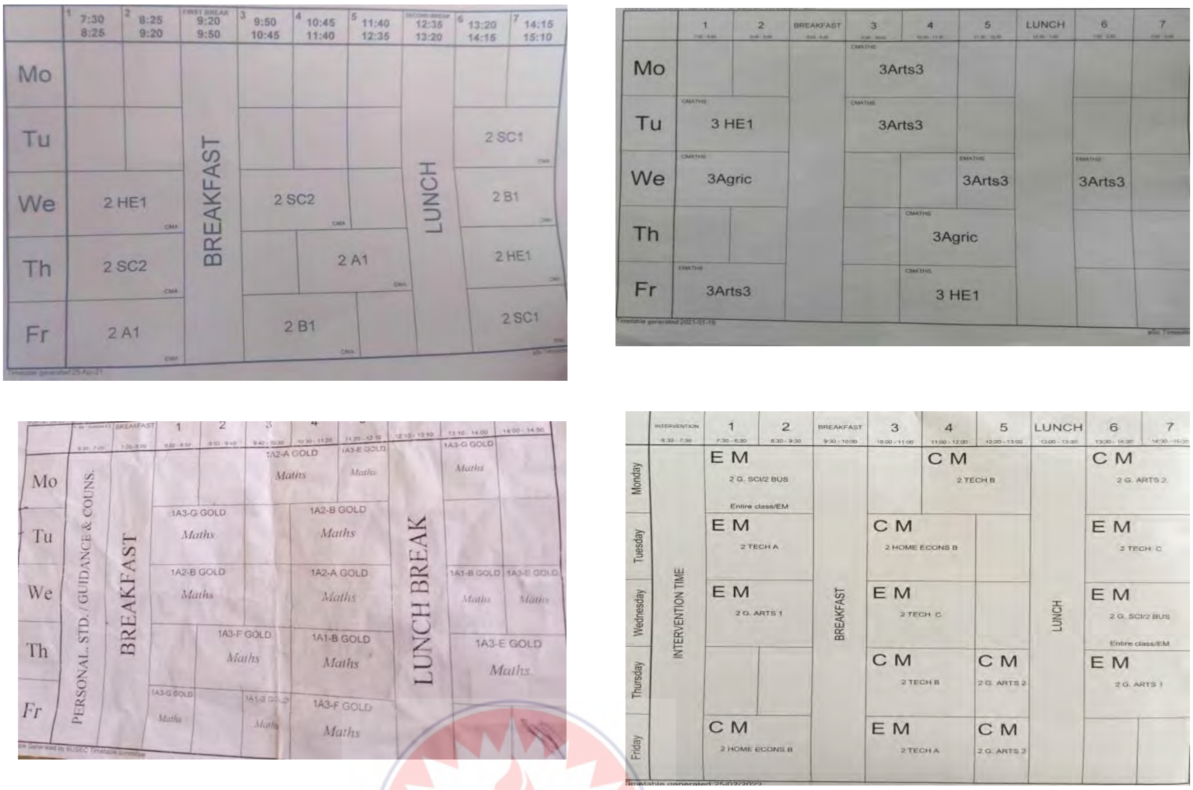


Figure 4. 7: Pictures showing the time tables of some mathematics teachers

Time table of core mathematics teacher in one of the senior high schools visited who teaches 20 periods per week for 1hour per period. Some senior high school mathematics teachers' time table show that some teachers teach 28 periods per week for both core and elective mathematics. One mathematics teacher who is also guidance and counseling officer for students revealed that that teacher teaches 24 periods per week with each period lasting for 1 hour. An interview with a mathematics head of department reveals that

"*as head of department, I teach 16 periods per week, mark all the lesson notes of the 18 staff members in the department, serve on the examination committee and the disciplinary committee*"

In an interview with one of the teachers was is teaching 28 periods per week, the teacher said that

"*I teach every day and at times getting time to rest is a problem because I start in the morning and will visit class upon class one after the other throughout the day*"

Increased in the number of classes

Some of the mathematics teachers interviewed indicated that the outbreak of covid-19 pandemic and its associated protocols caused their schools to reduce the class sizes which resulted in creating additional classrooms which have increased the number of periods of existing teachers especially mathematics teachers. In one of the schools visited, a class that consisted of 55 students was divided into two and one of the classes was moved to an uncompleted building. It was observed that the mathematics teacher could attend to individual students but the teacher complained that the number of contact hours with the same 55 students had doubled because he had to use the same contact time teach the second group.

Extra curricula activities

Mathematics teachers in senior high schools in Ghana perform other activities in their school apart from their core mandate of teaching students. Mathematics teachers who were interviewed revealed that outside preparing notes, teaching and marking students' exercises and test offer activities such as class advisors (form masters), masters on duty, serve on committees like sport committee, disciplinary committee, entertainment committee, welfare committee, time table committee and examination committee. Other teachers said they serve as house masters/mistresses, and head of departments. All these activities the mathematics teachers said add to their workload in the school but no wait is assigned to these extra curriculum activities.

One mathematics teacher lamented*;*

"I attended mission senior high school and during our time the bell boy would get up 3:00am and wait till 4:00 am to ring the bell for rising and everybody would be up. There was no teacher on duty coming to wake us up but today in my school, the headmaster demand from masters on duty to be at the dormitory at 4:30 am to wake students up before going to prepare for class. It is so difficult for those of us who live outside campus"

Another mathematics teacher said;

"*can you imagine, even student's entertainment teachers are supposed to be there to supervise yet nothing is given to the teacher as remuneration! For me it is not surprising that most students seem not to do well in mathematics because the work is huge but the labourers are small especially in this school. The headmaster is too difficult and if I get the chance I will leave because some schools do not worry their teachers like here"*

One other mathematics teacher said

"*I teach 28 periods a week, and unfortunately there is no teacher for PE and because I have passion for sports, I have ended up being the PE instructor for the school. I am on field almost every day including Saturdays to train students in various sporting activities but I am not even remunerated for that"*

It could be deduced from the reports that there seems to exist some differences in what pertains in senior high schools that brings inequality in work conditions for mathematics teachers in senior high school. The researcher was going to interview 10 mathematics teachers but on the fifth person, it was realized that the respondents were providing almost the same answers which indicated a saturation point of the interview so the researcher ended the interview at that point.

4.5 What is the influence of GES School Placement Categories (GES-SPC) on the levels of demand for mathematics teachers in senior high schools? (Research Question 2)

This section assesses the association between GES school placement category and the levels of demand for mathematics teachers in SHS in order to determine the effect and/or influence of GES school placement category on demand for mathematics teachers in senior high schools in Ghana. A crosstabulation analysis was performed on the GES school placement category and the adjusted total teaching workload (in categories because of the nature and range of the data) of SHS mathematics teachers and the results presented are in Tables 4.6, 4.7 and Figure 4.8

Table 4.6
Association between GES school placement category and adjusted total teaching workload of SHS mathematics teachers

	Adjusted Total Teaching Workload Categories			
School's Placement Category	Workload less than 20 periods per week	Workload 20 - 22 periods per week	Workload over 22 periods per week	Total
Placement Category A School	12	3	9	24
Placement Category B School	18	15	33	66
Placement Category C School	24	12	57	93
Placement Category D School	6	0	6	12
Total	60	30	105	195

Table 4.7

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.119[a]	6	.661
Likelihood Ratio	4.467	6	.614
Linear-by-Linear Association	.725	1	.394
N of Valid Cases	1955		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is .62.

A crosstabulation was conducted to test independence of GES-SPC and adjusted total teaching workload of SHS mathematics teachers. A chi-square test of association was performed and was observed that there was no significant association between GES-SPC and mathematics teachers adjusted total teaching workload, $\chi^2(6, N = 195) = 4.12$, p= .66 at 0.05 alpha level. These results suggest that GES-SPC does not depend on mathematics teachers adjusted total teaching workload and vise-versa. Thus, GES-SPC does not influence mathematics teachers adjusted total teaching workload and the adjusted total teaching workload of mathematics teachers of SHS does not also determine the GES-SPC that the mathematics teacher is to teach.

However, it appears from Table 4.6 that mathematics teachers teaching in GES-SPC ‘C’ have more teaching workload than the rest of the categories and that more of the mathematics teachers are teaching over 22 periods. The detailed presentation of adjusted teaching workload (in categories) and GES-SPC are found in Figure 4.8.

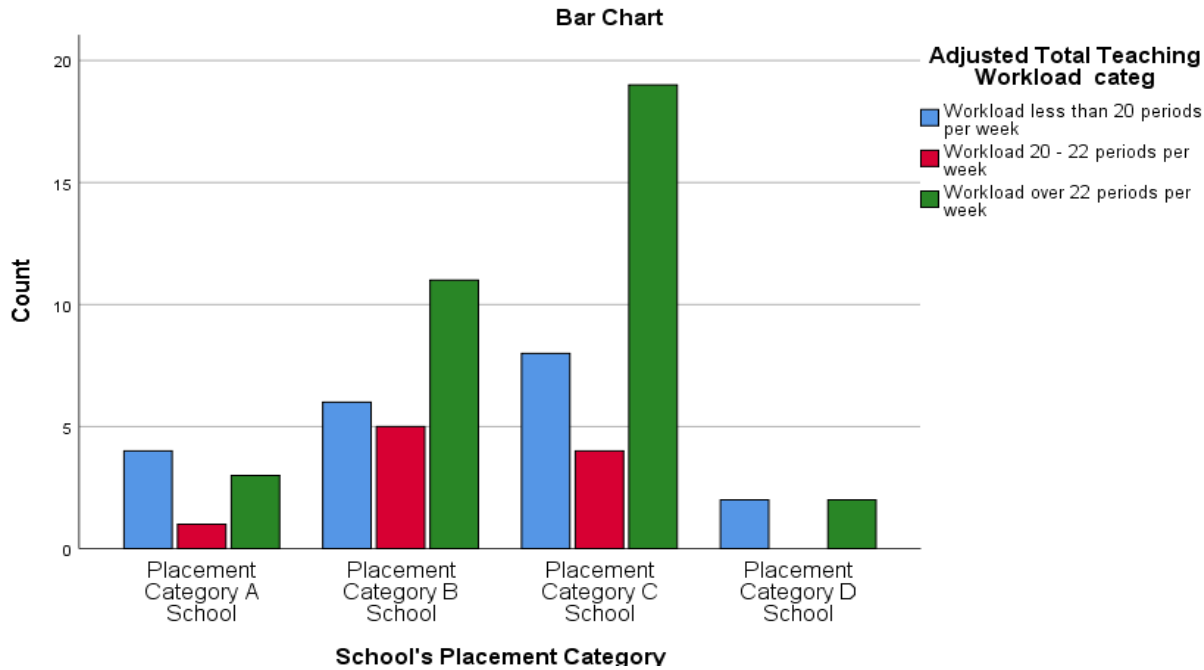


Figure 4. 8: Mathematics teachers' adjusted teaching workload based on GES-SPC

A component bar graph was used to compare the adjusted total teaching workload of mathematics teachers in the various GES-SPC and the results reveal that mathematics teachers teaching in categories B and C have more teachers teaching over 22 periods which was the common GES required periods for core mathematics teacher in SHS.

4.6 To what extent are SHS mathematics teachers prepared for the implementation of the IEMC? (Research question three)

This section looks at the extent to which senior high school mathematics teachers are prepared to implement inclusive education mathematics curriculum. The teacher preparedness is treated under three dimensions of training which are used to determine the mathematics teachers' readiness to implement the curriculum. The three dimensions which were used to assess the mathematics teachers' readiness were based on the teachers' academic and professional training in university/college, in-service education and training programmes received on the job and experiences/interactions obtained on the job/school.

4.6.1 Mathematics teachers' preparedness/readiness to implement IEMC

To assess mathematics teachers' preparedness/readiness to implement IEMC, respondents were asked to answer three questions based on their academic and professional training obtained from university/college attended, any form of in-service education and training programmes received on the job and the experiences/interactions gathered from the teaching job and in the school. The original data obtained from respondents were recoded into not ready, uncertain and ready so as to make analysis and interpretation easier for comprehension. The results of descriptive analyais of the readiness data are presented in Table 4.8

Table 4.8

Mathematics teachers' general preparedness to implement IEM

Training type	Mean	Standard Deviation
In-service education and training programmes	2.49	0.812
Experiences/interactions in the school	2.82	0.527
University/college training	2.85	0.441
Cumulative readiness	2.72	0.465

The results presented in Table 4.8 indicate that mathematics teachers who were involved in the study generally feel that they are moderately prepared/ready to implement inclusive education mathematics curriculum. This is demonstrated by the score for the cumulative readiness of mathematics teachers to implement IEMC as shown in the Table 9 $[M = 2.72, SD = 0.465]$. It is clear from figure 4.10 that mathematics teachers in senior high schools who participated in the study feel that the training received from their universities/colleges is the highest contributor that prepared them to be ready for the implementation of IEMC with a mean score $[M =$

$2.85, SD = 0.441]$. This was closely followed by the mathematics teachers experiences gathered from or interactions with the teaching job and in the school have prepared respondents enough to be ready to implement IEMC with a mean score of $[M = 2.82, SD = 0.527]$. Interestingly, respondents seem not to be sure if the in-service education and training programmes on the job contribute to their preparedness to implement IEMC because the mean score was found to be $[M = 2.49, SD = 0.812]$. This condition does not look favourable for GES because respondents (mathematics teachers) do not have confidence in the kind of training provided by GES towards the implementation of the new curriculum. The results also seem to portray that mathematics teachers who were involved in the study believe in the kind of academic and professional training received from their universities/colleges because the institutions prepared them to be ready for the implementation of IEMC. The results also suggest that experiences and interactions in the schools they teach have made them ready to implement IEMC.

The results in line with researches which show that there is a relationship between teacher's knowledge about inclusive education and the kind of inclusive practices demonstrated in the mathematics classroom. This is seen in numerous studies such as Beachem and Rouse (2012); Florian and Black-Hawkins (2011); Sharma, Forlin and Loreman (2008) who established the link between teachers' training in SEN/D, their attitudes toward inclusion and inclusion strategies and practices. These assertions made the researcher to follow up the results with interviews with some of the respondents in their schools and document analysis of some mathematics education departments of the respondents' institutions so as to obtained in-depth knowledge about mathematics teachers' readiness to implement IEMC.

4.6.2 Mathematics teachers' exposure in college or university to IEMC

The other dimensions of teacher preparedness are the familiarity/experience of mathematics teachers with the concept of inclusivity and mathematics teachers' awareness inclusive education. The responses of mathematics teachers who were involved in the study reveal that they are generally prepared to implement IEMC but this preparedness comes as a result of some dimensions which include experience or familiarity with the concept of inclusivity. This section assesses the experiences and/or familiarity of respondents on IEMC from their colleges or universities which is recoded as exposure in college/university studies to IEMC. The five-point Likert scale was recoded into three-point Likert scale after critical analysis of the data and results obtained from the interviews and observations made from some of the schools which were involved in the study. The strongly disagree and disagree were combined as disagree, not sure and agree were put together as uncertain and strongly agree was made agree. This became necessary because during the interview it was observed that most of the interviewees were not sure of most of the items they agreed to and the cross checking of the courses read at the universities and colleges were not explicit of inclusive concept and strategies. The result of the nine items which were used to assess the exposure in college/university studies to IEMC is presented in Table 4.9

Table 4.9

Mathematics teachers' Exposure in college/university studies to IEMC

	Disagree	Uncertain	Agree	Mean	Std. Dev.
Read about IEMC in the general education courses	30	93	72	2.21	0.686
Took a course that prepared me for differentiated teaching practices	30	117	48	2.09	0.621
Practiced how to use inclusive education strategies in mathematics teaching	39	123	33	1.97	0.602
Read about IEMC in the mathematics courses	57	87	51	1.97	0.738
Took a course on mathematics teaching that involved how to create equitable opportunities in an inclusive education classroom	48	108	39	1.96	0.661
Took a course in preparing materials for creating equitable opportunities in inclusive education classrooms	57	90	48	1.96	0.727
Took a course in creating equitable opportunities in an inclusive education classroom	51	102	42	1.96	0.684
Took a course that prepared me to use scaffolding in teaching.	54	117	24	1.85	0.609
Practiced how to create equitable opportunities in inclusive education learning environment	69	96	30	1.81	0.680
Cumulative exposure in college/university to IEMC				*2.02*	*0.599*

The results in Table 4.9 show that the mathematics teachers who took part in the study mostly are uncertain about their exposure in college/university studies to inclusive education concepts and hence have limited experience in inclusivity. The cumulative average score of respondents' exposure in college/university with inclusive education concept and strategies was found to be $[M = 2.02, SD = 0.599]$ which is within the interval of uncertain among the three points on the Likert scale. The results indicate that all the nine items used to assess the exposure of mathematics teachers in college/university to IEMC has an average score of around two points which represent uncertainty toward exposure to inclusivity. A better understanding and real nature of the situation of exposure to inclusive education is illustrated in Table 4.9. From the Table, majority of the teachers who were involved in the study indicated their uncertainty about exposure to inclusive education mathematics curriculum.

Interestingly, 123(63%) respondents stated that they are uncertain to have ‘Practiced how to use inclusive education strategies in mathematics teaching’. In fact, combining the number of respondents who disagreed and those who are uncertain to exposure in college/university to IEMC, it is obvious that mathematics teachers in SHS are not exposed to inclusivity and are unfamiliar with inclusive education concepts and strategies to implement IEMC. These results inform providers of mathematics teacher education in the institutions that train the respondents of the study to look at their training programmes to make more room for inclusive education concepts so that mathematics teachers would be more familiar and experience inclusive education concepts and strategies. This this confirms Mónico et al. (2018) who argue that inclusive education comprises with the ability of the students to participate in teaching and learning activities in the classroom which requires more training for and participation from teachers. Also, the true realization and ultimate success of inclusive education depends largely on the regular classroom teachers (Mitchell, 2010), and teachers’ knowledge about inclusive education is one of the most important elements in the actualization and successful implementation of inclusive education (Mónico et al., 2018).

4.6.3 Awareness of inclusive education mathematics curriculum

This section looks at another dimension of mathematics teachers’ preparedness to implement IEMC which deals with respondents’ awareness of inclusive education concepts and practices. To measure respondents’ level of agreement with their awareness of inclusive education concept and practices, 16 items which consist of 9 positive statements and 7 negative statements about concepts and strategies of inclusive education were used and the results presented in Table 4.10 .

Table 4.10

Mathematics teachers' awareness of inclusive education mathematics curriculum

	Disagree (%)	Uncertain (%)	Agree (%)	Mean	Std. Deviation
An IEMC requires teaching activities planned with all students in mind	13	41	46	2.33	0.705
In IEMC classroom, every student is made to feel welcome, irrespective of one's diversity	10	51	39	2.28	0.647
An IEMC builds on the differences among students in ways that value every student equally	16	41	43	2.27	0.730
IEMC requires that teachers and parents work together	15	51	34	2.19	0.680
IEMC requires that differences among students are viewed as problems that must be overcome	11	61	28	2.18	0.601
In IEMC classroom, good students are encouraged to help students with difficulties in mathematics	16	50	34	2.18	0.695
IEMC classroom is where differences are celebrated, embraced and valued	21	46	33	2.12	0.729
In IEMC classroom, differences between students are viewed as resources to support learning	16	56	28	2.12	0.663
IEMC is only about including students with special needs in mathematics	43	45	12	1.69	0.679
IEMC seeks to maintain all forms of barriers to learning	31	51	18	1.87	0.694
An IEMC classroom makes it difficult for students who are gifted to learn with students who have challenges in mathematics	48	36	16	1.69	0.743
IEMC encourages students to learn independently without collaboration	52	39	9	1.57	0.657
IEMC requires that all students should be given the same kind of task during lessons	60	28	12	1.52	0.704
In IEMC classroom, students with unequal abilities helping each other in a classroom amount to cheating	57	34	9	1.52	0.660
In IEMC classroom, mixed ability groupings of students will encourage copying	64	28	8	1.43	0.633
In an IEMC, teaching encourages the participation of only the intelligent students	67	27	6	1.39	0.602
Cumulative use if inclusive concepts and strategies				*1.91*	*0.391*

The results in Table 4.10 show that mathematics teachers who were involved in the study seem not to be certain about their awareness of inclusive education concepts and practices. The cumulative average score of the respondents' awareness of inclusive education concepts and practices was found to be $[M = 1.91, SD = 0.391]$

which is in the range of uncertain. This is not surprising because about half of the items used to determine the respondents' awareness of IEMC have mean score less than 2 especially the negative statements which are clear indication of respondents not sure of their awareness of inclusive education concepts and practices. However, a critical assessment of the items used for the measurement of inclusive awareness reveal that most of the teachers who participated in the study might not have understood the items well because, from Table 4.10, it is observed that most of the respondents were uncertain about the positive statements with all the items having a mean score hovering around 2. On the other hand, most of the respondents disagreed to the negative statements which seem contradictory. For instance, the negative statement 'In an IEMC, teaching encourages the participation of only the intelligent students' received 67% of respondents' agreement but a positive statement 'IEMC requires that differences among students are viewed as problems that must be overcome' had 61% of the respondents being uncertain. These two issues are clear contradiction about inclusivity which implies that either the respondents could not understand the items or have inadequate knowledge about inclusive education concepts and practices.

4.7 To what extent do SHS mathematics teachers use of inclusive education strategies in the implementation of the mathematics curriculum (IEMC)? (Research Question Four)

It is possible for one to be thinking that he/she is prepared to implement an idea but if the person is not applying the various concepts involved in the idea, then its implementation could be fraud. To really assess the preparedness to implement the IEMC, the mathematics teachers' use of inclusive education concepts and strategies were assessed using eleven items. The results obtained are presented in Table 4.11

Table 4.11

Mathematics teachers' use of inclusive education concepts and strategies

	Not at all used (%)	Occasionally used (%)	Used most of the time (%)	Mean	Std. Deviation
Vary the student groups for mathematics classes in the term	51	42	7	1.57	0.633
Have the materials that help to practice inclusive mathematics teaching in the school	34	58	8	1.73	0.592
Assign students to the groups	10	82	8	1.97	0.425
Make students work in groups during mathematics lesson	7	87	6	1.99	0.369
See the students as average mathematics students in achievement	14	73	13	2.00	0.522
Give special attention to student(s) with any form of disability in mathematics class	18	63	19	2.01	0.615
Have opportunity to support any student with learning difficulties in mathematics in my class	17	58	25	2.09	0.645
Identify extremely dull student(s) in my mathematics class for special attention	16	59	25	2.09	0.645
Identify extremely good student(s) in my mathematics class	8	64	28	2.21	0.565
Teach with every student in mind	9	61	30	2.21	0.591
Give special attention to students with learning difficulties in mathematics in my teaching	7	63	30	2.22	0.573
Cumulative usage of inclusive education concepts and strategies				*2.01*	*0.358*

The results presented in Table 4.11 shows that most of the respondents occasionally use concepts and strategies of inclusive education in teaching mathematics in their schools. This is seen from the cumulative average of frequency of use of inclusive education strategies with a mean score of [M=2.01, SD=0.358]. Interestingly, the results shows that the inclusive strategies which are mostly used by the mathematics teachers in SHS who were involved in the study are 'teaching with every student in mind' and 'giving special attention to students with learning difficulties in mathematics in my teaching' with each of them having 30% of the respondents using them most of the time. However, as much as 87% and 82% of the respondents indicated that they occasionally assign students to groups and Make students work in groups during mathematics lesson respectively. These results might seem worrying but not surprising because if teachers are not exposed to inclusive education concepts and are not aware of the inclusive education practices, it would be extremely difficult for such teachers to use the concepts and strategies. Also, these results reveal that respondents are not clearly sure of their understanding of inclusive education concepts and practices and therefore do not apply the practices regularly in their teaching. This is likely to affect the teachers' ability to implement the inclusive education mathematics curriculum. These results reflect Bricker (2000) who opine that the use effective instructional methods and strategies such as differentiated pedagogy and scaffolding, adapt instruction, and provide equal learning opportunities for all children. The teachers are also expected to assess children's development, prepare an effective learning environment, engage all children in learning activities, use different instructional methods and strategies, and work with families for the benefits all learners (Bruns & Mogharberran, 2009). The lack of knowledge, skills, and experiences to fulfil these roles is one of the most important barriers to effective inclusion (Pivic, McComas, & La Flamme, 2002; Soodak, Erwin, Winton, Brotherson, Turnbull & Hanson, 2002).

4.7.1 Analysis of the qualitative data

The previous section was dedicated to the analysis of the quantitative data of research questions 4 and 5. A presentation on the results obtained from the mathematics teachers' preparedness to implement IEMC, mathematics teachers' exposure to inclusive education concepts and practices, and mathematics teachers' use of inclusive education practices in mathematics classroom was made. In this sub-section the data obtained from the follow up interviews based on the findings from the quantitative data analysis is presented. The data obtained from the follow up are mainly qualitative in nature. The data were gathered from the various interviews conducted with some senior high school mathematics teachers who answered the questionnaires and some who did not take part in answering the questionnaires. This was done to ascertain the truth or otherwise of the results obtained quantitative part of the study. The analyses of the qualitative data are presented on themes and some verbation from the interviewees.

4.7.2 Mathematics teachers' exposure to inclusive education

In order to verify mathematics teachers' exposure to inclusive education and inclusive mathematics education concept and practices 10 teachers were interviewed on their understanding of inclusive mathematics education. The responses received from the teachers showed clearly that most of the teachers are not familiar with inclusive mathematics education. However, few of the teachers interviewed have fair knowledge about inclusive education in general but thought of it as including people with disability in the mainstream school system. For instance, in an interview with one head of mathematics department, he admitted that he has been hearing of inclusive education but has not taken keen interest of it because

"*I thought it was for some few selected schools and since my school is not one of such schools, I am not worried about it*"

When the head was asked if he remember reading any course about inclusivity at the training institution he graduated from, he responded

"*To be frank with you sir, I can only think of special education which was a general cause but not at the department*"

Another mathematics teacher interviewed said

"*My roommate during my master programme was special education students whose thesis was about inclusive education so I got the opportunity to learn something about inclusive education but not inclusive mathematics education*"

Interestingly, a check at the undergraduate programmes of the two major mathematics education departments which trained almost all the mathematics teachers who are involved in the study do not explicitly have courses on inclusive mathematics education. Also, there is no clearly defined topic on teaching mathematics in an inclusive classroom which probably might have contributed to the teachers who graduated from these departments having limited or inadequate exposure to inclusive mathematics education concepts and practices. This result is in consonance with the argument by Verma and Saini (2020) who claim that when it comes to discussing families and social attitude towards children with special needs, it is important to consider the teachers. Teachers can develop a positive attitude towards children with special needs, however, when teachers are not trained to handle these children in regular or segregated schools, it becomes a challenge for them to handle and develop a positive attitude towards them. Also, Mathew and Akanzire (2021) opine that parent expect that Ghanaian teachers should be able to recognize their children's strengths and support them in inclusive classroom. They further indicated that the teachers can pick up content that will be relevant and related to their children's lives. They assuredly believed that teachers can do everything they can to ensure that the weaker learners also come along with the good learners in the classroom. Therefore, if teachers are not aware of the inclusive education concept and practices, then the expectation of the parents would not be met

4.7.3 Mathematics teachers use of inclusive education practices

The researcher employed observation to assess mathematics teachers' use of inclusive education practices because the teachers have indicated in the interviews that they were not exposed to inclusive concepts and practices. The observation was actually done to find out if probably mathematics teachers are practicing inclusivity in their classroom but they might not be aware of such practices as inclusive education practices.

There were thirteen items on the observation check list which were categorized into three themes as; Grouping/Group work; Individual attention; and identification of students with special needs in mathematics. Twelve classes were visited to observe mathematics lesson in order to ascertain the activities that go on during the teaching and learning process in a mathematics classroom in senior high schools. It was observed that 9 (75%) of the mathematics teachers whose classes were observed do not employ grouping of students during the teaching and learning of mathematics. The remaining 3 (25%) of the teachers whose classes were visited engaged the students in some form of group activities. However, the students were assigned to the groups by the students themselves, every student joined the group of his/her choice. In one class for example, the teacher asked the students to sit in pairs so the students just pulled and pushed their desk to either left or right to sit with anybody available. In another instance, the teacher said "let us form groups quickly and take this exercise…" in each of the three cases where there was some form of grouping the students were grouped during the lesson. None of the teachers was involved in the grouping process which indicates that the teachers allow the students to join groups of their choice and select partners they preferred studying with. Interactions with some of the students after the lesson revealed there were no permanent groupings for mathematics classes but if it happens that group work is given then students select their own group members based on their preferences.

It was observed from the lessons that mathematics teachers seem not to have time to attend to individual students during the teaching and learning process in the mathematics classrooms. It was found in almost all the 12 classes visited that the mathematics teachers moved from the front part of the class to the rear, and from the right side to the left part given instructions and explaining concepts to the students. In most cases the teachers put something on the board and start walking through the classroom but hardly were the teachers seen to be looking at the work of the students and checking what exactly the students were doing in order to comment on the students' work. In some few cases, about two instances, the teachers went to check what the students were doing after the students had asked the teachers questions for clarification. A follow up questions to some of the teachers whose lessons were observed revealed that the demands of the syllabus for the students to cover within the period of study and the time allotted for each mathematics lesson within the week would not permit a teacher to attend to individual students needs but sometimes in critical situation extra activities were provided to such students.

Furthermore, it was found during the observations that mathematics teachers in whose lessons were observed do not either consciously or unconsciously identify students with special needs in mathematics. In one particular lesson there was a student who kept on getting up and quickly sitting down throughout the lesson but there was no reaction from the teacher. An enquiry from the student after the lesson showed that the student was having difficulty in reading what the teacher was writing on the board from the back where he was sitting. In another instance, a particular student during the mathematics lesson was always turning the left ear to the direction of the teacher but the teacher did not notice what the students was doing in order provide any form of assistance to that student. As for students whispering to one another during the lessons needs not to be talked about because that was rampant but the teachers never worried about the whispering. The results reflect the argument by Gyasi, Okra and Anku (2020) who say the major area in which the classroom teacher is seen glaring is the approaches to classroom management. In the classroom situation, the seating arrangement, instructional methods, lesson preparations and the activities are put into consideration. The classroom teacher needs to identify those learners who need special care and make sure they have the right place to sit. The choice of instructional methods is one of the roles of the teacher in managing the classroom. The teacher needs to use a variety of methods in order to meet individual learning needs.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter presents the summary of the study, conclusions drawn from the research work and recommendations of the research study. It also provides the summary of major findings and implication of this study for practice. It finally presents some suggestions for further research studies.

5.1 Summary of the Study

The current study was to determine mathematics teachers' supply and preparedness for the implementation of inclusive education mathematics curriculum (IEMC) in senior high schools in Ghana. The study employed two fundamental theories of social paradigms, the social participatory model which is in line with Wenger (1998) communities of practice model and a social inclusive model by Asp-Onsjö (2006). Participation is considered as getting involved in the teaching and learning process which cannot be properly done without the directive of the teacher. The inclusion is of three dimensions as spatial inclusion, social inclusion and didactical inclusion. Spatial inclusion deals with amount of time a student spends in the same room as compared with other classmates. The social dimension is concerned with the way in which students participate in the school. The didactical part is concerned with ways in which students' classroom involvement relates to the teacher's teaching approach. The main consequence of adopting this social and participatory model is to recognize that success and failure in school mathematics do not rest solely on individual students' academic abilities or weaknesses but could be linked to the social opportunities and social disadvantages.

The demand models adopted the aggregate teacher labour market theory by Zabalza, Turnbull, and Williams (1979). It was observed in that theory that labour market for teachers could be seen as part of demand and supply system with extra complication that the government is practically the sole hirer of labour. The mathematics teachers demand in senior high schools in Ghana can be determined by the number of SHS students in the country's senior high school, and the GES desired students-to-teacher ratio. In this situation, the demand for SHS mathematics teachers is fixed based on the government's desire and capability to hire the needed mathematics teachers.

Since Ghana signed treaty of inclusivity in 1992, literature reveals that studies conducted focus on the aspect of inclusion regarding infrastructure, physical presence and integration of person with disability into the mainstream school system (Deku & Vanderpuye, 2017, Mensah, 2019, Vanderpuye, 2013). with limited studies on assessing mathematics teachers' demand by the policy, mathematics teachers' supply for its implementation and the level of teachers' knowledge, preparedness for and use of inclusive education curriculum and its teaching strategies and practices. This study employed mixed methods to assess mathematics teachers' supply and their preparedness to implement IEMC in this era of free SHS where students with diverse backgrounds and different abilities are taught the same mathematics. The study brings to bear the level of mathematics teachers' inclusive teaching practices in Ghanaian senior high schools which informs stakeholders of education on various steps to take in order to get every study involved so that no student is left behind.

The study was guided by the following research questions;

1. To what extent does the supply meet demand for SHS mathematics teachers in Ghanaian senior high schools for the implementation of IEMC?

2. What is the influence of GES School Placement Categories (GES-SPC) on the levels of demand for mathematics teachers in senior high schools?
3. To what extent are SHS mathematics teachers prepared for the implementation of the inclusive education mathematics curriculum (IEMC)?
4. How adequately are SHS mathematics teachers aware of inclusive education concepts and strategies for the implementation of the inclusive education mathematics curriculum (IEMC)?
5. How adequately do SHS mathematics teachers' use inclusive education strategies in the implementation of the inclusive education mathematics curriculum (IEMC)?

In order to answer the research questions, the study employed two phase sequential explanatory mixed methods (Creswell, 2014; Denzin & Lincoln, 2018). The first phase employed quantitative approach while the second phase used the qualitative methods. Questionnaires were used to gather quantitative data from mathematics teachers in Ghana and this was followed by interviews and observations for the qualitative data in some Ghanaian senior high schools. A sample of 195 willing mathematics teachers was randomly selected to participate in the study. The instrument for the study was validated and piloted to test for its reliability. The various ethical considerations were adhered to so as to protect the security of the participants. The quantitative data obtained were analysed with the help of SPSS statistical package while the qualitative data were analysed under themes and through verbal responses.

5.2 Summary of findings

1. The analysis of the demand for and supply of mathematics teachers in Ghanaian senior high schools based on students-teacher ratio and mathematics teachers' workload revealed that mathematics teachers demand exceed supply. This means that mathematics teachers in SHS are less than the number of mathematics teachers needed to teach in the schools.

2. The study also revealed that there are mathematics teachers' distributional imbalances and inequalities in mathematics teachers' workload in Ghanaian SHS. This indicates that while some school have more mathematics teachers resulting in less workload for the teachers, other school have less mathematics teachers resulting in more workload for the mathematics teachers in such schools.

3. It was found in the study that the demand for and supply of mathematics teachers in SHS have no significant association with GES school placement categories.

4. It was found out from the study that mathematics teachers in senior high schools feel that they are moderately or partially prepared to implement inclusive education mathematics curriculum. The study further revealed that SHS mathematics teachers are uncertain as to whether the college and/or university's training obtained exposed them to inclusive education concepts and practices and the checks with the programmes of the two major universities that trained mathematics teachers for senior high schools in Ghana showed that there are no explicit courses on or for inclusive mathematics education. This is likely to make it difficult for the mathematics teachers to implement the inclusive education mathematics curriculum.

5. The mathematics teachers in SHS are not also certain of their awareness to inclusive mathematics education concepts and practices because the study showed that as some of the teachers were not sure of their awareness others provided contradictory responses which were confirmed by the interview results.

6. The study revealed that mathematics teachers in SHS occasionally use inclusive education concepts and practices in their mathematics classrooms which are likely to affect the teachers' preparedness to implement the IEMC.

5.3 Conclusion

This study introduces a new perspective to the various studies which have investigated inclusive education in Ghana (Mensah, 2019; Deku & Vanderpuye, 2017; Vanderpuye, 2013). It assessed mathematics teachers demand for implementation of inclusive education mathematics curriculum. As stated by Chen (2009) that in a typical teacher labour market, it difficult for teacher demand to meet supply due to the monopoly of the market by the government been the sole hirer of public teachers. Also, demand for teachers usually exceeds supply because government have fixed budget for education and hires the services of teachers based on available funds as it seems to be the case of Ghana. The results showed that mathematics teachers' supply does not meet demand for mathematics teachers to implement inclusive education mathematics curriculum in senior high school in Ghana. The current situation seems problematic because as argue by Ingersoll (2001), large numbers of qualified teachers depart from teaching jobs for reasons other than retirement. Qualified teachers supplied by various teacher training institutions may not end up in classrooms dues to many factors including condition of service and geographical locations (Ingersoll & may, 2010). This could lead to inadequate supply of teachers resulting in the imbalances in teacher demand and supply. Moreover, data shows that the amount of turnover accounted for by retirement is relatively minor when compared to that associated with other factors, such as teacher job dissatisfaction and teachers pursuing other jobs. Besides there could be qualified teachers in the system seeking for teaching job but due to policy issues and budget constrains such teachers are not recruited (Chen, 2009; Gilford & Tenenbaum, 1990).

It was revealed from the results that even the available teachers are not adequately prepared to use inclusive education concepts and practices that would benefit every student based on the students' abilities. The true realization and ultimate success of inclusive education depends largely on the regular classroom teachers (Mitchell, 2010), and teachers' knowledge about inclusive education is one of the most important elements in the actualization and successful implementation of inclusive education (Mónico et al., 2018). Also, if the teachers do not have the skills required to assist students with different learning abilities in the same classroom as observed by Gök and Erbaş (2011) and Batu (2010) then such teachers would find it difficult to implement the inclusive mathematics curriculum. This implies that if nothing is done to equip the mathematics teachers on inclusivity in mathematics education, the whole idea of inclusive education being preach by the new curriculum would fail.

The results showed that most mathematics teachers in senior high schools are not aware of inclusive education which makes it difficult for such mathematics teachers to implement the inclusive education mathematics curriculum. This according to Demir and Akalin (2014), regular school teachers themselves admit that the most critical hurdle to the admission of students with special needs into their classrooms is their own inadequate knowledge and experience in inclusive system of education and its related practices. Besides it is argued by many scholars that in many instances, the regular school teachers believe that they do not have adequate training sufficient enough to manage diversity in their classrooms (Amr, Al-Natour, Al-Abdallatb & Alkhamra, 2016; Agbenyega & Deku, 2011; Sharma, Forlin, & Loreman, 2008). It is therefore not surprising that most of the mathematics teachers are not aware of inclusive concepts as by the current study. If training institution fail to include in their training programmes some courses in inclusive mathematics education, then their products would continue to be handicapped in implementing inclusivity in their mathematics classrooms.

However, the results revealed that GES school placement categories do not have influence on the levels of demand for mathematics teachers in senior high schools in Ghana. It is interesting to note that in many jurisdictions geographical location of schools significantly influences the demand and supply of teachers as suggested by Falch and Strom (2005); Shield et. al (2004) and Podgusky and Monroe (2004). These writers argue that policy makers and various stakeholders of education should recognize that even after an individual has chosen teaching as a profession, the one has the right to make a choice of a geographic location to work. This is because the decision regarding the location or area to teach is affected by many factors which may be financial, road network, social amenities, and other resources. It is evident that certain limited non-financial rewards associated with certain areas (semi-urban and rural areas) with limited resources, impede on the satisfaction derived from teaching in such areas as compared to teachers who are in areas with abundant resources that are valued by all (MCEETYA, 2001, 2003). But the result of the current study shows that mathematics teachers in SHS do not really care about the location of the school and are prepared to teach in any school. The study suggested that appropriate measures are put in place to supply well-trained mathematics teachers to implement the inclusive education mathematics curriculum.

5.4 Recommendations

Based on the findings of the study and the conclusions drawn, the following recommendations are made for the consideration of the various actors within the confines of the study;

1. In order to balance demand and supply of mathematics teachers and fair distribution of mathematics teachers in SHS, the various institutions that train mathematics teachers for senior high schools should step up their intake in order to increase the supply of mathematics teachers. Also, educational stakeholders and players could institute some incentives for students who accept to read mathematics education programme in the universities to encourage more student to read mathematics education programme and also offer special incentive packages for mathematics teachers who accepts posting to schools with inadequate mathematics teachers so as to attract more qualified mathematics teachers into such schools.
2. In determining the workload of mathematics teachers, one needs to take into consideration the class sizes of the teacher and the number of periods of the teacher together with standard student teacher ratio but not just the number of periods of the teacher.
3. The various institutions that train mathematics teachers for senior high schools are encouraged to inculcate into their programmes some courses on inclusive mathematics education concepts and practices in order to equip their products with the requisite knowledge about inclusive mathematics education

4. The education stakeholders may need to organise in-service training for mathematics teachers in SHS on inclusive mathematics education in order to make it easy for the mathematics teachers to implement inclusive education mathematics curriculum.
5. It was discovered in the study that in determining the balance between mathematics teachers' demand and supply, the adjusted model which is based on the assignment of weights based on class sizes and number of periods for a teacher per week should be used.
6. The mathematics teachers in senior high schools are encouraged to take refresher courses on inclusive education to equip themselves for their own professional development.

5.5 Future Research

The study has provided an insight into the state of mathematics teachers demand and supply in senior high schools and their distributional inequalities using some mathematical models, a further study should be conducted to verify and validate the models using different sample sizes in order to generalise the models for application.

Further study should be conducted on the adjusted model which is based on the assignment of weights based on class sizes and number of periods for a teacher per week to authenticate its use.

There is the need for collaborative study between UEW and MoE to collect authentic data on SHS students' enrolment and supply of teachers for the four core subject areas to replicate this study.

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APPENDICES

Appendix A Letter for Participant Consent

YOUR APPROVAL TO PARTICIPATE IN STUDY

I am Richard Asumadu Oppong, from University of Education, Winneba, Department of Mathematics Education. I am conducting a survey on the implementation of inclusive education mathematics curriculum. The rationale for the survey is to evaluate the preparedness of schools and teachers for the implementation of inclusive education mathematics curriculum.

Briefly, the data collection methods will include a questionnaire survey and interview. The survey will be conducted at a time that is considered convenient for you and that of the interview will be done on a different day at your convenience.

If you agree to participate in this research, please fill in the consent form below. If you do not want to participate, I thank you for your consideration.

If you require further information, I can be contacted through my email - raoppong@uew.edu.gh; or cell phone number 0244983971.

Thank you for your consideration.

RICHARD ASUMADU OPPONG

CONSENT STATEMENT

I________________________________, of___________________________________ have agreed to participate in the research study being conducted by Richard Asumadu Oppong to evaluate the preparedness of schools and teachers for the implementation of inclusive education mathematics curriculum. I understand the study will involve questionnaire survey and interview. I understand that all information including my name and the name of the school, will be kept confidential. I understand that these activities will not disrupt our programme.

Signed: ______________________________

Date: ______________________________

Appendix B Questionnaire

QUESTIONNAIRE

Survey on teacher demand and preparedness for inclusive education mathematics curriculum

INSTRUCTION

Please, in each section, either put a tick in the box that corresponds to your choice or write your own answer/response in the space provided.

SECTION A: DEMOGRAPHIC INFORMATION

1. What is your Gender?
   i. Female ☐
   ii. Male ☐

2. What is your age? ……………………………………

3. Which year did you complete tertiary education (i.e. university, polytechnic, etc.)?

   ……………………..

4. What is your highest qualification in mathematics? (Tick only one)
   a) Master's degree ☐
   b) Bachelor's Degree ☐
   c) Diploma/HND ☐

5. (a) Which of the following qualification do you hold? (Tick only one)
   a) M.Ed. (Mathematics) ☐
   b) B.Sc. (Math. Education) ☐
   c) B.Ed. (Mathematics) ☐
   d) Diploma (Math. Education) ☐
   e) Cert-'A' ☐

   b. Which tertiary education institution did you obtain your t professional qualification in mathematics?

   …………………………

6. How long have you been of teaching mathematics at the SHS level?

   ……………………………………

7. Name of your institution and district in which it is located:

   Name ……………………………….…………….………………
   District ………………………..………………………………
   Region……………………………………………………………..

8. (a) How will you describe the management of your school? (Tick one)
   i.Public ☐
   ii.Private ☐

(b) If you are in a PUBLIC SENIOR HIGH school, which GES school placement category is your school? (i.e. A, B, C or D)?

……………………….

9. (a) Is your school a PUBLIC TECHNICAL/VOCATIONAL school?

a. Yes ☐

b. No ☐

(b) If No to 9 (a) above, which GES school placement category is your school? (i.e. F or G)?

……………………….

10. How many mathematics teachers were in your school before the COVID-19 lockdown?

……………………….

11. How many mathematics teachers were in your school were teaching ONLY elective mathematics before the COVID-19 lockdown?

……………………………….

12. How many mathematics teachers you school were teaching BOTH core and elective mathematics before the COVID-19 lockdown?

……………………………….

13. (a) Was your school running the double track system before the COVID-19 lockdown?

a. Yes ☐

b. No ☐

(b) If No to 13 (a) above, what was the total number of students enrolled in the school before the COVID-19 lock down?

………………..

14. How many classes were in the school before COVID-19 lock down (e.g. if for form 1, there were only 4 science classes, 5 Visual Arts classes and 3 Business classes, then the total number of form 1 classes is 12 classes)

(a) Core mathematics

SHS 1	SHS 2	SHS 3	Total

(b) How many of the classes took Elective mathematics in each of the forms?

SHS 1	SHS 2	SHS 3	Total

15. What is the average class size of a core mathematics class (i.e. average number of students enrolled in a core mathematics class)?

……………………..

16. What is the average class size of an elective mathematics class (i.e. average number of students enrolled in an elective mathematics class)?

………………………..

17. How many core mathematics periods per week does a student attend class?

…………………..

18. How many elective mathematics periods per week does a student attend class?

…………………..

19. (a) Do you think your school require additional mathematics teachers?

i.Yes ☐
ii.No ☐

(b) If YES, to Question 19(a) above, briefly explain why you think so?

____

____

____

____

____

SECTION B. USE OF INCLUSIVE STRATEGIES/PRACTICES

On a scale of 1 – 5 (see details below), *rate (by clicking the appropriate number) how often or frequently you use the inclusive education strategies and practices* described in the table in your teaching:

1 = never (N)
2 = almost never (AN)
3 = occasionally (O)
4 = most of the time (MT)
5 = almost always) (AA)

Indicate with a tick, which of the following you do in your teaching of mathematics

Inclusive teaching strategies		N		T	A
20. Make students work in groups during mathematics lesson					
21. Assign students to the groups					
22. Always have permanent students' groups for mathematics classes					
23. Give special attention to student(s) with any form of disability in mathematics class					
24. Identify extremely good student(s) in my mathematics class					
25. Identify extremely dull student(s) in my mathematics class for special attention					
26. Teach with every student in mind					
27. Give special attention to students with learning difficulties in mathematics in my teaching					
28. Always have opportunity to support any student with learning difficulties in mathematics in my					

Inclusive teaching strategies		**N**		**T**	**A**
class					
29. Always see my students as average mathematics students					
30. Always have the materials that help me to practice inclusive mathematics teaching in my school					

SECTION C. FAMILIARITY WITH INCLUSIVE EDUCATION

Below are statements about your experience of inclusive education mathematics curriculum in college or university. On a scale of 1 – 5 (1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree), rate your agreement to the statements by clicking the appropriate response. (Please rate EVERY option according to the scale)

Statements about your experience of inclusive education mathematics curriculum in college or university	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
31. I read a course about inclusive education in my general education course in college/university?					
32. I read a course about inclusive education in the mathematics programme in college/university?					
33. I took a course about creating equitable opportunities in an inclusive education classroom in college/university?					
34. I took a course on mathematics teaching that involved how to creat equitable opportunities in an inclusive education classroom?					
35. I took a course in school that deals with preparing materials for creating equitable opportunities in inclusive education mathematics classroom?					
36. I read a course that prepared me to use scaffolding in teaching.					
37. I read a course that prepared me for differentiated teaching practices					
38. I had opportunity in the university/college to practice how to use inclusive education strategies in mathematics teaching					
39. I had enough time in university or college					

Statements about your experience of inclusive education mathematics curriculum in college or university	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
to practice how to create equitable opportunities in inclusive education learning environment					

SECTION D. PERCEPTION OF USEFULNESS OF INCLUSIVE EDUCATION STRATEGIES

Please indicate your opinion regarding each of the following statements about inclusive education in the mathematics curriculum. On a scale of 1 – 5 (1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree), rate your agreement to the following statements about impacts of the use of technology. (Please rate EVERY option according to the scale)

Statements about impacts of the use of technology	Strongly Disagree 1	Disagree 2	Undecided 3	Agree 4	Strongly Agree 5
40. Inclusive education mathematics curriculum is only about including students with special needs in mathematics					
41. In Inclusive education mathematics curriculum classroom, every student is made to feel welcome , irrespective of one's disability					
42. Inclusive education mathematics curriculum seeks to remove all forms of barriers to learning and full participation for all students					
43. Inclusive education mathematics curriculum requires that differences among students are viewed as problems that must be overcome					
44. Inclusive education mathematics curriculum encourages students to learn collaboratively					
45. Teaching with inclusive education mathematics curriculum means that all students should be given the same kind of task during teaching					
46. Inclusive education mathematics curriculum teaching encourages the participation of only the intelligent students					
47. Inclusive education mathematics curriculum requires teaching activities planned with all students in mind					
48. In inclusive education mathematics curriculum classroom, good students are encouraged to help students with learning needs in mathematics					
49. Inclusive education mathematics curriculum classroom makes it difficult for students who are gifted to learn with students who have severe					

Statements about impacts of the use of technology	Strongly Disagree 1	Disagree 2	Undecided 3	Agree 4	Strongly Agree 5
challenges in mathematics					
50. Inclusive education mathematics curriculum classroom is where differences are celebrated, embraced and valued					
51. Inclusive education mathematics curriculum builds on the differences among students in ways that value every students equally					
52. In Inclusive education mathematics curriculum classroom, differences between students are viewed as resources to support learning					
53. In inclusive education mathematics curriculum classroom, students with unequal abilities helping each other in a classroom amount to cheating					
54. In inclusive education mathematics curriculum classroom, class grouping consisting of intelligent students will encourage copying					
55. Inclusive education mathematics curriculum requires that teachers and parents work together					

Thank you.

Appendix C Interview guide

1. How many students do you have in your school?
2. Do you have enough mathematics teachers?
3. Do you need additional mathematics teachers and why?
4. How many periods do you teach in a week?
5. Apart from teaching, what other things (duties or responsibilities) do you have in the school?
6. What do you know about inclusive mathematics education?
7. What do you do in your mathematics classroom to get all your students to be involved in the class?
8. How do you practice inclusivity in your mathematics classroom?

Appendix D Observation check list

Inclusive teaching strategies	**Tick**
1. Make students work in groups during mathematics lesson	
2. Assign students to the groups	
3. There are permanent students' groups for mathematics classes	
4. Give special attention to student(s) with any form of disability in the class	
5. Identify extremely good student(s) in the class	
6. Identify extremely dull student(s) in my mathematics class	
7. Teaches with every student in mind	
8. Teaches in a conducive classroom	
9. Encountered student with learning difficulties in mathematics in teaching-learning (T-L) process	
10. Provides opportunity to support any student with learning difficulties in the class	
11. See students as average mathematics students	
12. Identifies students with learning need in mathematics	
13. Have enough materials that help all students to participate in the T-L process	

Appendix E Results of the pilot study

Table 3.1 Case Processing Summary for the Reliability Test

		N	%
Cases	Valid	41	100.0
	Excluded[a]	0	.0
	Total	41	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.904	39

Appendix F. Number of teachers teaching in the various senior high schools.

10. How many mathematics teachers were in your school before the COVID-19 lockdown?

		Frequency	Percent	Valid Percent	Cumulative Percent
alid		3	1.5	1.5	1.5
		3	1.5	1.5	3.1
		3	1.5	1.5	4.6
		9	4.6	4.6	9.2
		30	15.4	15.4	24.6
		9	4.6	4.6	29.2
		6	3.1	3.1	32.3
	0	24	12.3	12.3	44.6
	1	9	4.6	4.6	49.2
	2	12	6.2	6.2	55.4
	3	9	4.6	4.6	60.0
	4	12	6.2	6.2	66.2
	5	6	3.1	3.1	69.2
	6	21	10.8	10.8	80.0
	7	9	4.6	4.6	84.6
	8	12	6.2	6.2	90.8
	0	9	4.6	4.6	95.4
	2	3	1.5	1.5	96.9
	3	3	1.5	1.5	98.5

4	3	1.5	1.5	100.0
otal	195	100.0	100.0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
10. How many mathematics teachers were in your school before the COVID-19 lockdown?	195	2	24	12.17	4.967
Valid N (listwise)	195				

The association between number of math teachers and the GES school placement categories.

10. How many mathematics teachers were in your school before the COVID-19 lockdown? * School's Placement Category Crosstabulation

Count

		School's Placement Category				
		Placement Category A School	Placement Category B School	Placement Category C School	Placement Category D School	Total
10. How many mathematics teachers were in your school before the COVID-19 lockdown?		0	0	0	3	3
		0	0	0	3	3
		0	0	0	3	3
		0	0	9	0	9
		0	9	18	3	30
		0	3	6	0	9
		0	3	3	0	6
	0	6	6	12	0	24

	1	0	6	3	0	9
	2	6	3	3	0	12
	3	6	3	0	0	9
	4	0	6	6	0	12
	5	0	3	3	0	6
	6	0	3	18	0	21
	7	0	3	6	0	9
	8	0	6	6	0	12
	0	3	6	0	0	9
	2	3	0	0	0	3
	3	0	3	0	0	3
	4	0	3	0	0	3
Total		24	66	93	12	195