UNIVERSITY OF EDUCATION, WINNEBA

STUDENTS' AND TEACHERS' CHALLENGES IN TEACHING AND LEARNING MATHEMATICS IN LARGE CLASSES IN THE TEMA CENTRAL MUNICIPALITY

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MASTER 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 requirement for the award of the degree of Master of Philosophy (Mathematics Education) in the University of Education, Winneba

APRIL, 2022

DECLARATION

STUDENT'S DECLARATION

I, Rhoda Botchway, 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: _____

SUPERVISOR'S DECLARATION

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

Name of Supervisor: Prof. Damian Kofi Mereku

Signature: _____

Date: _____

DEDICATION

To my husband Mark-Ohene Koranteng, and my children Nana Kofi, Nana Yaw and Oheneba Kojo Ohene-Koranteng.

ACKNOWLEDGEMENTS

I wish to express my gratitude to my supervisor Professor D. K. Mereku for his mentorship, guidance, supervision, objective criticism, suggestions and corrections which contributed greatly to the completion of this thesis. I am also grateful to Professor S. K. Asiedu-Addo, Professor C. A. Okpoti, Professor M. J. Nabie, Dr. J. Apaw at the department of Mathematics of Education UEW, for their wonderful guidance and counselling which has helped shaped my horizon and experiences.

Also, I wish to express my sincere thanks to Mrs. Stella Turkson, Mr. Isaac Adueni-Boakye, Mr. Asemani, Mr. Edem Amevordzie, Dr. Michael Mickson, Ridwan Yahaya, my family and my entire course mates who assisted me to climb further the academic ladder.

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ABSTRACT

This study investigated senior high school students and teachers challenges in teaching and learning Mathematics in large classes as well as teachers‘ frequent use of effective large class size instructional techniques in Tema central municipality. To achieve this,199 students as well as 48 Mathematics teachers were purposively sampled from four (4) public senior high schools in Tema Central municipality. The explanatory sequential design was employed as the research design. For the quantitative part, questionnaires were used to collect data from the students and teachers. Also, simple random sampling was used to select twenty (20) mathematics teachers out of the 48 teachers and interviewed for the qualitative part. The findings from the study showed that Mathematics teachers in Tema Central Municipality had classes above 40 as 90% of the mathematics teachers taught in schools whose STR exceeded the Ministry of Education‘s STR of 40:1. From the findings, the three topmost challenges encountered by teachers were increasing stress on teachers, difficulties in students control and class size affecting students‘ academic performance with means rating from 4.98, 4.93 and 4.89 respectively. Students also encounter challenges such as distractions by unserious students, lot of noise making and teachers spending more time controlling students rather than teaching with mean rating of 4.99, 4.99 and 4.91 respectively. In dealing with these challenges, Mathematics teachers in Tema Central municipality has devised effective large-class instructional techniques in teaching including activity-based instruction (mean frequency of use 4.82) and varying questioning techniques to engage students‘ participation (mean frequency of use 3.92). The implication for these findings is the need for more classrooms to be built by the government and Ministry of Education ensuring that enrolment in senior high schools is reduced to the required number by GES to maintain the STR to 40:1, and also organizing workshops to train mathematics teachers in the use of effective large class instructional techniques.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter consists of background to the study, statement of the problem, purpose of the study, research questions which served as a guide for the study, significance of the study, delimitations and limitation of the study and finally organization of the rest of the study.

1.2 Background to the Study

The economic growth of the twenty-first century may not be realized without adequate attention given to the teaching and learning of mathematics at all levels of the school's system of education (Agah, 2020). Mathematics is recognized as one of the most important subjects in the school curriculum across the world (Suleiman & Hammed, 2019). It is the basis of scientific and technological knowledge that greatly contributes to a country's socioeconomic development (Suleiman &Hammed, 2019). Despite the importance of mathematics and a compulsory requirement for gaining admissions into Tertiary Institutions in Ghana, the problem of mass failure across the different levels of education is common knowledge. Among other factors that can affect students' interest in the subject is class size and the various instructional techniques employed by mathematics teachers in such classes. Class size has been found to affect the students' learning, productivity and the teacher's strategies in teaching (Aoumeur, 2017).

Mwirigi and Muthaa (2015) also believe that high and quality standard of education can be achieved based on the number of student- teachers supervised in the classroom. The researcher agrees with Mwirigi and Muthaa (2015) and suggests

that for education to be considered as quality, the number of students taught by the teacher should also be taken into consideration. Teacher's ability to deliver effective and efficient teaching comes when certain conditions prevail in their services to students. Such conditions include limited enrolment to ensure movement in the classroom. A report from the Ministry of Education (2018a) shows that there has been an increase in enrolment of students from 7,101,763 to 13,768,124 of students in the public senior high schools. On the contrary, the report did not match the 100% increase to teacher's intake among senior high schools in Ghana. Also, the Ministry of Education outlined some of the challenges encountered as the cause of high enrolment due to the free senior high school. Among some of the challenges outlined are (1) Funding (2) access (3) staffing and (4) classroom space (MOE, 2018b).

The purpose of education is to equip or empower students to acquire knowledge, develop skills and talents. However, Osei-Mensah (2012) asserted that the purpose of education may not be accomplished if mass enrolment of students was adopted without conforming to the class size which the teacher can handle to ensure the development of skills, talents and empowerment of knowledge. This means that class size plays an essential role for both the student and the teacher. Adeoye (2013) and Togunloju (2015) believe that class size has a very strong influence on students' academic performance.

As trends in Education across the globe have reflected increase in student's enrolment (Ademola, 2014), the issue of class size and its associated challenges in teaching and learning of mathematics need to be given much attention. Ghana like most countries across the globe has adopted and implemented to a large extent the

Education for All (EFA) policy. As part of governments making education access a key aspect of national development, Ghana has implemented the development of policies aimed at eliminating all obstacles to EFA. Such policies include capitation grants, school feeding programs, free -senior high school as well as the distribution of free school uniforms and exercise books among others (GES, 2018b). This has resulted in increased enrolment without a corresponding increase in classrooms and relevant infrastructure which has resulted in large classes. For example, according to the GES statistics, 2020, the gross secondary school enrolment ratio in Ghana has increased from 47.35 in 2008 to 77.67 in 2020.

Also, in their findings in managing the effects of large class size in Ghana, Ananga and Tamanja (2014), showed that at the senior high school level for example, the Northern region recorded an average of 70 students whiles Greater Accra with an average of 60 students in a class. They further outlined rapid population growth and lack of school infrastructure such as classrooms as major factors leading to large classes in schools in Ghana. Many studies have shown overcrowded classrooms as an international issue that hiders an efficient teaching and learning process (Hachem & Mayor, 2019). This was also supported by Sa'ad, Adamu and Sadiq (2014), as they concluded that overcrowded mathematics class is one of the causes of poor performance in mathematics in public schools. Their studies hence suggested that class sizes should be moderate in order to help students who may have problems in understanding concepts that are being taught.

What constitutes a large class size however varies in different contexts as Ngoboka and Schultz (2002), argue that the definition of the optimal class size remains a problem worth investigating. There is no global definition of what constitutes a

large class. According to Ayeni and Olowe (2016), class size refers to the number of students in a given course or classroom, specifically either the number of students being taught by an individual teacher in a course or classroom or the average number of students being taught by teachers in a school or educational system. However, Adeyemi (2018) defines class size as, an educational tool that can be described as an average number of students per class in a school. In counties such as Canada, Australia, Romania, Czech Republic, USA and Slovenia has less than 30 students recommended for a standard class size; Turkey, Netherlands and Norway have 20 or less students for a standard class size; Japan and Singapore have above 30 students as a standard class size (Mokobia and Okoye, 2011). These fall within the UNESCO recommended standard of (25) as the number of students in a classroom.

In Ghana however, Ghana Education Service (GES) instituted student to teacher ratio (STR) of 40:1‘ (GES, 2018). In this present study therefore, class size is the population in terms of number of students per teacher. A large class size falls within 41 and above learners to one teacher while small class size is within 15-40 learners to one teacher (Aliu, 2015). Many scholars including Molnar (1999), Booze and Maloney (2001) and Shuaibu (2003) all support this classification of class sizes. Therefore, in this present study, class size with 40:1 STR will be categorized as small class size while class size with 41 and above students per teacher will be categorized as large class size as this is in connection with GES STR.

Although there are several definitions and descriptions to what constitutes a large class, the challenges that these large classes bring to stake holders and the educational system as a whole is of great concern globally. For instance, large classes are one of

the most significant concerns facing schools in the United State (Hachem & Mayor, 2019), the UK, Ireland as well as China (Leiyang, 2018). In some Africa countries such as Nigeria, Kenya and South Africa challenges in large class size has over the years been a great issue. (Mutisya, 2020).

Even though teachers and parents agree that smaller classes are better for learning, sometimes in a bid to cut cost, school administrators battling with tight budgets want a bigger class size (Mathis, 2016). These large classes do bring challenges to both the leaners and teachers. Among such challenges in large classes is classroom management which includes student discipline and time spent in handling non-instructional tasks (Ananga & Tamanja, 2017). Logistics concerns such as tasking attendance, grading, providing frequent and detailed feedback quickly become unmergeable (Allen &Tanner, 2005). To account for these logistical concerns, many teachers may use unproductive teaching methods such as relying strictly on lecture (Cuseo 2007 & Carpenter, 2006). Allen & Tanner (2005) outlined that lecture-based large classrooms lead to very little interactions between instructors and students, causing the student to feel anonymous and isolated.

These feelings of isolation lead to lower motivation, poor engagement, lower attendance and distancing behaviours from the students. Also, Watson Todd (2006) summarizes major problems that other researchers have highlighted when teaching large classes. Watson says teachers of large classes often face problems in: Teaching strategies, management skills, ways to build student -student interactions and friendly student -teacher relationships, teaching feedbacks and evaluations among others. These challenges can make teaching in large classes very difficult

and even more especially for Mathematics teachers. As mathematics teachers are faced with the problem of achieving effective teaching that would result in better performance of students in both internal and external examinations, there is the need therefore for them to deal with these challenges in large classes and also use the effective instructional strategies to help students to get the best of the mathematics lessons. The use of good instructional skills and methodologies in large mathematics classes among other factors can influence the achievement of learners in mathematics. Koko & Oroworuku (2016) defined instructional techniques as strategies that teachers can use to facilitate the teaching and learning of a particular subject or lesson. Boadu (2015) added that instructional techniques when effectively used in teaching has the tendency to incorporate students learning experiences, thereby making the subject content more receptive and interesting. With the right teaching techniques in large classes, teachers can achieve learning objectives which will be reflected in the students‘ academic performance in mathematics.

Taking into account large mathematics classes, the selection of strategies to increase student‘s engagement and involvement in the mathematics classroom is critical. The use of these strategies helps learners to also generate their own varieties of meaningful strategies which aid the learners in learning (Lee et Al, 2008). Hence in mathematics classroom, what matters most is the quality of the teacher and his/her approach to teaching, specifically the capacity to create a culture for organizing large classes in such a manner that learning can be successfully mediated.

The effectiveness of the instructional technique that a Mathematics teacher uses thus cannot be down played in a Mathematics classroom and more especially in large

Mathematics classes. This position is even more important in a developing country such as Ghana where evidence points that most of the mathematics classes in the senior high schools are large thereby affecting instructional time and classroom management (Ananga & Tamanja 2014).

In line with this, researchers such as Blatchford (2003) and O'Sullivan (2006) have in fact suggested shifting focus from concerns on class size to investigate what kind of teaching techniques in small and large classes actually makes a difference.

With growth in population, school enrolment has increased and Tema Central municipality is one of the municipalities with an increase in school enrolment. For example, in the 2017 academic year, Tema Methodist day senior high school, had an enrolment of about 40 students in the home Economics class and 35 students in the science class, however there has been an increment to 60 and above and 50 and above respectively in such classes during the 2018 academic year. Also, Presbyterian senior high school, Tema in the 2017 academic year, also had an increment in student‘s enrolment from 45 to about 60 in the Visual Arts class and also 40 to 65 and above in the Home Economics class in the 2018 academic year. With these increase in enrolment in the municipality, both teachers and students face challenges in these large classes. The researcher hence wants to investigate mathematics teacher‘s perspective of the effect of class size on teaching and learning, the challenges in such classes as well as the instructional techniques used to deal with those challenges.

1.3 Statement of the Problem

The government of Ghana implemented Free Senior High School (FSHS) in the year 2018, with the main aim of making education accessible to all senior high

(SHS) students‘ irrespective of their economic backgrounds, which has led to increase in enrolment in most SHS. As one of the densely populated cities, the Tema Central municipality has had an increment in student enrolment since 2018 (GES, Tema metro) in senior high schools, leading to an increase in classes. Senior high schools according to GES, Tema Central metro has had an increase in enrolment in all the senior high schools increasing the number of students in a class from an average of 30 in a class to 60 and above in a class. This has therefore increased the STR in the municipality.

Although the Ghana Education Service (GES) instituted a teacher to students‟ ratio of 1:40, with the aim of enhancing effective teaching and learning procedure effectively in class, the Tema Central municipality has a teacher to student ratio of 1:60 or above in the mathematics classes. As a result of the increase in teacher – student ratio, challenges such as classroom management, students‘ participation and the often use of effective instructional techniques in the mathematics classes among others has been some of the challenges the senior high schools face in the municipality. Adeyemi (2018) in his findings on the influence of class size on the quality of output in senior high schools revealed that schools having an average class size of 35 and below obtained better results in the secondary school certificate examination (SSCE) than schools having more than 35 students per class. Also, both Toth and Montagna (2002) reported that increase in enrolment in many institutions which has become major concerns of students could definitely lead to an ineffective teaching method for teacher educators having large class sizes of 50, 70 or more. Al- Jarf's (2006) on a study on large classes outlined that large class size makes it difficult for teachers to have enough time and to pay attention to each student and also to give every student a chance to speak and participate in class.

In other words, such context makes some students, especially the shy or weak, to be neglected and left behind.

Research has also shown that mathematics is often perceived as difficult and as a result students‘ interest in the subject is low. (Fritz et al, 2019). Moreover, according to National Mathematics Centre, 2009, students‘ poor performance in internal and public examinations in Mathematics have been attributed to teachers‘ strategy of teaching, students‘ attitudes, unavailability of learning materials among others. Mathematics teachers often develop instructional methods or strategies that they think is appropriate for teaching each topic in their lessons, with the aim of attaining the desired change behaviours of learners especially in large mathematics classes. These instructional strategies are the most potent variable that can influence students‘ mathematics interest (Anigbo, 2016). One study of class size in calculus courses for example found that any potential effect of class size on student performance is mediated by the individual instructor and the instructor‘s ability or guide (Jarvis, 2007).

Hence mathematics teachers‘ instructional techniques play an important role in large classes. From personal experience and observations, these large mathematics classes pose a lot of challenges to teachers such as classroom management, teaching strategies, teaching feedback and evaluation among others. Other teachers in Presbyterian senior high school, Tema for example have also expressed how they have to deal with these challenges in addition to teaching with effective instructional techniques to help students improve in their academic performance in mathematics. According to the Tema Metropolitan education office statistical report, there has been an increase in enrolment from 2018 to 2020 (Tema Metropolitan

Education Office, Report, 2020). The report showed an increase in student enrolment from 14.2% to 20.5% during the past three years. This has resulted in large classes with a teacher to ratio going up from 1:35 to 1:50 and above, which is in contrast with GES teacher to student ratio of 1:40. This has thereby led to the researcher raising questions about the challenges teachers and students face in these large mathematics classes and the instructional techniques used in such classes in the municipality.

A considerable number of researches however have been conducted on the influence of large classes and how it affects academic performance. Examples of such studies include the studies of Adeyemi (2018), Akoto -Baako (2018), just to mention a few.

There is however inadequate information on teachers and students challenges as well as frequent use of instructional techniques in the area of mathematics which many students have fear and loathsome experiences about. It is for this reason that this study seeks to ascertain teachers' and students' challenges in teaching and learning in large mathematics classes, as well as the instructional techniques used in large mathematics classes in senior high schools in Tema Central municipality. Mathematics teachers' instructional techniques play an important role in large classes. From personal experience and observations, these large mathematics classes pose a lot of challenges to teachers such as classroom management, teaching strategies, teaching feedback and evaluation among others.

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1.4 Purpose of the Study

The purpose of this study was to analyse the challenges faced by students and teachers in Teaching and Learning Mathematics in large Classes as well as the instructional techniques teachers use in Tema Central municipality.

1.5 Objective of the Study

The objectives of the study were to:

1. investigate the challenges Mathematics teachers encounter in teaching in large classes in senior high schools in Tema Central Municipality.
2. ascertain challenges senior high school students encounter in large mathematics classes in Tema Central municipality.
3. investigate how often mathematics teachers use effective large class instructional techniques in the Tema Central Municipality.

1.6 Research Questions

1. What challenges do Mathematics teachers encounter in teaching large classes in Tema Central municipality?
2. What challenges do senior high school students encounter in learning in large mathematics classes in Tema Central municipality?
3. How frequently do mathematics teachers use effective large class instructional techniques in the Tema Central Municipality?

1.7 Significance of the Study

It is envisaged that the study will be beneficial to school authorities and policy makers. This study sheds light on the challenges in large mathematics classes and instructional techniques used in such classes. The outcome of the study is, therefore, expected to assist all policy makers, educators and other advocacy stakeholders identify best practices in Mathematics instruction.

It will also further create a clearer picture of the instructional characteristics of successful Mathematics teachers from which may lead to the development of professional training and teacher education programs.

The study will also contribute to existing knowledge on challenges in large mathematic classes and the instructional techniques that can be employed in these classes in Ghana and the world at large. Thus, the study will serve as a useful guide and reference material for researchers, scholars and academicians.

1.8 Limitations

For a study of this nature, it would have been appropriate to include every senior high with large class in the district. However, given limitations of finance and time, the study was restricted to three senior high schools in the municipality. Also, the

study was restricted to only form two students with large classes. Some students were also not available to answer the questionnaire which affected the time in collecting the data for the analysis in time. Some teachers were also not available on the due time for the interview which also delayed the data collection.

1.9 Delimitation of the Study

The study was delimited to students of only form two (2) students in four (4) selected senior high school in Tema central municipality. The participants were selected with no consideration of their ethnic, cultural and socio-economic background. It was clear that those who were selected were not the true representation of the whole Public Senior High School population in Ghana, but it can be presumed that those that were selected share common challenges and barriers with the rest of the population in Ghana. The form two students were used as they all had the common characteristics of large classes.

1.10 Definition of terms

Some of the words within the study are given operational definitions as they are used in the context and scope of the research as follows:

Large Class Size: In the context of this study, it is considered as a class that contains more than 40 students as stipulated by the Ghana Education Service.

Instructional Techniques: They are strategies teachers use to help students become independent, strategic learners. They also influence learners‘ achievement and let teachers diversify the instructional applications Marzano (2003)

1.11 Organization of the Study

The study was organized under five chapters. Chapter one consists of the

background to the study, statement of the problem, the purpose of the study and the research questions. The chapter also includes delimitation of the study, limitation of the study, definition of terms as well as the organization of the study.

Chapter two, deals with the review of related literature on the theoretical framework of the study This includes class size, challenges in large class size and instructional techniques in large class size the latter part of this chapter discussed relevant, empirical and theoretical literatures that have informed the design and execution of the study.

Chapter three describes the methodology that was employed for the study. The chapter describes the research design, population, sample and sampling procedure, research instrument, validity and reliability of the instrument and data analysis.

Chapter four of the study concentrated on the results and discussions of findings. Chapter five is the final chapter of the study. It gives summary of the study and draws conclusions on the key findings of the study. It outlines recommendations from the study and suggested areas for further research, presents the summary, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

As a mechanism, research on literature review is a systematic, explicit and empirical approach through which researchers, scholars and practitioners could identify, evaluate and synthesize an established body of completed and documented study (Fink, 2010). This chapter reviewed the relevant literature and the researcher was aware of the fact that other authors have written on this topic. For this reason, it was necessary to review literature related to the topic. Information was gathered from journals, abstracts, the internet, books, and works people have done on managing class size. For easy referencing, the literature was reviewed under the following sub-headings:

1. Theoretical framework;
2. Teaching and learning mathematics
3. Historical information on class size
4. What constitutes large class?
5. Challenges in teaching and learning in large class size
6. Class size and academic performance
7. Instructional techniques in teaching large classes
8. Suggestions in dealing with large class size
9. Summary

2.2 Theoretical Framework

The theoretical framework is a collection of theories that support research (Ofori & Dampson 2011). The theories related to this study are Constructivist theory, Class management theory and Traditional classroom management theory.

2.2.1 Constructivist theory

Constructivist learning is a dynamic and active process of constructing meaning and transforming learning as the learner interacts with the environment (Grabinger & Dunlap, 1995). There are four main principles frame of constructivist learning theory: knowledge is constructed, rather than passively absorbed; knowledge is socially invented not discovered, learning is essentially a process of making sense of the world and real-live situations, and effective learning requires meaningful problem-solving activities (Fox, 2011). In constructivist learning theory, learners are considered as active meaning makers as they reflect on the material for learning, which means they integrate new materials with the existing reservoir of knowledge. Constructivist believe that instead of confronting learners with simplified problems and basic skills drills, they ought rather to deal with complex real-life situations, as exemplified in teaching in over-crowded classrooms.

The socio-constructivist learning theory is a variant of the constructivist learning (Gordon, Habley & Grites, 2008). According to Tomei (2009) –Constructivist learning theory meaning is seen as a cognitive activity that produces mental models that represent perceptions of reality" (p.60). Generally, CLT aims to identify how to implement learning processes in the classroom, and how knowledge is constructed (Butler & Griffin, 2010). Socio-culturalist argued that, learners learn from experts and from their peers through collaboration. Woolfolk (2010) however has pointed that this approach is conducive to small classrooms where a teacher can use student-centered teaching and learning. In this research, the teachers are expected to assist learners to construct knowledge through collaboration with peers in the classroom. However, it becomes more difficult to do this in large and congested classrooms.

2.2.2 Classroom management theory

Hattie (2005) is one of the originators of classroom management theory. Within this theory, Hattie (2005) suggested that, it seems plausible to claim that improving class management require teachers to reconfigure the interaction, curricula and strategies used by teachers in large classes to change the students‘ interactions into the small classes. The theory shows that teachers continue to use the same interaction, curricula and strategies with the student regardless of how many students are there. There is the need therefore for teachers to change the strategies they use in a classroom regardless of the size of the class.

2.2.3 Traditional classroom management theory

In traditional classroom management, the teacher is considered as a director. Creating an effective learning environment which involves organizing activities in the classroom, teaching and physical classrooms for effective time and creating a happy and productive learning environment and minimizing distractions. Traditional classroom management helps to ensure that misbehaviour is rare (Erdogan et al.2010).Teachers who adopt to traditional classroom management ,use effective learning time, adjust their teaching to the level of student preparation and plan their time effectively in overcoming discipline problems. Effective classroom management increases student involvement, decreases destructive behaviour and provides benefits for the student learning time (Oliver & Reschly, 2007). As the director in a traditional classroom, mathematics teachers in large classes can manage their large classes to reduce distractions and misbehaviour of students in class which can help to make teaching more effective.

2.3 Effect of Class size on Teaching and Learning Mathematics

A country's strong mathematical culture contributes to the global development of a strong industrial culture. For this and other reasons, mathematics is now a required subject in almost every country from preschool through secondary school. Ghana Education Service (GES) and the Ministry of Education (MoE) have developed a mathematics syllabus based on the premise that "all students can learn mathematics and should learn mathematics" (CRDD, 2010).

The government took the decision as part of its efforts to cultivate a strong human resource for the country's economic development. This strategy, on the other hand, hasn't been without its drawbacks. Several explanations have been proposed to explain why mathematics is in such a horrible state. According to Adolphus (2011), among the causes include inadequate mathematics teaching in primary, junior, and senior high schools, a lack of motivation and incentives, and low job prospects in mathematics in many sectors of the economy other than teaching.

In April 2006, Ghana, along with other English-speaking (Anglophonic) countries in West Africa, took part in the West African Senior School Certificate Examination (WASSCE). According to WAEC, Chief Examiners' Reports have frequently showed that children continue to do poorly in mathematics across the country (2014, 2015 and 2016). Poor arithmetic performance among students has been a global problem, prompting developing countries to join projects aimed at bringing good change to their communities (Sinyosi, 2015). Mathematics excellence can help developing countries enhance their education systems, which will help shape the future and prospects of their young people; create infrastructure; and boost

economic knowledge, culture, and morals, as well as their people's living conditions (Roohi, 2012).

Mathematics is recognized as one of the most important subjects in the school curriculum all across the world (Suleiman & Hammed, 2019). It is the basis of scientific and technological knowledge that greatly contributes to a country's socioeconomic development (Suleiman & Hammed, 2019; Kiwanuka et al., 2015). Many individuals rely on mathematics in their daily lives (Ali & Jameel, 2016). Mathematics, according to Enu, Agyeman, and Nkum (2015), is one discipline that has an impact on all aspects of human existence at various levels. According to research by Sa'ad, Adamu, and Sadiq (2014), both education and human existence cannot function effectively without the knowledge of mathematics.

Mathematics is the backbone and a tool for every country‘s scientific, technological, and economic advancement, according to studies by Tshabalala and Ncube (2016). Despite the highly praised and recognized importance of mathematics, as well as the fact that it is a prerequisite for the majority of subjects, poor achievement and lack of interest in mathematics among students continues to be a source of concern in both developed and developing countries' schools, colleges, and universities (Naiker et al., 2020; Sharma et al., 2018).

As far as students are concerned, mathematics remains one of the most complex subjects in school (Ali & Jameel, 2016). It is a common misconception that mathematics is exceptionally challenging and complex. The majority of students have a fear of this subject as a result of this misconception (Sa'ad, Adamu, and Sadiq, 2014; Sharma et al., 2018). Furthermore, 21st century mathematics students arrive in class with a major lack of fluency and dependability in problem-solving, a

negative attitude, numerical and algebraic manipulation and simplification (Sharma et al., 2018; Yeh et al., 2019).

The ability to solve problems mathematically is essential for a society's economic prosperity (Lipnevich et al., 2011). It is also crucial for a country's scientific and technological progress (Enu, Agyeman, & Nkum, 2015). This is due to the fact that mathematics is necessary for understanding other fields such as engineering, physics, social science, and even the arts (Phonapichat, Wongwanich, & Sujiva, 2014). Mathematics, according to Abe and Gbenro (2014), has a multifaceted function in science and technology, with applications spanning all fields of science, technology, and business enterprises.

Mathematics has become an important part of the educational curriculum due to its importance. The mathematics curriculum, according to Ngussa and Mbuti (2017), is designed to give students with knowledge and skills that are critical in today's rapidly changing technological environment. High failure rates in mathematics, according to Ngussa and Mbuti (2017), are caused by a variety of factors that finally cause students' learning to become disoriented.

Many experts consider attitude to be a crucial contributor to greater or poorer mathematics performance among students' factors (Ngussa & Mbuti, 2017). A person's learned inclination to respond positively or adversely to an object, situation, concept, or another person is referred to as attitude (Sarmah & Puri, 2014). Attitudes may alter and evolve over time (Syyeda, 2016), and having a good attitude can help children study better (Akinsola & Olowojaiye, 2008). A negative attitude, on the other hand, impedes effective learning and, as a result, affects learning outcomes and, as a result, performance (Joseph, 2013). Teaching and

learning mathematics are complex tasks but students‘ motivation can be highly influenced by instructional practices (Spanias, 1999). According to a study conducted by Leong (2013), teachers selected immediate classroom situations as one of the factors that influenced the understanding of good mathematics teaching. Teaching large classes has been found to adversely affect morale, motivation and self-esteem of teachers. A consistent relationship was found between class size and teaching by Blatchford et al (2007), they found that the larger the class the more non- teaching time, which gets to affect the teaching of mathematics.

In learning mathematics in large classes, many studies have shown that class size is an important factor that determines how much students learn. Sa‘ad, Adamu and Sadiq (2014) for example concluded that overcrowded mathematics class is one of the poor performances in mathematics in schools. Other studies suggested that class size improves students‘ academic achievement (Osim, 2012). It is therefore not surprising that among other factors that affect learning of mathematics in Ghana, class size has been one of the major challenges. As class size may affect leaners learning attitudes which will in turn affect their academic performance. There is the need therefore for mathematics teachers to use strategies which help in teaching in such large classes. This study therefore seeks to probe the possible challenges and instructional strategies for managing large class size in Ghana.

2.4 Historical Information on Class Size

At the turn of the twentieth century, a demand for schools to become more efficient and to practice the scientific management method resulted in the first-class size studies. Spaulding in 1946, (a school superintendent) emphasized the economic side of efficiency and provided efficient examples from his district in Newton,

Massachusetts. Using his method of analysing per-pupil costs and pupil recitation costs, Spaulding provides school districts with a way to reduce educational expenses by increasing class sizes and decreasing the number of teachers (Vandenberg, 2012).

When criticized for his plan, Spaulding referred to the thousands of dollars that could be saved by a district and explained how this saved funding could be used to pay for the very expensive elective courses (Vandenberg, 2012). Spaulding did not explain how academic achievement would be affected by such cost-cutting measures. The days of academic accountability would soon follow, creating the class size dilemma that twenty-first century school system leaders now have to address as they attempt to balance the budget and close the educational gap.

Vandenberg (2012) pioneers in meta-analysis research regarding class size and student achievement, found that class sizes of fifteen or less students were the ideal, especially for at-risk elementary school children. Researchers subsequently identified limitations to Hanushek‘s analysis of the effect of class size on academic achievement and have provided studies to support the idea that decreasing the number of students within the instructional setting does positively affect learning (Vandenberg, 2012).

2.5 What Constitutes a Large Class?

Rapid population growths, reduction of school fees and migration have resulted in overcrowded classes in under-resourced schools (Burkman 2002). What constitutes a large class size varies in different contexts. Class size can be defined as the total number of students in a class. It is an educational tool that can be used to describe the average number of students per class in a school; it is an important factor that determines students‘ learning outcomes and one that can be directly

controlled by policy put in place by the government (Togunloju, 2015). Large class size is any class composition wherein the total population of students ignites evident challenges associated in providing quality education and obstructs classroom management or classroom behaviour (Maringe & Sing, 2014). Handi and Arante (2015) positioned that a class compromising of 30 students is considered a normal class and if it exceeds that number, then such a class can be classified as a large class.

Adeyemi (2018), however defined class size as an educational tool that can be described as an average number of students per class in a school, while Hoffman (2016) described it as the number of students per teacher in class. Also Hess (2001) assumed that a class is considered large it has 30 students or more, whiles Benbow et al (2007) termed a class to be large when the Pupil-Teacher Ratio (PTR) exceeds 40:1. Ehrenberg et al (2001) however argue that class size is not the same as PTR, with the former referring to the actual number of students taught by a teacher at a particular time and the latter having to do with the global measure of the human resource brought to bear on children's learning. This seeks to explain why while the required PTR for basic schools in Ghana is 35:1, however the actual class size is 40 and above. By contrast a class size of 30 is considered large and in need of reduction in Western Countries (Benbow et al 2007). For example, in Saudi Arabia, a class of 45 students is considered large, whereas in South Africa the provincial learner-teacher ratio in KwaZulu Natal is 1:40 (Department of Education, KwaZulu, 2009). In other countries such as China, Japan, Pakistan and India, a class of 80 students and more is deemed to be large (Dalal, 2013).

Although Ghana was at 27.25 pupil-teacher ratio in primary schools in 2018 (UNESCO Institute of Statistics, 2020), Ghana has many more schools that are

associated with a large number of pupils at the same age. Nevertheless, there have been major regional variations in national pupil-classroom ratio (PCR). According to the Ministry for Education, Ghana (2018), the PCR of public elementary schools is 55:1 for kindergarten, 38:1 for primary school, and 35:1 for Junior High School (JHS) and 40:1in the Senior High School. Given the strides that Ghana has made in enhancing access for all to education, obstacles remain that prevent the acquisition of knowledge in quality learning by thousands of children (Kweitsu, 2019). These obstacles include the challenges that large classes bring as well as the instructional strategies that teachers need to employ in teaching such classes. Regardless of the number of students in class, it's the teachers perception towards the class size in a certain context with particular tools and facilities that are provided that make classes either small or large (Ur ,1996). Hence it can be said that large classes are those with specific number of students that teachers cannot handle and resources are not enough to facilitate the teaching and learning process which poses a problem to both teachers and students .This study is based on a PTR of 40:1 as estimated by Ghana Education Service (GES).Hence a class based on this study with students above 40 will be considered large.

2.6 General over view of Challenges in Large Classes

Challenges with overcrowded classrooms have been reported all over the world. For instance, large classes are one of the most significant concerns facing schools and teachers in the United States today (Hachem & Mayor, 2019), the UK and Ireland (Donnelly, 2019) and China (Leiyang, 2018). Additionally, overcrowded classrooms are also found in some countries in Africa such as Nigeria, Kenya, South Africa (Mutisya, 2020). Ghana is also experiencing unprecedented levels of overcrowding as a result of the FCUBE and school feeding program

and Free Senior High School (Kweitsu, 2019; Ministry for Education, Ghana, 2018). Teachers around the world, like Ghana, have trouble managing overcrowded classrooms (UNESCO Institute for Statistics, 2018).

Chepkonga (2017) indicated that the consistency of school amenities tends to have an indirect impact on learning and instruction. This suggests that educational outcomes are dependent on, class size, instructional methods, Teacher competence and abilities, instructional and learning atmosphere, and subject matter, all affecting educational outcomes in both of these respects. As stated by Shamaki (2015), the content of the learning atmosphere is closely associated with the performance of the students in different subjects, so that literature surveyed from different developing countries in Africa, notably from Mozambique, Uganda, Zimbabwe, and Nigeria, revealed the connection between class size and learner success (Mutisya, 2020).

According to Siperto (2017) in Mwanza, the overpopulated classrooms have been identified as increasing and sustaining problems that obstruct successful teaching and learning operation. According to Siperto, the proportion of learners she researched in the classes was too high for the small space of the classroom to be accessible. Siperto found that in all the schools studied, the teacher-student ratio ranged from 1:80-90. In such a scenario, educators were finding it impossible to implement successful teaching methodology. The investigator also noticed that educators were overwhelmed in such a way as not to be able to walk around a classroom.

Similarly, Mutisya (2020) published research in Kenya with the same experience as Siperto‘s in Mwanza. Free primary education in Kenya culminated in dangerously overpopulated classes in which the learner-centered method was quite

challenging for the educators to introduce. Mutisya complained that although most of the classes were built to fit 45 students, the classrooms had between 80 and 90 students, beyond the number prescribed by the Ministry of Education. The consequence of this is that during classroom interaction, it continues to hinder teacher-student and student-student engagement, with detrimental effects on their academic success.

Overcrowding in classrooms is an international issue that hinders an efficient teaching and learning process (Hachem & Mayor, 2019). Yelkpieri et al., (2012) argued that large class size is one of the problems in the educational sector that developing nations have been grappling with. Hornsby, Osman and De Matos-Ala (2013) suggest that the diversity of student characteristics (e.g., ability, age, background, and experience) as well as instructor characteristics (e.g., experience, skills, competencies) should be considered when labelling a class as ~~l~~arge." in the end, these are not important.

According to Marais (2016) the first problem a large class encounters is that because there are so many students, the teacher cannot give attention equally to all of them. Therefore, when questions are asked, only abler and less shy students are eager to answer. A second problem is due to differences in background knowledge (Hayes, 2016). Large classes are always heterogeneous and heterogeneous classes are especially problematic when they are large. Lack of adequate and conducive spaces, properly outfitted to facilitate innovative and technology-aided teaching in classes, was another component of the problem (Marais, 2016)

Handi and Arante (2015) argued that, there are three commonly perceived problems associated with teaching in large classes, namely physical, psychological

and technical. Handi and Arante further explained these problems in detail as follows: The teachers in large classes may feel physically weary; they may speak louder and move more often or longer distances than they do in small classes unaware. Psychologically; some teachers find it intimidating to face a large –crowd" of students, especially when they do not have much idea who their students are and what their students are expecting from them. To the teachers in large classes, students are not –faces". Other problems such as monitoring attendance and checking assignments are also constantly worrying many teachers involved in large class teaching.

Yusuf, Onifade and Bello (2016), found that class size has a highly significant impact on students' attention most strongly, then punctuality, motivation and participation but not a rate of participation and asking or answering questions. In their perspective, Nwanneka and Amaechi, (2012) advanced that the lower the number of students in the classroom, the better the educational quality of the learners involved. Jacob and Olawuyi (2016) acknowledged that large class size undermines the tone of discipline among students during the course of teaching. This is in tandem with the submission made by Nyiam (2012) that over-populated classrooms lead to over stretching of available school facilities and overcrowded examination halls which paves way for examination malpractice.

In the same vein, Agba (2010) argued that students' overpopulation would have effect on the tone of the school which may in turn dampen the morale of both teachers and students. Such that it would encourage an adoption of lecture method of instruction among teachers, less active student involvement in the learning process, reduced frequency of instructor interaction and feedback to students.

Blatchford (2011) also stressed that at both primary and secondary levels, smaller classes lead to pupils receiving more individual attention from teachers and having more active interactions with them.

Smaller classes easily lead to active and individualized learning of students, which varies greatly from the typical lecture method used in many large classes (Benton & Pallett, 2013). Hence this study through literature will review some instructional strategies that teachers can use in large classes to make teaching effective in such classes amidst all the challenges that large classes may come with.

2.6.1 The advantages of teaching large classes

According to Bosser et al (2015), a large class presents many problems for both teacher and students, but it also has several advantages that teachers can exploit to help their students study well. First, more students mean more competition, in a large class, there are students of different levels, but it is human nature to want to perform better than others. Furthermore, abler students will complete with other advanced students and even weaker students will want to compete so as not to be considered to be among the poor students. Teachers can take advantage of this fact in any different ways.

Secondly, a large class can encourage students‘ confidence (Li & Li 2021). In this kind of class, a weak student is likely to find many other students of the same level. The student will find that he or she is not the only weak student (Bosser et al., 2015). Whenever such students speak, they know that if they say something wrong, other students will be sympathetic and not so critical of their mistakes. This builds up them confidence, which is an important factor when learning a mathematics. Furthermore, doing group work makes students less shy

when contributing- if they make a mistake, only a few people hear it, not the whole class (Bosser et al., 2015).

Thirdly, having many students in one class means sharing more experiences and the more students there are in a class, the more knowledge and experiences that can be shared among the class members. This makes the class an enjoyable place for students to learn and an interesting group for a teacher to teach (Bosser et al., 2015). Finally, a large class creates an atmosphere of cooperation. Since students know that the teacher cannot attend to every individual, they have no other choice but to help themselves make progress. By teaching themselves and collaborating, everybody feels they are close to each other and this in turn helps to improve the results of their studying (Bosser et al, 2015).

Large classes also have their own synergy, where students from all backgrounds come together and form a body of knowledge that is greater than its parts (Bosser et al, 2015). They further stated that this synergy is dynamic and can be used to encourage positive attitudes toward the overall learning experience when one use best practices in teaching.

2.7 Challenges in Teaching and Learning in Large Classes

2.7.1 Classroom management

Classroom management is a critical part of effective and successful instruction. Effective classroom management initiates with well-organized and efficient lesson plans preparation, helps a teacher teach and students learn. Students perform well in an optimistic classroom atmosphere and an environment in which they feel secure, safe cared for and involved (Aslam et al., 2014). Keeping students well behaved and on task will allow the teacher to concentrate on the instruction of the lesson being

taught and will allow more time for facilitating the learning. However, in teaching large classes, studies have shown that classroom management among others becomes a problem (Akoto 2018, Ananga & Tamanja 2017). The literature regarding how class size affects classroom management, including student discipline, is fairly consistent in its results, showing that as class size increase, time spent handling non-instructional tasks also increases (Vandenberg, 2012).

Ananga and Tamanji (2017) in their study on managing the effects of large class sizes on quality education in Ghana with 27 head teachers, 233 teachers and 311 students from primary schools, Junior high school and senior high school in all ten regions in Ghana, revealed that large class have a negative impact on teacher‘s teaching students and classroom management. In their study, with regards to classroom management, majority of head teachers (85%) and 87% of teachers were of the opinion that the management and control of students became very difficult in large class. An effective classroom management, more importantly, attributed to the arrangement of the physical environment of the classroom, management planning and programming activities, relationship management and communication in the classroom and behaviour management of students (Erdogan & Kurt, 2015).

Collier-Meek Johnson Sanetti and Minami (2019) explored the complex dynamics of classroom management, which includes exercising the appropriate discipline even the seasoned teachers struggle to implement consistently without the support of other teachers. Marzano and Marzano (2013) stressed that ~~–te~~acher-learner relationships are the cornerstone for all other aspects of classroom management” (p.6). In this regard, a committed and passionate teacher has to adapt to a participative approach

to manage the classroom and win the hearts and minds of the learners in maintaining effective learning environments (Thornton & Luthy 2019).

Garwood (2016) pointed out that learners spend more time in school, and specifically in the classroom than any other place, and that learner who are learning in the rural areas regard the classroom as one of the most important settings for their emotional, behavioural, and cognitive development. The study conducted by Sibiya, Gamede and Aleanya (2019) points to classroom management problems in rural schools arising from various factors such as learners' family environment, community, teaching methods, and the classroom environment. The physical layout of the classroom has to be taken into consideration as it can constrain teachers from applying their classroom management skills. If teachers do not attend to these problems, learners who misbehave respond poorly to regular classroom instruction (Garwood and VernonFeagans 2017).

2.7.2 Teacher and student interaction

Blatchford (2011) asserts that class size differences affect both the pupils and the teacher in that, large classes present the teacher with more class control difficulties such as more pupils' inattentiveness and off-task behaviour while in smaller classes, there is more individual teacher contact with pupils and more support for learning. Large class size which has limited physical space results in an increase in student behaviour, increase in safety issues and decrease in instructional activity variety (Blatchford et al., 2007).

Results from approximately 140 teachers surveyed from Burke Country, North Carolina suggested that smaller classes (15 or less students) helped teachers prevent discipline problems through the personal relationships they were able to

establish with their students. Teachers stated that in smaller classes, they were able to interact more with the students and prevented discipline problems from occurring. Their findings were replicated in teacher surveys from teachers in New York class size reduction programmers _where teachers also stated that being able to get know their students personally allowed them to have less discipline problems (Finn et al, 2003).

Blatchford (2011) in their study they concluded that, students in small classes in elementary grades are more engaged in learning behaviours and display less disruptive behaviours than do students in large classes.

2.7.3 Stress

Teachers teaching large classes remain under immerse pressure to teach well in the class regardless of the size of the class. Difficulty in managing students results in stressful condition for teachers. Teachers in such classes do lots of work each day and every year the work load increases with increasing students. Large classes cause noise, inappropriate behaviour of students, inability of teacher to interact with students and a large volume of work needs to be checked and graded. Two studies as cited by Faraz (2012), Dharmadasa and Gorrell (1989), in their study on large classes in Sri Lanka, with 722 respondents to teacher‘s stress inventory from large cities, small towns, villages and from public and private schools, showed findings that over 90% of teachers responded that stress was one of the causes of large classes. Also 80% of teachers responded to not keeping records of students in large classes due to the number of students and work load. Also in Nigeria, Okebukola and Jegede (1989), as citied by Faraz (2012), studies the determinant of occupational stress among teachers in Nigeria through examining

events, objects or circumstances which are perceived by Nigerian teachers as stress inducing. The data collected through questionnaire from finding shown that poor service conditions, large classes and inadequate of teaching were the contributors of stress on teachers. Other causes of stress in large classes includes: teacher's lack of coherent relationship with their students, fewer teaching methods, dissatisfaction on both the students' and teachers' side and a common perception that teachers are of low statues in an institute where they teach large class (Carpenter, 2006).

2.7.4 Instructional activities

Small class increases teacher and student interactions (Blatchford et al., 2003a). Teachers in smaller classes are able to provide students with more instructional feedback (Pedder, 2006). Daily interactions with students enabled teachers to assess the instructional and emotional needs of their students (Blatchford et al., 2003a). Being able to have quality interactions with their students is an important aspect of smaller class sizes as this facilitates the teacher to plan and implement effective instructional activities (Blatchford et al., 2003a). The use of direct instruction of individual students is one result of increased teacher and student interactions that positively affect the instructional activities of the classroom. Research has (Blatchford et al., 2003a) shown that teachers devoted more time in the direct instruction of individual students in smaller classes. Having smaller classes also allows the teacher to create smaller groups for group instruction, resulting in more opportunities for teachers to interact with individual students and to provide more meaningful instruction to all students in the class (Finn, Pannozzo, & Achilles 2003).

Smaller classes allow teachers to interact more with their students through such methods as direct instruction. Another result of smaller class sizes is the opportunity for more flexible teaching activities, including the use of more non-traditional activities. Observation data of classes of children aged 5-7 years showed that teachers of smaller classes (average of 52 students per teacher) were more likely than teachers of larger classes (average of 33 students per teacher) to use activities other than whole group lecture. These teachers were observed as using smaller group activities, more inquiry-based activities, and more open-ended activities (Blatchford et al., 2007).

Teacher questionnaire data suggested that smaller classes facilitated the use of non- traditional activities because the teachers felt more comfortable with having the students move around the room. The teachers also stated that they felt they knew the abilities of their students better because of their frequent interactions with the students (Blatchford et al., 2007). Teacher survey data indicated that teachers were more likely to use innovative teaching strategies when the class was small because the teacher felt like he or she could maintain the attention of the students better (Blatchford et al., 2007). Because small class numbers encourage more interactions with the students, teachers are more comfortable with using non-traditional activities to better meet the needs of all students.

2.7.5 Non-instructional tasks

Increasing the number of students in the classroom affects the teacher to-student interactions and the student-to-student interactions (Blatchford et al., 2003a; Blatchford et al., 2007). Increasing the student population also affects the amount of non- instructional duties of the teacher. Data from 788 teacher questionnaires

showed that teachers of smaller classes found the decrease in grading and recordkeeping responsibilities conducive to increasing achievement. The less time spent grading students allowed more time and energy for planning and teaching. Eliminating activities to decrease the grading workload in larger classes was cited by teachers as being a common practice even though they knew that this could negatively affect the achievement of the students (Blatchford et al., 2007). Effectively meeting the needs of all students within the classroom through instruction and outside the classroom through assessment was cited as being important by all teachers in the study.

However, teachers within larger classes (average of 33 students per teacher) noted less job satisfaction than teachers in smaller classes (average of 19 students per teacher). One reason for this decrease in teacher morale was identified as being unable to effectively handle all of the non-instructional tasks required (Blatchford et al., 2007). Larger classes require teachers to devote more time outside the class for the completion of non-instructional tasks. Smaller classes enable teachers to focus more on the planning of instruction and to have greater job satisfaction.

Students in large classes are more likely to display off-task behaviour, such as talking with peers on topics unrelated to the instruction and to be in need of teacher redirection; thus, large classes often result in the wasting instructional time and low academic achievement (Finn & Achilles, 1999). This increase in time being utilized for classroom management results in less time being utilized for instructional purposes, which means teachers are unable to enhance their lessons through engaging activities and/or instruction. Hindering the use of more activities is also the lack of physical space presented by large classes, and the lack of teacher-to-

student interactions (Blatchford et al., 2007). For each classroom management issue, time is taken away from the instruction of the students, affecting their academic achievement. Teachers also reported that large classes increased grading workloads and decreased their job satisfaction (Blatchford et al., 2007). Increasing class sizes increases the amount of classroom management. Time used by a teacher to discipline students or to record attendance is time taken away from instruction and learning.

2.7.6 The impact of student and teacher behaviour

Class size has been found to affect students' behaviour. Through research reviewed and analysis, Finn, Pannozzo and Achilles (2003) found empirical evidence that student engagement increased when class size was reduced. Finn et al found that teachers of small classes spend more time on instruction and less classroom management or matters of discipline. When class size was reduced, students became more engaged academically, as well as socially. Academic engagement referred to student behaviours related directly to learning process, such as: time on task, attentiveness, participation in learning activities, and taking initiative in the classroom (Finn et al 2003). The increase in engagement in the classroom is what led to an increase of learning in all subject areas.

Academic engagement and social engagement are the skills needed in the classroom. According to Finn et (2003) students who are withdrawn or who engage in disruptive behaviour in the elementary grades are associated with depressed academic performances. Moreover, when antisocial behaviour disrupts the teacher or other students, learning is hindered for the whole class.

A review of the findings learning behaviours that were conducted by Finn et al found a significant difference in percentage of students definitely on-task favouring small classes in reading but not in mathematics. An experimental study which was called Tennessee STAR (Student/Teacher Achievement Ratio) was conducted for year 3 (where trained observers observed a total of 52 grade 2 classrooms in 13 schools during reading and mathematics. The observation recorded teacher-to-student and student-to-teacher contacts in behavioural, academic or procedural contexts and took descriptive notes to gather information in both small and regular classes. Conclusion form the study showed that students were likely to get a turn more often during lessons and also students initiated more contacts with teachers in small classes. Also, researchers (Blatchford et al, 2008) analysed approximately 800 teachers regarding how teachers perceive class size affecting instructional and management practices. Teachers' survey data suggested that as the number of students increased in the classroom, instances of student's misbehaviour also increased. Larger classes (31 or more students) were harder for teachers to manage than smaller classes (25 or less students). Teachers cited that more student misbehaviour occurred in the large classes, resulting in more time being on controlling the students rather than teaching (Blatchford et al, 2007).

Through observation of approximately 330 classrooms in Tennessee, Finn et al identified an improvement in students' behaviour in smaller classes (13-17 students per teacher) than in larger classes (22-25 students per teacher). Lazear (2001) has also supported other literatures on the fact that large class size affects student behaviour. He made the assumption that one child's disruption destroyed the ability of all students to learn at that moment. When a student misbehaves, the teacher must attend to him/her and thus the learning of the student and his classmates was

being affected. In addition to disobedient students, a student who asked a question to which all other students knew the answer disrupted the learning process. In order to demonstrate his theory, Lazear offered a model that uses ‗p' as the probability that a student does not interfere with classroom learning. ―It was expected that ‗p' will be relatively high because even having p-98, in class of 25 students results in 40 percent disruption of the time (Lazear, p. 720).

The better the behaviour of student, Lazear argued, the fewer the number of teachers ‗n' needed. The relationship of *n* to *p* demonstrated why there were more students in a college lecture than in kindergarten class. Pedder (2006) also suggested that smaller classes benefited student achievement claiming that teachers in small classes paid greater attention to each pupil. Students in these classes experienced continuing pressure to participate in learning activities and become better, more involved students; attention to learning went up and disruptive and off-task behaviour went down. Again, Pedder believed that class size might impact classroom processes and pupils' learning. He stated that smaller class size allowed teachers to cover more curriculum and student to be more cognitively engaged. These two features led to improve student achievement. He further asserted that in larger classes, more attention is needed for non-academic activities.

2.7.7 Limited physical space

Another classroom management issue that must be addressed in larger classes is limited classroom space. The lack of physical space is a factor affecting instruction, and according to Blatchford et al. (2007), having students closer to each other in physical proximity leads to classroom management issues due to the teacher's inability to effectively separate disruptive students from the general population in

larger classes. More arguing among the students was also observed in larger classes and contributed by teachers as the students being too close to each other (Blatchford et al., 2007). A lack of physical space within larger classes (31 or more students) compared to smaller classes (25 or less students) was cited in teacher surveys as creating an inflexible learning environment (Blatchford et al., 2007).

Graue et al. (2007) found that smaller classes enabled teachers to provide increased focus to activities through the designing of specialized learning environments throughout the room, allowing students to separate from the whole group learning experience physically and academically. A large number of students in a small classroom (45) mean that teachers are unable to effectively manage student behaviour, resulting in instructional issues and safety issues. A lack of physical space prevents teachers from being able to use a variety of instructional strategies and to modify the learning environment to better meet the needs of the students (Blatchford et al., 2007). In order to provide the best possible learning environment for all students, teachers need to be able to vary their activities. Without the physical space to do this, academic achievement could decrease. Increasing the students in the class affects the amount of space available and implementation of instructional activities.

2.7.8 Difficulty in providing timely feedback

Productive feedback is another challenge that teachers encounter in large classes. Quality feedback should be timely, individualized and regular; however, this becomes a challenge when the class is large. Stressing on feedback in good writing, Docherty (2010), stressed that ~~–e~~lear expectations to students and the opportunity for students to receive feedback contribute to better student writing. This outlines the

important role of timely feedback in the classroom. Yelkpieri et al, also supported the fact that teachers find it difficult to give constructive and timely feedback to students in large classes.

UNESCO, 2006 also asserts that a major difficulty in teaching large classes is finding ways to provide feedback to, and receive it from, students. Feedback helps students see how well they are doing and whether they have understood the lesson. Consequently, the more feedback the teacher provides to the students, the better, because it will not only help them but also the teacher.

Ananga and Tamanja (2017), in their study in Ghana on the managing effect of large class on quality education, from their findings showed that 89% of head teachers and 80% of teachers were of the view that large class size limits teachers' ability to deliver specific feedback to all students in the classroom. Some teachers from the study in Greater Accra outlined that ~~–~~it takes time before feedback is given because of the size of the class. ~~–~~Other teachers also from the Central Region outlined that ~~–~~We are unable to give the required number of exercise and assignments, which in a way according to the teachers affected the quality of the assessment of students. Therefore, the challenge of providing timely feedback cannot be overlooked in large classes.

2.7.9 The effect of class size on the teaching-learning process

Scholars such as Horning (2007) believe that class size affect the teaching-learning process. Arias and Walker (2004), also agrees to this that public schools and colleges need smaller classes in all courses and they have a positive effect on improving students' performance as well as achievement. They also added that the smaller the class is in the college context; success is more likely. Horning (2007)

again believes that large classes have negative effects on lectures in the college. She says that lecturers in large classes can‘t give their students individualized attention or detailed responses.

Hornsby and Matos-Ala (2013) believe that large classes in the higher education system pose a threat to the quality of teaching and the educational environment. Hornsby and Matos-Ala (2013) claim that large classes are challenging not only for students, but for university instructors also. This environment can be challenging for the later because they want to deliver a meaningful learning experience to their students. It also affects the former as their aim is not only to gain knowledge, but also to develop critical thinking skills.

Class size hence play a key role in the effect of teaching and learning process especially in higher education as the goal in higher education goals move beyond simple knowledge acquisition to promoting student engagement and higher order cognitive functions.

2.8 Class Size and Academic Performance

Adeoye (2013) and Togunloju (2015) believe that class size has a very strong influence on students‘ academic performance. Class size is also very likely to affect the kinds of questions asked by teachers. A study conducted by Harfitt (2012) in Hong Kong secondary schools showed that teachers in small classes are likely to ask open-ended questions, which may lead to more interaction between teachers and their students, whereas in large classes, teachers are likely to ask their students closed questions.

According to Talebi, Davodi, and Khoshroo (2015), there is a relationship between the skills, techniques and class size and student academic achievement. One

component of an effective classroom management is verbal and non-verbal skills. The skills can influence the behaviour of individual student and students in communal. The influence could be positive or negative depending on the behaviour of the teacher.

It can be inferred that it is essential to implement effective strategies in supervising, efficient monitoring, organization, communication and lesson delivery to manage classroom behaviour and occurrences of distractions in large classes (Akin, Yildirim & Goodwin, 2016; Eisenman, Edwars & Cushman, 2015).

2.9 Some Suggestions on how to deal with challenges in Large Class Size

2.9.1 Self-Regulated Learning

Student‘s Self-Regulated learning bases assessments tend to increase and enhance students' learning (Granberg, Palm & Palmberg, 2021). Furthermore, examining how self-regulated learning can enhance students‘ learning performance is essential (Zhu, Au & Yates, 2016). By addressing this gap, a study will be able to reveal valuable information on how self-regulated learning strategies can enhance learning performance for undergraduates (Zhu, Au & Yates, 2016).

In dealing with the impact of student‘s behaviour, students can develop self-regulation. Research has found self-regulated learning to be a significant predictor in learning and performance (Haron et al., 2015). The literature has shown that self-regulated learning plays a role in distinguishing high scorers from low scorers, based on academic tasks which are focused on understanding instead of acquisition (Greene et al., 2018). Likewise, another research has revealed that students performed better with the use of self-regulated learning strategies as opposed to students who did not (Haron et al., 2015). Thus, it is clear that self-regulated

learning strategies are necessary for the higher education sector to improve students' learning and performance.

2.10 Instructional Techniques in Teaching Large Classes

Teaching has basically transcended from the use of verbal presentation and the use of chalk to write on the blackboard to the stage where intelligible resources assist teachers in the process of transmitting knowledge to learners (Bûsljeta, 2013). In order to achieve that, a teacher deploys a number of methods, designs and actions, one of which includes the usage of instructional techniques. Koko and Nkpolu-Oroworuko (2016) defined instructional techniques as strategies that teachers can use to facilitate the teaching and learning of a particular subject or lesson. Boadu (2015) added that instructional techniques when effectively used in teaching has the tendency to incorporate students' learning experiences, thereby making the subject content more receptive and interesting.

Good or effective teaching do not emanate except from adequate preparations and effective utilization of essential learning materials in teaching (Koko & Nkpolu-Oroworuko, 2016). Also, instructional techniques can be used to encourage teaching and learning activities. It can also help to reduce the rate of forgetting, thereby helping students to concretize learnable bit of information (Koko & Nkpolu-Oroworuko, 2016). Instructional techniques are tools that assist teachers in teaching as well as strategies which promote good teaching and learning (Koko& Nkpolu-Oroworuko, 2015). One paramount significance of instructional techniques is that they concretize students learning and achieve set goals of education (Koko & Nkpolu-Oroworuko, 2016). On the other hand, wrong use of instructional techniques in teaching can attract adverse effects on learners.

Bûsljeta (2013) outlined that some of the instructional techniques in teaching large classes include: encouraging the process of understanding, decoding, organizing and synthesizing the educational content, logical thinking and reasoning. Nevertheless, mention has to be made that if these goals will be attained, it solidly depends on the effective use of instructional techniques in teaching.

Bûsljeta (2013) pointed out three main stages that teachers need to follow in order to ensure effectiveness in the usage of instructional techniques: selection and initial evaluation stage, presentation and interpretation stage, and the final evaluation stage. It must be stated clearly that the competencies that must be brought to bear in each of the stages are mutually inclusive. To Bukoye (2019), the factors that teachers must consider in the selection of instructional techniques are paramount in ensuring effective use of instructional techniques. This meant that if teachers consider significant factors in the selection of instructional techniques, its effective usage will be compromised.

A study conducted in Tanzania showed that there was lack of instructional materials in the teaching of history as compared to the Sciences. (Koko & Nkpolu- Oroworuko, 2016). However, the inadequacy of instructional techniques is not a comprehensible ground for teachers to justify their incompetency in as much as the usages of instructional techniques are concerned.

Agufuna, and Mukwa (2018), also in a study –assessment of the criteria used by teachers in selecting learning resources" sought to find the factors teachers consider in the selection of instructional techniques for teaching. Stratified random sampling was used to select one hundred and sixty-eight secondary school teachers to take part in the study. Descriptive statistics was used to analyse the findings. The study

assessed how the variables: lesson objectives, lesson topic, syllabus coverage, age of students, time available, cost of materials, class size, class level, teachers level of preparedness influenced teachers‘ choice of instructional materials. It reported that 90% of teachers agreed to it that, the lesson objectives affected the way they selected learning resources for instruction. About 58% of lecturers agreed that the study topic determined which learning techniques they selected for instruction, while another 35% tended to agree. Research data revealed that 80% of teachers agreed to the fact that syllabus coverage affected the resources they selected for use in instruction. The study results revealed that 52.4% of teachers agreed to the point that the age of pupils was one of the criteria they used in determining the learning resources they used in instruction, while a further 35.1% tended to agree to this fact. 40% of teachers tend to disagree that time available determined the learning resources they selected to use while instructing, while another 35% disagreed.

With regard to class size, 42% of teachers reported that they consider class size in the selection of instructional materials for teaching; further 31% of the teachers tend to agree to the fact. On the part of cost of materials, 42% of the teachers settled on the point that they consider the cost of the teaching-learning materials in the selection process, another 27 also tend to agree on the same element. Again 42% of teachers disagreed with the notion that teachers take into consideration their level of preparation, further 20% tend to disagree. The researcher concluded that lesson objectives, syllabus coverage, topic of the lesson, and age of students where the key factors teachers consider in the selection of instructional techniques as compared to factors such as teacher preparation, class size, time available (teaching periods) and cost of materials as less than 50% of the teachers agreed on such variables. This study will hence review some instructional techniques that can be

used in large classes to make teaching more effective and also to help to improve in students‘ academic performances.

2.10.1 Corporative learning/pair learning

Corporative learning strategy is one of the most effective way teachers can help students learn in large mathematics classes. Several definitions of corporative learning have been offered by educationist. Felder and Brent (2010), define corporative learning (CL) students working in teams on an assignment or project under conditions in which certain criteria are satisfied. These conditions include members being held individually accountable for the completion of content which in turn facilitate the completion of the assignment or project. Learning in small groups plays an increasing role in modern pedagogy, from K-12 to higher education and there is strong evidence that students working in small groups outperform students working individually in several key areas, including knowledge development, thinking skills, social skills, and course satisfaction (Barkley, Major & Cross, 2014). A myriad of terms has been used to describe such learning in the past four decades, but most commonly these group-based processes are called cooperative or collaborative learning.

These approaches are built on developmental and educational theory, suggesting that learning is fundamentally a cooperative, collaborative process of socially constructing knowledge (Slavich & Zimbardo, 2012). Research in different subject areas and with students of various ages has demonstrated positive effects of cooperative learning on academic achievement and the development of higher-order thinking skills (Davidson, Major & Michaelsen, 2014). This instructional strategy if used in large classes can help students to relate well with other peers as well as to improve in the academic performances.

2.10.2 Inquiry-based learning

Bacon and Matthews (2014) stated that, inquiry-based learning refers to the process of learning through inquiry, enabling students to raise, address and answer interesting questions, in order to formulate solutions to meaningful problems by identifying, examining and drawing on the available evidence. Inquiry-based learning in the humanities aims to cultivate understanding and reasoned judgment through the study of sources, arguments and worldviews. It thus emphasizes ethical reasoning and reflection on the human condition and it requires students and teachers to consider and engage with multiple (disciplinary and social) frameworks, angles and positions (Grant, Swan, & Lee, 2017).

Inquiry-based learning proves more effective in promoting students‘ application, deep thinking and reasoning skills (Kuhlthau, Maniotes, & Caspari, 2015). It also improves students‘ command of the subject matter while promoting 21st century competencies, emphasizes active investigation and knowledge construction through the process of inquiry and encourages students to consider different perspectives and encourages students to evaluate, adjust and construct evidence-based interpretations (Grant, Swan, & Lee, 2017).

Khan et al., (2020), sought to determine how inquiry-based learning curriculum would affect students‘ academic achievements. Their study compared 10th grade student who had chosen chemistry elective. The students were separated into two groups, the control groups were taught using inquiry-based instruction and the experimental groups were taught using inquiry-based instruction techniques. Post-class testing indicated that the students who were taught using inquiry-based instruction reflected significantly higher academic achievement than those taught

using traditional methods.

2.10.3 Formative assessment

According to Prasanthi and Vas (2019) formative assessment is used in the first attempt of developing instruction. In this method, assessing a student‘s performance during instruction, and usually occurs at regular intervals throughout the instruction process is done. It is used to monitor student learning and to provide feedback during the course. It is used for finding growth over time. Formative Assessment can be a means for teachers‘ professional development and can be fruitful (Khan, Zaman & Saeed, 2020).

Assessment is the key process in assuring quality education (Lamanauskas & Vilkonienė, 2015). The problems of assessment – and formative assessment (FA), in particular – have been widely addressed by teachers, teachers‘ educators, and researchers for several decades. Formative assessment has a variety of definitions. However, different researchers have come to a consensus regarding certain characteristics pertaining to this form of assessment. Formative assessment is based on regular and interactive evaluation of students‘ work, it provides feedback on their learning in terms of the specified goals, and indicates what the next steps in teaching should be (Wiliam, 2016).

FA develops students‘ competences, mainly their ability to learn, i.e., students are able to learn from their mistakes, evaluate the results of their learning process, and propose how to improve their own performance (Looney, 2015). FA is also important in the process of developing social and personal competences (Marshal, 2015). There are studies that have not statistically confirmed any significant influence of FA on students‘ performance or academic achievement (e.g.,

Andrews, 2015; Collins, 2015).

According to Andrade (2013) the essence of formative assessment is informed action. That is, teachers must know how to respond to the information obtained through assessment and adjust their instruction according to students' needs; students must be equipped with strategies and have the motivation needed to improve their work and deepen their understanding after receiving feedback. In other words, formative assessment does not simply result in better learning, but rather, drawing upon the theory of action, formative assessment is assumed to initiate particular actions which, in turn, lead to better learning outcomes (Bennett, 2014).

Andrade (2013) added that, formative assessment has the two main purposes of (1) providing information about students' learning to teachers and administrators in order to guide them in designing instruction; and (2) providing feedback to students about their progress in order to help them determine how to close any gaps between their performance and the targeted learning goals. Assessment is found to be one of the most essential and influential educational tools for either promoting or demoting student learning and the capacity to perform. For teaching writing and portfolio, assessments and formative assessment play a crucial role (Bader et al., 2019). Assessment can either help the students to perform at their optimum or not perform at all due to stress and anxiety caused because of the exam load, assessments can lead to the active involvement of students (Buyukkarci & Sahinkarakas, 2021).

Similarly, Leenknecht et al., (2020) study also focused on students' own motivation in relation to formative assessments and discovered a link between students‘ motivation and competence towards tasks. Baranovskaya (2017) stated that, the

prime purpose of classroom assessments is to allow students to demonstrate/present their learning to share and learn from each other, rather than identifying the mistakes and highlighting them and then discouraging the student. It is inevitable to say that the emphasis of assessment is on various aspects of instruction and learning outcomes.

2.10.4 Demonstration

Generally, demonstration method is a method of providing lessons by exhibiting and demonstrating. The demonstration method is a method of teaching by demonstrating things, events, rules, and sequences of activities, either directly or through using instructional media which is relevant to the subject matter or material that will be presented (Dimyati & Mudjiono, 2013). The purpose of teaching using a demonstration method is to show the process of occurrence of an event according to the teaching materials, how they are attained and the ease to be understood by the students in teaching learning process. In order for children to emulate examples of actions demonstrated by educators, there are several important things that educators must pay attention to. First of all, what the educator shows and does must be clearly observed by the child being taught. Secondly, in giving a sound explanation the educator must be clearly. Thirdly, the demonstration must be followed by children's activities to mimic what has been designated and done by educators (Amriyah & Mahmudi, 2015).

Mathematics learning is a process that is intentionally designed with the aim of creating an environmental atmosphere allowing one to carry out mathematics learning activities, and the process is centred on educators teaching mathematics by involving the active participation of students in it (Esmonde, 2017). The advantages of

demonstration methods can make teaching clearer and more concrete, so avoiding verbalism namely understanding in words or sentences (Dimyati & Mudjiono, 2013), learners better understand what is learned and more interesting teaching process learners are designed to be active, observe adjust between theory and reality, and try to do it yourself (Mansyur, 2013). The demonstration method can also reduce errors when compared to just reading a book, because students have obtained a clear picture of the results of their observations (Ramayulis, 2014).

Demonstrations in use as a teaching strategy may prove beneficial for students with different or special learning needs. It is assumed that, when combined with traditional methods, demonstrations can be effective for low-achieving students with high visual and spatial intelligence but with limited cognitive abilities (Radem, 2009).

Demonstration as an instructional strategy that can be used in large Mathematics classes involves illustrating a point in a lecture or a lesson by means of something other than routine visual aids or other means of instruction. Demonstrations can increase the curiosity of students in large classes, which can sustain their interest in the class, and also enhance their thinking abilities. In a study, Giridharam and Raju (2017) investigated the impact of Teaching Strategies and Impact of Teacher Effect on the students' Academic achievement in engineering education. They adopted two different teaching strategies, demonstration and lecturer strategies. Demonstration strategy was found to be significantly better than lecture strategy.

2.10.5 Visual Aids

The term visual aids have been defined by many scholars. Budinski (2014) views visual aids as any materials or demonstrations presented during an oral presentation to

support or enhance verbal message. This means that, well prepared visual aids are useful in complementing unclear and incomplete information communicated orally by the teacher, On the other hand, King (2018) see visual aids as any materials which are employed during teaching in order to facilitate learning by stimulating visual senses.

From this view, visual aids are more useful in enabling learning as they provide additional stimuli apart from oral information given by teachers. This implies that visual aids enable learners to obtain concrete realization of objects and phenomena. Hamilton (2014) also defined visual aids as anything presented to an audience in a form that listeners can see to supplement the information they hear. For the purpose of this study, visual aids refer to any instructional devices that appeal to the sense of sight used by teachers to facilitate meaningful learning. They include real objects (realia), models, specimens and pictures.

Developments in the field of science and technology particularly in the 21st century have contributed greatly to increase in availability of visual aids (Sisiliya, 2013). For instance, invention of computers has simplified the design and making of visual media (Costley, 2014). New projection instruments and materials that appear every year have revolutionized ways of displaying visual content.

According to Recto (2015), before reaching the period of puberty, primitive children, were able to learn by doing and by observing daily social practices. Boys were taught how to hunt, fish and dig while girls learned to do home chores by watching their mothers. In many cases real objects were preferred for teaching children. For example, arrows, bows and spears were common tools that the boys were taught how to use. Since the purpose of education was to teach practical skills,

children leaned visually by participating and imitating adult activities (Kerubo, 2016).

In the same vein, adults preferred to impart knowledge to young learners through real objects and visual demonstrations. During initiation, particularly in local African societies, the boys and girls underwent sustained period of instruction which was made possible with extensive use of sculptural figures and artworks, most of which were made of wood and metal. Many concepts were explained visually and the children learned by practicing and observing their trainers. Although visual representation of ideas varied from one society to another, they all served as a media to facilitate comprehension (Kerubo, 2016). Cassady (2014) advanced the fact that visual aids are effective in conveying ideas and content more easily than verbal descriptions for visual learners, and are important learning enhancements in the classroom. Makokha and Wanyonyi (2015) noted that there is insufficiency on the availability of learning and teaching materials and that, teachers rely on chalk and talk method to teach language skills. They conclude that learners do not perform well in language skills development due to insufficient resources.

Research conducted by Quarcoo-Nelson, Buabeng and Osafo (2012) to investigate the impact of visual arts learning and teaching materials on students‘ achievement in Physics showed that when appropriate audio-visuals are integrated into the curriculum to complement the traditional method, higher learning outcomes in terms of achievement scores would probably result. In a study, senior high school students taught with the audio-visual aided instruction achieved better than students taught with the traditional method. To improve teaching in Ghana schools Quarcoo-Nelson et al. (2012) suggested that teachers need to explore different varieties of

audio visual aids to use in their teaching. Tety (2016) indicated that visual arts learning and teaching materials are key to teachers‘ and students‘ performance. In response, teachers use different strategies to minimize the challenges in quality learning and teaching materials. When integrated as an instructional tool in large classes, visual aids can help students remember the lessons better hence improving academic performance in large classes.

2.10.6 Use of technology

According to Ranasinghe and Leisher (2009), integrating technology into the classroom begins when a teacher prepares a lesson that use technology in meaningful and relevant ways. Technology helps to aid the lessons that teachers teach in the classroom. Ranasinghe and Leisher added that technology should assist the teacher in creating collaborative learning environment. Some students who participated in the lessons believed that the computer helped then understand what the teacher was saying about the lesson (Herron, 2010). Computers are used as a support when they are incorporated into the teacher‘s professional practice outside the classroom providing assistance to classroom teaching (Meneses et al., 2012).

A more specific categorization of the educational uses of ICT would be very useful especially for technology-rich classrooms. These types of classrooms are characterized by a high level of access, both by teachers and students, to a wide variety of technologies that can help teaching and learning, and by a high level of skills in the educational uses of these technologies (Craig, Ault & Niileksela, 2011). Fisher, Exley and Ciobanu (2014) discussed how classrooms are turning to technology for teaching and learning, and how teacher‘s roles have changed. The teacher becomes the facilitator, who takes the students on their learning journey,

learning with them instead of ‗teaching' them. Students need to make judgments about and be able to calculate the value of the content they gather. Learners are also self-assessing using technology. This helps to ―move learners from being the consumers of information to being producers of it" (p. 11).

Research shows that while growing up in the ever-growing technology world, the incorporation of technology helps motivate students to learn. For example, Shaen, Hayden and Zydney (2016), discussed a project they conducted that allowed third grade leaders and first graders to work together and create an app that will allow kindergarteners to practice math strategies. This weeklong project allowed students to use technology, collaborate, and teach. Schaen et al. study deliberated on the process that the students went through and the outcomes of the project. This technology enhanced project motivated students who wanted to continue building and working at home. ―The project gave young students a real-world purpose for planning and creating collaboratively" (p. 509).

2.11 Summary

This project work examined teaching and learning Mathematics in large classes: challenges and use of instructional techniques in Senior High Schools in Tema East Municipality as a case study. The literature review covered the following; theoretical framework, teaching and learning mathematics, historical information on class size, what constitutes large class? Challenges in teaching and learning in large class size, class size and academic performance, instructional techniques in teaching large classes, suggestions in dealing with large class size among others. It came to light that; large class size is any class composition wherein the total population of students ignites evident challenges associated in providing quality

education and obstructs classroom management on classroom behaviors. The study found that overcrowding in classrooms is an international issue that hinders an efficient teaching and learning process and some researchers argued that, large class size is one of the problems in the educational sector that developing nations have been grappling with. The next chapter would cover the research methodology.

CHAPTER THREE

METHODOLOGY

3.1 Overview

The purpose of this chapter is to provide the detail description of the methodology that was used in the study. Research methodology according to Kothari (2004) is a way to systematically solve the research problem. The chapter covers the research design, the target population, sample and sampling techniques, construction of research instruments, pilot study conducted to ascertain the reliability and validity of the research, data collection techniques and data analysis procedure, and ethical consideration for the study.

The study was guided by the following questions;

1. What challenges do mathematics teachers encounter in teaching large classes in Tema Central Municipality?
2. What challenges do senior high school students encounter in learning in large mathematics classes in Tema Central Municipality?
3. How frequently do mathematics teachers use effective large class instructional techniques in the Tema Central Municipality?

3.2 Research Design

A research design is an overall plan for collecting data in order to tackle the objective of the study (Fraenkel & Wallen, 2000). Similarly, the ultimate goal of a good research design is to guide the researcher on the type of data to collect, how to collect, process and analyses them in order to answer the research questions or test the research hypothesis (MacMillan & Schumacher,2001, p166).

This study adopted a mixed method approach being a blend of both quantitative and qualitative methods. The rationale for this strategy was to ensure that the aims of the study were fully addressed and also that the weaknesses of one instrument were complemented and strengthened by the other (Creswell,2012).Also according to Johnson and Onwuegbuzie (2004),the fundamental principle of mixed research design is that researchers should collect multiple data using different strategies, approaches and methods in such a way that the resulting mixture or combination is likely to result in complementary strengths and non-overlapping weakness. They further argue that the effective use of this process is a major source of justification for mixed methods research because the product will be superior to mono-methods studies.

Additionally, the mixed research approach allows one to explore the meaning of construct or phenomenon from more than one perspective. (Johnson & Onwuegbuzie, 2004). The explanatory sequential design method was used in collecting data for the research.

According to Creswell & Plano (2011), an explanatory sequential mixed methods design consists of first collecting quantitative data and then collecting qualitative data to help explain or elaborate on the quantitative results. This was used in answering the first research question. The rational for this approach is that the quantitative data and result provide a general picture of the research problem; more analysis, specifically through qualitative data collection is needed to refine, extend or explain the general picture.

In using the explanatory sequential design, data was first collected quantitatively by using questionnaires which helped to gather data on their perception and

challenges in large mathematics classes. This was followed with the qualitative aspect which was in the form of interview. The interview helped the researcher to get more explanations on the challenges that teachers encounter in large mathematics classes.

The use of mixed method is important because it increases both the reliability and validity that are vital in measuring a concept. The quantitative aspect was designed to gather data on challenges in teaching and learning in large as well as the frequent use of effective large class instructional techniques. The qualitative study on the other hand enabled the researcher to obtain in-depth information on teachers in teaching large mathematics classes in Tema Central municipality.

3.3 Population

The target population for the study was all senior high schools in the Tema Central municipality which comprised of five (5) public senior high schools. However, because of time and cost implications, four (4) public senior high schools were selected. They were Chemu senior high school, Tema Methodist day senior high school Our Lady of Mercy (OLAMS) and Presbyterian senior high school, Tema. The 2021/2022 academic year form two students who made up seven thousand three hundred and thirty students (7, 330). Also, all Mathematics teachers in the municipality were part of the target population. The mathematics teachers made up of 63 teachers of which 5 are females and 58 are males. Table 3.1 gives the population for the study.

Table 3.1: Population of Senior High Schools (SHS) in Tema Central Municipality

Name of SHS	Number of Students	Number of Teachers
Chemu SHS, Tema	1,893	**18**
Our Lady of Mercy SHS	1,346	**12**
Tema Methodist Day SHS	1,914	**15**
Tema Manhean SHS	1,235	**10**
Presbyterian SHS, Tema	942	**8**
TOTAL	**7,330**	**63**

Source: Tema Metro Office

3.4 Sample and Sampling Procedure

Regarding sample size, Patton (1990) suggests that there are no hard and fast rules for sample size in qualitative research, it all depends on what the researcher wants to know, the purpose of inquiry and what can be with available resources. Four (4) public senior high schools out of the five (5) public senior high schools were sampled for the study. Table 3.2 shows the sample size for the four selected public senior high schools. From the table, the total population of 7,330 and 63 students and mathematics teachers respectively were the population of the study. An error margin of 7% was used to calculate the sample size for both teachers and students using Miller and Brewer (2003)

$$n = \frac{N}{1+(N\,(e)^2)},$$

where; n = Required Sample Size; 1 = Constant; N = Population; E = Error; Term (%).

The 7% error margin was chosen for convenience which means that 93% of the information gathered from the respondents is accurate. This formula was used to calculate the sample size for the study because the sample size influences the precision of the estimates and also the power of the study to draw conclusions. Tables 3.2 and 3.3 show the sample size determination for students and teachers respectively using the formula.

Table 3.2: Sample Size Determination for Students

Sample Size (N)	**?**
Total Population	7,330
Constant (1)	1
Error Term (E)%.	7%
Exponent	2
(N(e)^2	2
1 +(N(e)^2	36.917
n = N/1+N(e)^2	**199**

Source: Field Survey (2022)

Table 3.3: Sample Size Determination for Teachers

Sample Size (N)	**?**
Total Population	63
Constant (1)	1
Error Term (E)%.	7%
Exponent	2
(N(e)^2	2
1 +(N(e)^2	1.3087
n = N/1+N(e)^2	**48**

Source: Field Survey (2022)

According to Kamangar and Islamic (2013), sampling is the process of selecting a statistically representative sample of individual from the population of interest. The sampling techniques that were used are purposive and simple random sampling for both the students and Mathematic teachers. Purposive sampling technique was used to select the 199 form two students from the four public senior high schools (Chemu senior high school, Tema Methodist day senior high school, Presbyterian senior high school, Tema and Our Lady of Mercy SHS). Creswell (2009) sated that purposive sampling is employed because of the special characteristics of the school in facilitating the research. In purposive sampling, the units of the sample are selected not by a random procedure, but they are intentionally picked for the study because of

their distinctive characteristics. In all four sampled schools the researcher noted that the form two students had a common characteristic of having a class above 40, so they were sampled as well as the forty-eight mathematics (48) teachers purposively. The forty-eight teachers were selected purposively as they were teachings large classes.

Again, simple random sampling was used in selecting twenty (20) teachers from the forty-eight mathematics teachers and interviewed. Simple random sampling involves the selection of respondents in such a way that every person in the population has the same probability of being selected for the study and the individual does not affect selection of any other individual. (Johnson & Christensen, 2004). Each mathematics teacher from the forty-eight teachers had the same probability of being selected to be interviewed. Hence the use of simple random sampling for the twenty mathematics teachers.

3.5 Data Collection Instruments

In attempt to elicit relevant information for the study, the researcher employed questionnaire and interview guide as data collection instruments. The instruments which were developed in line with the literature review are presented in the sections that follow.

3.5.1 Questionnaires

Questionnaires are defined as text-based instruments that give survey participants a series of questions to answer or statements to respond either by indicating a response by marking a page or checking a box on paper or online for example (Brown, 2011). In this study, questionnaires were used to collect data from mathematics teachers and students in the sample. Closed -ended questionnaires

which were divided into parts were used. The first part had four-point Likert – type scale items on respondents‘ agreement to statements whose scores ranged from 1, Strongly Agree1, 2, Agree; to 4, Disagree. And the second part had five-point Likert-type scale items on respondents‘ frequency of observing or engaging in certain teaching practices whose scores ranged from 1, Never,2, Rarely; to 5 always.

The teacher‘s questionnaire was divided into three (3) main sections, Section A (items 1-10) elicited information on the challenges that mathematics teachers‘ encounter in teaching in teaching large classes in Tema central municipality .And Appendix C (item 1-15),elicited information on the challenges that students encounter in learning in large mathematics classes. Finally, Appendix D(item 1-9),was used to get information on mathematics teachers frequent use of effective large class instructional techniques. Section D (items 15-24) also elicited information on the frequent use of instructional techniques by mathematics teachers in large classes in Tema Central municipality.

3.5.2 Interview guide

An interview is a tool for particular questions to be proposed by the researcher who manages the line of questioning so as to acquire a certain response (Creswell, 2009). Interviewing is one of the most influential techniques employed in an effort to comprehend an individual‘s perspective, beliefs and values. As a result of its interactive nature, interviewing has many benefits over other kinds of data gathering methods such as questionnaires.

According to Bryman & Bell (2007), a semi-structured interview follows a list of concerns and questions that the researcher wishes to cover during a period. The

reason for choosing the semi-structured interview guide technique is basically due to the researcher's aim to encourage the interviewees to freely discuss their view on the challenges in large Mathematics classes. Semi-structured interviews provide the opportunity to regulate the order of the questions and the respondents have the possibility to expand their ideas and speak in a great detail about diverse subjects rather than relying only on concepts and questions defined in advance of the interview (Bryman & Bell, 2007).

Apart from the questionnaires, a semi-structured interview was used in the present study to have an insight into the teachers' perception on large classes in Tema Central municipality. A semi-structured interview was used as a qualitative instrument and steps were taken to ensure the data obtained are trustworthy by giving the interviewees the opportunity to check what the questions meant, and allowing enough time to respond in the case of complex questions; being flexible with the order of the questions asked and the topic discussed; probing and following up with questions to seek clarification or further explanations. Twenty (20) Mathematics teachers out of the 48 teachers were selected and interviewed to give the researcher more information on mathematics teacher's perspective of large classes in Tema Central municipality. The semi-structured guide can be found in Appendix B.

3.6 Pilot-Testing of Instruments

Bryman and Bell (2007), suggested a need to conduct a pilot study before the actual study in order to ensure that all the research instruments as a whole function well. Piloting was done before the actual study was carried out in Tema Central municipality. This was done for the purpose of clarity of the questionnaires. Other items which were found to elicit similar responses were eliminated or

reconstructed. This enabled the researcher to do the necessary changes before administering the final instruments. Piloting was done in Kpone Senior High school, form two Home Economics classes as they had similar characteristics with the target population. The piloting was done to enable the researcher to discover any weakness in the instrument, check clarity of the questions and also make needed corrections to allow the research to be done free from flaws.

3.7 Validity and Reliability of the Instruments

The validity of a test instrument is the extent to which the items in an instrument measure what it is set to measure. Validity is the exactness and precision of deductions based on the finding from the research (Mugenda & Mugenda, 2003). If a test does not serve its intended function well, then it is not valid. The validity of the instruments was carried out to check the correctness of the data collection instruments during the pilot study. These checks the appropriateness of the data collection instruments thus the questionnaires and the interview guide. To determine the degree to which the Instrument used for the study would measure accurately what it is to measure, content validity approaches was be used. Both instruments were given to a research supervisor. Any elements of ambiguity in the instruments were corrected before the pilot test.

The instruments were given to other equally competent assessment experts to assess the contents and items included in the questionnaires and the interview guide as well. The aim was to review any ambiguities, threatening items and other problems which needed to be solved before trying out the instrument. Their constructive and informative responses were used to improve the instruments and produce the final form which was used for the study.

A reliability test was carried out with the purpose of testing the consistency of the research instruments so that the research instruments were improved by revising or deleting items. To determine the reliability of the instrument the pilot study was conducted. Piloting determines whether questions and directions are clear to respondents /subjects and whether they understand what is required from them. Piloting is also done to determine the feasibility of using a particular research instrument in a major study. It provides an opportunity to try out the instruments for completion of the instruments, especially if it is being used for the first time. Piloting entails a trail administration of a newly developed instrument in order to identify flaws and requirements (Shilubane, 2010).

3.8 Ethical Considerations and Data Collection Procedure

Resnik (2020) defined ethics in research as the discipline that studies standards of conduct such as philosophy, theology, law, psychology or sociology. In other words, it is a method, procedure or perspective for deciding how to act and for analysing complex problems and issues. Protection of participants and their response were thus assured by obtaining informed consent, protecting privacy and ensuring confidentiality. To ensure this, the participants were given code names in order to prevent the exposure of their identities. They also thoroughly briefed about the study, the purpose and the possible benefits. The researcher permitted participants to freely withdraw or leave at any time if they deem it fit. Also, as a way of preventing plagiarism, all ideas, writing, drawing and other documents or intellectual property of other people were dully referenced.

In conducting research, Creswell (2008) instructed researchers to seek or obtain permission from the authorities in charge of the site of the study because it involves

a prolonged and extensive data collection. Hence a consent letter was attached to the introductory letter which was dully signed by the Head of the Mathematics Education Department at University of Education, Winneba. The introductory letter is presented in Appendix E. The letter was given to the Director of the Tema Central Education service to enable the researcher collect data on the total population of students and teachers in the municipality. The letter was duly accepted and the data on the teachers and students was provided by the Tema Metro office which enabled the researcher to get information on the population for study.

Also, an introductory letter from the Mathematics Education Department of University of Education, Winneba was given to the heads of the heads of the three sampled schools with a consent letter attacked to it. The heads of the three schools willingly agreed to the request and allowed the researcher to conduct the research in the schools. A date was then fixed after the permission was granted by the heads of the three sampled schools. The collection of data took four weeks.

The data was in the form of responses from questionnaires and interview. The data collection on the students started with the researcher administering the questionnaires in each school which took two weeks to outline the challenges students‘ encounter in large mathematics classes. The sampled 48 mathematics teachers were then given the questionnaires on the challenges in teaching large mathematics classes which also took two weeks. Twenty mathematics teachers out of the 48 were then interviewed. During the interview, the researcher assured interviewees of confidentiality, trustworthiness of the data including transferability, confirmability and dependability. Lincoln and Guba (1985) use the terms credibility, transferability, dependability and confirmability to group various

procedures together in qualitative research. They established that trustworthiness of research and its findings are the central issues in positive ideals of validity and reliability.

Credibility establishes that the representation constructed through research is indeed valid and believable and not to just assume that there is a value of truth. To ensure credibility, the study triangulation, prolonged engagement with data, negative case analysis, member checks and referential adequacy were all procedures that were used to increase the credibility of the qualitative studies. This helped in making the findings of the study accurate.

Transferability measures whether or not to what extent the study's results are applicable within other contexts, circumstances and settings (Lincoln and Guba 1985). This was ensured in this research by the researcher describing the participates, the site for the research and the methods of collection of data. Transferability was ensured in the study so that the behaviour and experiences through the interview can become meaningful to an outsider. Also, as the district is characterised by mathematics teachers who teach large classes, the participants for the study were described as the results can be applicable to other parts of the district where mathematics teachers teach large classes. Also, the students who were used for the study were described as students from large classes which can also mean the results from the study can be applied to other students in large classes in Category B and C schools in other parts of Ghana.

Dependability involves tracking the precise methods used to collect data, analysis and interpretation so that the study would theoretically be replicated by other researchers and generate consistent results (Lincoln and Guba 1985). This was

achieved by the researcher selecting some M.Phil. in Mathematics Education students to do an inquiry audit on the interview guide.

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. It is concerned with establishing the interpretations of the findings are derived from participants‘ responses in the data. To ensure this, the researcher described the data analysis processes used in order to provide a rationale for the decisions arrived at from the participants‘ responses.

3.9 Data Analysis Procedure

Thematic analysis was chosen as the method of analysis for the qualitative part of the study. Thematic analysis is used to generate themes which capture a phenomenon which are then explained (Ryan & Bernard, 2000). It has been argued that thematic analysis provides the basis of many qualitative analyses (Ryan & Bernard, 2000). Thematic analysis was applicable for the qualitative part of the study as it aimed at drawing out of themes on teachers‘ perspective of large mathematics classes. The interview was again recorded by a smart phone and analysed and also verbatim quotations were used to support the discussions. Again, data collected for the quantitative part was analysed using descriptive statistics including frequency tables, standard deviation, minimum and maximum scores, and measures of central tendency. The Statistical Package for the Social Science (SPSS) for Windows (2010) was the computer program used for the analyses of the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

The purpose of this research was to examine senior high students and teachers challenges in learning and teaching in large mathematics classes as well as the teacher‘s frequent use of effective instructional large class techniques. Data was collected using questionnaire and interview guide. The data obtained were organized and presented using descriptive statistics including frequency tables, standard deviation, minimum and maximum scores, and measures of central tendency. The results are presented and discussed in this chapter according to the research questions, which are:

1. What challenges do mathematics teachers‘ encounter in teaching in large classes in senior high schools in Tema Central municipality?
2. What challenges do senior high school students encounter in learning in large mathematics classes in Tema Central municipality?
3. How frequently do mathematics teachers use, effective large class instructional techniques in Tema central municipality?

4.1 Demographic Characteristics of Participants

This section described the participants in this study with respect to their gender distribution, age distribution, and level of education, status distribution and the years of experience. A summary of the characteristics of the students and teachers respectively are presented in the Table 4.1.

Table 4.1: Demographic Characteristics of the Teachers

Variables	Frequency(N=48)	Percentage
Gender		
Male	44	91
Female	4	8
Age		
25-30 years	8	17
31-35 years	13	27
36-40 years	21	44
41-50 years	4	8
51-55 years	2	4
Highest qualification in mathematics		
Diploma	3	6
Bachelor's Degree	36	75
Master's Degree	9	19
Period of Teaching Mathematic		
1-5 years	15	31
6-10years	**33**	**69**

Source: Survey data, 2022

From Table 4.1 above, it is evident that most of the teachers were males (44) as compared to females (4). The data also showed that a majority of the teachers were within the age category of 31-35 years (13) and 36-40 years (21). Thus, a majority of the teachers were in the category of full age and strength. From the Table, it is also evident that most of the teachers had bachelor's degree in Mathematics, with 36(75%) of the respondents. All the teachers perceived their class to be very large and, in some cases, there were more classes in other subjects compared to Mathematics. Table 4.2 presents the demographic data of the respondents.

Table 4.2: Demographic Characteristics of the Students

Variables	Frequency(N=199)	Percentage (100%)
Gender		
Male	87	44
Female	112	57
Age		**1**
10-14 years	7	4.0
15-19 years	150	73
20-24 years	40	21
25-29 years	2	1.0
Course of Study		**43**
General Arts	65	33
Home Economics	75	38
Visual Arts	59	30

Source: Survey data, 2022

From Table 4.2, it was clear that most of the students were within the age range of 15 to 19 years (150). Besides, the data also showed that a majority of the students were studying Business, Home Economics and General Arts. The students did indicate that on the average there are 62 students in each class and this possess a major challenge for the study of mathematics in the school. The 48 sampled mathematics teachers of the selected schools gave details of the number of classes in both core and elective mathematics classes. From Table 4.3 and 4.4, all four schools had more classes for core mathematics than elective mathematics. Tables 4.3 and 4.4 show the of number of classes in core mathematics classes.

Table 4.3: Distribution of Number of Classes in Core Mathematics Class

SCHOOL	SHS 1	SHS 2	SHS 3	TOTAL
Chemu SHS	13	12	17	42
Tema Methodist Day	16	8	8	32
Presbyterian SHS, Tema.	11	11	11	33
Our Lady of Mercy (Olams).	10	12	13	35

Source: Survey data, 2022

Table 4.4: Number of Students in Elective Mathematics Class

SCHOOL	SHS1	SHS 2	SHS3	TOTAL
Chemu SHS	7	6	9	22
Tema Methodist Day	2	2	2	6
Presbyterian SHS, Tema	4	4	3	11
Our Lady of Mercy (OLAMS)	5	4	4	13

Source: Survey data, 2022

4.2 What challenges do mathematics teachers' encounter in teaching in large classes in senior high schools in Tema Central municipality? (Research Question 1)

The first research objective sought to determine mathematic teachers' challenges in teaching in large classes in Tema Central municipality. In answering the question on the teachers' challenges on large mathematics classes, forty-eight (48) mathematics teachers were given questionnaire out of which twenty (20) were interviewed to throw more light on the challenges the teachers encountered. The questionnaire formed the quantitative part of study. Also, the interview formed the qualitative aspect of the study. Twenty (20) Mathematics teachers, making up of 17 males and 3 females were randomly selected and interviewed on their challenges in teaching in large mathematics classes.

During the interview, the teachers were asked to state the average class-size they teach in core mathematics in their schools. The responses indicate a teacher's school average class-size of 38 as the least and a teacher's school average class-size of 82 as the highest. Also, the responses indicated that all the mathematics teachers in the Tema Central Municipality considered a large class as one with a class size that exceeds 40 students. They added, they think so, because it is a GES policy that students should not exceed 40:1.

Table 4.5 shows a summary of the average number of students in their core mathematics classes as reported from the interview responses.

Table 4.5: Distribution of Average Students in Core Mathematics Class as Reported by Teachers

Class size < 40	1	5
40 ≤ Class size ≤ 55	12	60
55 < Class size ≤ 70	5	25
Class size > 70	2	10
Total	**20**	**100%**

Source: Survey data, 2022

Table 5 shows that out of the 20 teachers interviewed, only one mentioned having an average of not more than 40 students in his school, whiles as many as 12 (i.e., 60%) of teachers stated they had an average of students from 40 to 55 students. Also, five (i.e., 25%) of the teachers said they had an average of students from 56 to 70. Surprisingly, only two teachers said their average class size was 82, that is, above 70. The findings on the average number of students were in line with the findings of Ananga and Tamanja (2017), who observed that Greater-Accra was the third highest region with regard to large-class sizes in Ghana with an average class size of 67 students.

As stated in the literature review, Andi and Arante (2015) posited that a class composing of 30 students is considered a normal class and if it exceeds that number, then such a class can be classified as large class. Benbow et al (2007) also termed a class to be large when the Student-Teacher Ratio (STR) exceeds 40:1. Ministry of Education, Ghana also asserted to the fact the STR for senior high schools is 40:1. With 60% of the interviewed teachers having an average class size

of between 40 and 56 students, and 25% having an average class size of between 50 and 71 students, it can be argued that over 90% of mathematics teachers in the Tema Central Municipality teach in schools whose STR exceed the Ministry of Education's STR quota of 40:1. It can, therefore, be concluded that the majority mathematics teachers in the municipality are teaching large classes in core mathematics.

It must be noted that when asked if teachers in Tema Central had large mathematics classes, all 20 respondents responded yes as they were all teaching a class above 50 students. They further outlined that other mathematics teachers and even other core subject teachers were also teaching large classes which was a problem to all three sampled schools. For example, in Chemu senior high school, two Science teachers were made to help the mathematics teachers due to the work load as a result of large classes. The work load of large classes on Mathematics teachers in Tema Central was a common response from all the teachers that were interviewed. Most of the teachers suggested that the large classes needed to be divided and more teachers employed. All of the teachers mentioned that the school requires an additional math teacher and an extra class. One of the respondents noted that:

> *"I think all the classes should be reduced; it is too much for us"*

Another respondent also mentioned that:

> *"It is a difficult situation here, for me all the classes should be halved, and then more classrooms made for the remaining half of the students because the current situation we are going through is too much for us we cannot handle it"*

Planning was another challenge that mathematics teachers encountered in Tema central municipality. When asked how planning was done in large classes, one

teacher responded:

> *—Iuse mixed ability group teaching, where students are mixed from poor average and good, in a group to teach each other".*

It was alluded by another teacher that:

> *—For me I use teaching techniques which employ students' participation such as group work and questions."*

Another corroborated that:

> *"I try not to set too many objectives. Also, I use lecture method and follow up with solving of examples. "And again, I give students projects to get them involved in the class."*

When as if class size was associated with the quality of teaching, curriculum coverage and pedagogical innovation, all the 10 teachers responded yes., Some teachers explained as follows;

> *—One cannot easily cover the curriculum with large class since much time is spent on completing or achieving objectives*."
>
> *"Not all students are able to grasp the lesson hence I'm unable to use the time given to attend to all especially the weak ones in the bid to cover the curriculum which affects my way of teaching".*
>
> *"The quality of my teaching is affected because I sometimes use most of the time that need to be spent in teaching in handling distractions in the classroom such as noise makers and even truant students. This makes it difficult for me to cover the syllabus which I think affects my teaching in a way."*

Again, the data from the interview from the respondents showed that large classes affected students' academic performances in Mathematics. Among some of the responses are stated below with names of teachers coded.

Teacher A:

> *"Some of the students do not come to school which brings truancy and some do not part take in exercises which affects their academic performance. Because spacing is a problem it becomes difficult for me to go round and check the work students are doing because they are too many and can't attend to everyone."*

Teacher B:

> *"Yes, large Mathematics classes affect students' academic performances as some students are slow learners and need time to pick up certain concepts, so a smaller class size can help such students in attaining a academic performance."*

Teacher C:

> *"With large class, the teacher is not able to concentrate fully on promising students hence affecting their progress. Marking of exercise in large class is also difficult hence I am unable to give enough exercise to aid academic work."*

Teacher D:

> *"Smaller classes are characterized by students who pay attention and are focused. Adequate exercises can be given, marked and evaluated which improves on students' performances, but large classes make it difficult."*

With regards to the Ministry of Education's official's role in helping teachers to become better for large classes, the, teachers outlined that:

> *"Through workshops to resource and empower teachers will go a long way to helping teachers to cope with the situation of large classes".*

> *"By providing adequate infrastructure and necessary amenities such as classroom tables and chairs for the classes to be divided.*

> *"By proper supervision and monitoring by the officials in these large classes. And also, more classrooms should be created and more teachers employed to reduce the class size."*

As stated in the literature review, Andi and Arante (2015) posited that a class composing of 30 students is considered a normal class and if it exceeds that number, then such a class can be classified as large class. Benbow et al (2007) also termed a class to be large when the Student -Teacher Ratio (STR) exceeds 40:1. Ministry of Education, Ghana also asserted to the fact the STR for senior high schools is 40:1. With 60% of the interviewed teachers having an average number of 55 students in a class, and 25% having an average of 68 students in a class, it can be

concluded that Mathematics teachers in Tema central municipality has a STR which exceeds 40:1, thus it can be concluded that mathematics teachers in Tema central are teaching large classes.

The findings are consistence with the findings of Ananga & Tamanja (2017) in their article managing the effect of large size, quality education in Ghana. The findings from their report showed that Mathematics teachers had challenges in large classes. Among such challenges were the implementation of the curriculum, the method of teaching developed in the classroom, planning and giving feedback. Majority of teachers (93%) from their findings revealed that large class size affected their quality of teaching which also affected the academic performances of students.

Also, Ndethiu et al (2017) in their study on Kenya Secondary Teachers and Principals' perspective and Strategies on Teaching and learning with large classes, in their findings outlined that teaching large classes had negative impact on teaching and learning. Majority of the teachers from their findings outlined that students' performances were affected by large classes. Also, the teachers in Kenya used demonstrations, pair or group work and question and answers as some strategies used in large classes. With these strategies a lot of teachers in their study mentioned they showed a lot of confidence in large classes with the use of large classes strategies such as pair learning, demonstrations among other.

The study employed the use of frequency, mean and study deviation to analyse the results obtained from the questionnaires. The result has been summarized in Table 4.6.

Table 4.6: Challenges Teachers Encounter in Large Mathematics Classes

Statements	Mean	Std. Dev.
a) Increase stress on teachers	4.98	0.16
b) Ineffective students' control	4.93	0.21
c) Class size affects students' academic performance.	4.89	0.43
d) Poor classroom management resulting in noise making	4.76	0.02
e) Difficulty in coverage of the curriculum	4.73	0.59
f) Difficulty in proving timely feedback to students.	4.05	0.25
g) Student are less attentive in class.	4.03	0.38
h) Student show more disruptive behaviour	3.83	0.51
i) Poor planning and assessment	2.08	0.04

Source: Field Data, 2022

It is evident in Table 4.6 that due to the large class sizes, the teachers faced issues with poor classroom management resulting in noise making (Mean = 4.76, S. D= 0.02). The data also revealed that issues pertaining to ineffective student control became a major problem (Mean = 4.93, S. D= 0.21). Again, the data showed that the teachers agreed that Class size affects students' academic performance (Mean = 4.99, S. D= 0.43). These challenges were also outlined by the teachers in the qualitative data that management in large classes is poor due to noise making by students and also difficulty in giving students individual as well as adequate attention. As a result of these challenges the teachers emphasized through the qualitative data that students' academic performance in mathematics was affected as a result of the challenges. It can therefore be concluded from Table 4.6 that the three topmost issues the students agreed with about large class sizes were issues of increasing stress on teachers, difficulties in students' control and class size affects students' academic performance, which had mean ratings of 4.98, 4.93 and 4.89 respectively.

These findings corroborate the findings of Bryman and Bell (2007) who revealed that most difficult issues to deal with when it comes to large class size has got to do with the fact that there is very little class control and this is more often than not coupled with issues of increase of stress on the part of the teacher.

The study also sought to determine the challenges students encounter in large mathematics classes. The study employed the use of mean and standard deviation to analyse this objective. The results have been summarized in Table 4.7:

4.3 What challenges do senior high school students encounter in learning in large mathematics classes in Tema Central municipality? (Research question 2)

Table 4.7: Challenges Students Encounter in Large Mathematics classes

Statements	Mean	Std. Dev.
a. There are more distractions by students in large classes	4.99	0.73
b. There is lot of noise in large classes which makes it difficult to understand lessons.	4.99	0.43
c. Teachers spend more time controlling students rather than teaching.	4.91	0.26
d. There is limited physical space in large classes.	4.56	0.18
e. Large class increase the time teacher spends on handling non-instructional activities.	4.19	0.43
f. Students absent themselves from large classes more.	3.91	0.17
g. There is difficulty knowing the names of students.	3.85	0.25
h. Students are less attentive in large classes	3.83	0.51
i. Difficulty in giving more attention to individual students in large class.	3.46	0.27

Source: Field Data, 2022

Table 4.7 shows that the students agreed tremendously that they were faced with issues of more distractions (Mean = 4.99, S. D= 0.73). The data also revealed that issues pertaining to lot of noise in large classes which makes it difficult for learners to understand lessons was a major problem (Mean = 4.99, S. D= 0.43). It is also evident that the students unanimously agreed that mathematics teachers spent more time controlling students rather than teaching (Mean = 4.91, S. D= 0.26). The data also showed that there is difficulty on the part of the teacher to know the names of students (Mean = 3.85, S. D=0.25). The data also showed that there is difficulty on the part of teachers to give more attention to individual students in large class (Mean = 3.46, S. D= 0.27). It can therefore be concluded from Table 4.7 that the three topmost issues encountered by students are, more distractions students in large classes, lot of noise which makes it difficult for learners to understand lessons, and teachers spending more time controlling students rather than teaching, which had mean ratings of 4.99, 4.99 and 4.91 respectively. Both the teachers and students agreed teaching large classes was stressful as teachers spend more time controlling students rather than teaching.

Overcrowding in schools is a problem that has been noted in many different parts of the world. In the United States (Hachem & Mayor, 2019), the United Kingdom and Ireland (Donnelly, 2019), and China, big class sizes are a major issue for schools and educators (Leiyang, 2018). Moreover, certain African nations, like Nigeria, Kenya, and South Africa, have classrooms that are too crowded to teach effectively (Mutisya, 2020). In addition to the FCUBE, school meals, and Free Senior High School, Ghana is seeing record levels of congestion (Kweitsu, 2019; Ministry for Education, Ghana, 2018). Overcrowded classrooms are a problem for educators everywhere, including in Ghana (UNESCO Institute for Statistics, 2018).

It has been shown by Chepkonga (2017) that the reliability of school facilities has an indirect effect on teaching and learning. Class size, teaching strategies, teacher knowledge and skills, the classroom environment, and the curriculum being taught all have an impact on students' academic and social development. There is a correlation between class size and student achievement, as stated by Shamaki (2015), who found this correlation by surveying literature from several developing nations in Africa, especially from Mozambique, Uganda, Zimbabwe, and Nigeria (Mutisya, 2020).

Siperto (2017) reports that overcrowding in Mwanza schools is a growing and persistent issue that hinders effective instruction. Based on her findings, Siperto concludes that there are too many students for the classrooms to be functional. Siperto discovered that the ratio of teachers to students in all of the schools he looked at was between 1:80 and 1:90. Teachers were struggling to discover ways to execute effective teaching strategies in this environment. The researcher also observed that teachers were so busy that they couldn't even get up and wander around the classroom.

In a similar vein to Siperto's work in Mwanza, Mutisya (2020) has published research in Kenya based on the same kind of experience. Overcrowded classrooms were the result of Kenya's free primary education, making it difficult for teachers to implement the learner-centered approach. Mutisya said that there were too many children in classrooms despite the fact that the government mandated maximum class sizes of 45. As a result, it remains a barrier to both teacher-student and student-student involvement in the classroom, which has a negative impact on students' ability to learn. Classroom overcrowding is a global problem that makes

instruction more difficult (Hachem & Mayor, 2019). Large class sizes, according to Yelkpieri et al. (2012), are one of the educational challenges faced by developing countries. Despite the fact that Hornsby, Osman, and De Matos-Ala (2013) argue that diversity in student characteristics (such as ability, age, background, and experience) and instructor characteristics (such as experience, skills, and competencies) should be taken into account when classifying a class as "large," ultimately, these do not matter.

Marais (2016) argues that a huge class's primary issue is that the teacher simply cannot provide each student enough individual attention. This means that only the most confident and outgoing pupils will volunteer answers when questions are called for. The second issue arises from people's varying levels of familiarity with the topic at hand (Hayes, 2016). Heterogeneous courses are especially challenging to manage when they are large in size. One source of the issue was a lack of classroom space that was both suitable and well-equipped for using technology to enhance learning (Marais, 2016).

4.4 How often do mathematics teachers use effective large class instructional techniques in Tema Central Municipality? (Research question 3)

The study further sought to determine the instructional techniques used in large classes. A summary of the teachers‘ ratings of their frequency in using the instructional techniques that are effective in large classes has been displayed in Table 4.8.

Table 4.8: Mathematics Teachers' Frequency of Using Large Classes Instructional Techniques

Teachers' large classes instructional techniques	Mean	S.D
a. Use different instructional techniques including activity and inquiry-based instruction in large classes	4.93	0.08
b. Share power in the classroom by allowing students to provide meaningful input in making decisions about classroom practices, curriculum, and assessment	4.82	0.71
c. Use questioning to engage student participation in large class	3.92	0.39
d. Engage students in conversation about real-world problems and how mathematics can be used to examine them	3.71	0.31
e. Use formative assessment (formal and informal assessment procedure during teaching and learning).	2.71	0.28
f. Create a friendly atmosphere to encourage students to participate in class.	1.99	0.22
g. Use pair discussion strategy more than wide class teaching.	1.94	0.07
h. Make use of demonstrations	1.83	0.18
i. Attract learners' attention	1.42	0.47
j. Use of visual representations that enable my students to get involved in lessons	1.01	0.03

Source: Field Data, 2022

Due to the challenges faced in handling large classes, the mathematics teachers in the sample agreed to using typically, large-class instructional techniques (see Table 4.8) including (i) activity and inquiry-based instruction (mean frequency of use 4.93, S.D.= 0.08), (ii) share power in the classroom by allowing students to provide meaningful input in making decisions about classroom practices, curriculum, and assessment (mean frequency of use 4.82, S.D.= 0.71), and (iii) vary questioning techniques to engage student participation (mean frequency of use 3.92, S.D.= 0.39). Besides, it was revealed from the data that teachers engage students in conversation

about real-world problems and how mathematics can be used to examine them (Mean = 3.71, S.D = 0.31). The use of these instructional techniques was mentioned through the qualitative data obtained from the interviews. The teachers mentioned the use of teaching techniques which employed students‘ participation such as group work and use of questions.

However, the use of visual representations that can enable students to get involved in lessons received the least rating in terms of frequency of use (mean frequency of use = 1.01, S.D = 0.03). When asked why there is little or no use of visual representations by teachers, during the interviews, they explained that the Ghanaian educational system does not supply or support teachers to develop visual representations at the secondary school level.

The study revealed a significant positive relationship between large class size and the use of instructional techniques in teaching. Intelligible tools now aid instructors in the process of information transmission, a significant leap from the days of verbal presentation and chalk on the chalkboard (Bûsljeta, 2013). A teacher uses instructional approaches as one of many strategies, plans, and activities at their disposal to bring about this end. Koko and Nkpolu-Oroworuko (2016) defined instructional approaches as methods through which instructors might improve their students' engagement with and comprehension of course material. Teaching methods that effectively combine students' learning experiences make subject matter more accessible and engaging, as noted by Boadu (2015).

Good or successful teaching cannot emerge without thorough planning and the strategic application of necessary instructional resources (Koko & Nkpolu-Oroworuko, 2016). Instructional methods can also be utilized to promote educational

interactions. In addition to aiding retention, this practice can help pupils internalize easily digestible chunks of knowledge (Koko & Nkpolu-Oroworuko, 2016). Teaching aids and procedures that foster effective instruction are collectively referred to as instructional approaches (Koko& Nkpolu-Oroworuko, 2015). One of the most crucial roles that teaching methods play is in helping students learn and progress toward their educational goals (Koko & Nkpolu-Oroworuko, 2016). On the flip side, negative outcomes for students might result from teachers employing ineffective pedagogical strategies.

Bûsljeta (2013) highlighted various strategies for teaching big courses, including focusing on the students' ability to comprehend the material, decode it, organize it, and synthesis it, as well as the students' capacity for rational thought and discourse. However, it is important to note that successful implementation of instructional strategies is crucial if these objectives are to be achieved.

Bûsljeta (2013) outlined three primary steps that educators should take to guarantee the efficiency of instructional technique use: selection and first evaluation; presentation and interpretation; and final evaluation. It's important to emphasis that the skills required at each step are not duplicative of one another. Al-Makahleh (2011) argues that the most important step in ensuring that instructors effectively employ instructional methods is for them to take into account the elements that must be considered while choosing instructional approaches. This indicated that the efficiency of the chosen instructional methods would be affected if teachers took into account relevant aspects.

Agufuna and Mukwa (2018) aimed to identify the criteria instructors use to choose instructional strategies in their study titled "evaluation of the criteria used by

teachers in selecting learning materials." One hundred sixty-eight secondary school teachers were selected by stratified random sampling. Analysis of the data was performed using descriptive statistics. Instructors' instructional material decisions were analysed to determine the impact of such factors as lesson goals, lesson subject, syllabus coverage, students' ages, available class time, materials costs, class number, class level, and teachers' readiness. Ninety percent of educators surveyed agreed that lesson goals influenced their choices on which educational materials to use in class.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Overview

This chapter consist of the summary of the study, the key findings, conclusions and recommendations based on the findings.

5.2 Summary of the Study

The study investigated challenges in teaching and learning in large mathematics classes and teachers use of effective instructional techniques in teaching in Tema Central Municipality. The explanatory sequential method design was used. This design starts with the collection and analysis of quantitative data, then followed by the subsequent collection and analysis of qualitative data. This shows that the study employed both quantitative and qualitative approach through questionnaires for the quantitative and interview for the qualitative. In all 199 students and 48 mathematics teachers from four sampled schools were purposively sampled. This helped the researcher to administer the questionnaires which helped in collecting data on challenges that teachers' and students' encounter in large classes as well as the use of effective instructional techniques by the teachers.

Quantitative data analysis was performed using Statistical Products and Service Solution (SPSS) for Windows (2010). Descriptive statistics such as frequency, mean, percentage and standard deviations were used to describe the challenges teachers' and students' encounter in large mathematics classes, as well as the instructional techniques teachers use. Thematic analysis as well as verbatim quotations was used to analyse the qualitative data which threw more light on the challenge the mathematics teachers encounter in teaching large classes in Tema

Central municipality.

5.3 Key Findings of the Study

The research Question One was intended to investigate the challenges mathematics teachers encounter in large mathematics classes in Tema Central Municipality. The key findings from the data showed that the least and highest school's average class-sizes reported by the teachers were 38 and 82 respectively. As such most of the teachers in the municipality considered their mathematics classes as large as one with class size that exceeds 40 students is considered large according to GES policy. With 60% of the interviewed teachers having an average class size of between 40 and 56 students, and 25% having an average class size of between 50-71 students, it can be argued that other 90% of mathematics teachers in the Tema Central Municipality teaching in schools whose STR exceeds the Ministry of Education's STR quota of 40 :1. The findings again showed that the three topmost issues the teachers agreed with about large class sizes were issues of increasing stress on teachers, difficulties in students' control, and class size affects students' academic performance, which had mean ratings of 4.98, 4.93 and 4.89 respectively. The qualitative data obtained from the interviews indicated that teachers encounter such challenges in large classes as poor classroom management resulting in noise making, difficulty in giving students individual as well as adequate attention which affected students' academic performance.

The second research question was on challenges that students encounter in learning in large mathematics classes. The three topmost issues the students agreed with about large class sizes were issues of encountering more distractions by unserious students in large classes, lot of noise which makes it difficult for learners to understand

lessons, and spending more time controlling students rather than teaching, which had mean ratings of 4.99, 4.99 and 4.91 respectively.

The third research question sought to find how often mathematics teachers use effective large class instructional techniques in Tema Central Municipality. The key findings showed that mathematics teachers in the sample agreed to using typically, large-class instructional techniques including (i) activity and inquiry-based instruction (mean frequency of use 4.93), (ii) share power in the classroom by allowing students to provide meaningful input in making decisions about classroom practices, curriculum, and assessment (mean frequency of use 4.82), and (iii) vary questioning techniques to engage student participation (mean frequency of use 3.92). The qualitative data obtained from the interviews also indicated that Mathematics teachers in Tema Central Municipality employ the use teaching techniques such as group work and use of questions. The use of visual representations that can enable students to get involved in lessons received the least rating in terms of frequency of use (mean = 1.01, S.D = 0.03) and the teachers explained during the interviews that the Ghanaian educational system does not supply or support teachers to develop visual representations at the secondary school level.

5.4 Conclusion

From the findings it can be concluded that teachers in Tema Central Municipality are teaching large mathematics classes. More classrooms are needed in the senior high schools in Tema Central Municipality to enable reduce large Mathematics classes. GES as well as heads of schools for Tema Central Municipality should ensure that senior high schools‘ enrolment in Tema Central is done based on the required student to teacher ratio (1:40). Again, as a result of the large classes

teachers‘ and students‘ face challenges which affect teaching and learning thereby affecting students ‗academic performance in mathematics. There is the need therefore for Mathematics teachers to encourage active learning among students which will ensure that students are in charge of their own learning. This can help reduce the challenge of noise in large Mathematics classes by inattentive students and also improve students‘ ‗academic performance. From the findings, there is the need for Mathematics teachers to frequently use effective large class instructional techniques such as activity and inquiry-based instruction and also the use of questions to dealing with the challenges in teaching large Mathematics classes, there is the need for

5.5 Recommendations

Based on the findings of the study, the following recommendations have been made;

For Policy

- More classrooms should be built by the government as well as more Mathematics teachers employed by Ministry of Education to enable large classes to be reduced.
- GES and heads of schools should ensure that senior high schools‘ enrolment will be based on the required number of students as stated by GES (40 students in a class). This will enable the STR of 40:1 maintained.
- GES as well as heads of senior high schools should organize Mathematics teaching improvement programmes to give mathematics teachers better orientation on the use of effective instructional techniques in large classes in the various districts and municipalities.
- GES should ensure continuous monitoring in senior high schools in the use

of effective instructional techniques.

- The use of visual aids should be supplied and supported by Ministry of Education to aid in teaching large Mathematics classes.

For Teachers

- Senior high school teachers should attend workshops to be trained in the management of large classes.
- Mathematics teachers should set clear and consistent rules and regulations in large classes.
- Teachers should create a friendly atmosphere to encourage students to participate during lessons in large classes.
- Teachers should encourage active learning among students to help participate in large classes.
- Teachers should adopt and use frequently effective large class instructional techniques such as inquiry-based instruction and use of questions.

5.6 Suggestions for Further Research

The following are suggested for further research:

- ✓ The current study is limited in scope because it was based on only some selected senior high schools in Tema central municipality. To make the study more representative and the results generalized for the whole country, there is the need to replicate this study among populations, groups using larger geographic areas.
- ✓ Similar study should be conducted in other region using observation as a data collection tool as this study used interview and questionnaires for the data collection.

REFERENCES

Abe,T. O.& Gbenro, O. S. (2014).A comparison of Students' Attitudinal Variables towards Mathematics between private and public senior secondary schools. *Journal of Education Policy and Entrepreneurial Research, 1*(1), 32-39.

Ademola, E. O. (2014). Students' enrolment into tertiary institutions in Nigeria: The influence of the founder's reputation-A Case Study. Computing Information Systems Development, *Development Information & Allied Res. J. 5*(3), 55-82.

Adeoye, Y. (2013). The influence of school climate on teacher productivity and students' achievement. *Journal of Research in National Development, 8*(2), 15−18.

Adeyemi, T. O. (2018). The influence of class size on the quality of output in secondary schools, In Ekiti State in Nigeria. *American – Eurasian Journal of Scientific Research, 3*(1), 7–14.

Adolphus, T., (2011). "Problems of teaching and learning of geometry in secondary schools." *International Journal for Emerging Sciences, 1*(2), 143–152.

Agah, M. P. (2020). Challenges of Mathematics in Economic Development in the twenty-first century: Implications of tertiary education. *Journal of Education, Society and Behavioral Science, 33*(3), 20-25.

Agba, S. U. (2010). *Students' overpopulation and its effects on their academic performance in senior secondary school certificate examination in Obudu Local Government Area*. Unpublished B.Sc. Ed. project Owerri: Imo State University.

Agufuna, P. B., Too, J. K., & Mukwa, C. W. (2018). An assessment of the Criteria used by Teachers in Selecting Learning Resources for Language Instruction in Secondary Schools in Usain-Gishu Country, Kenya. *British Education Research Journal, 20*(5), 38-40.

AI-Jarf, R. (2006). Large student enrollment in EFL programs: Challenges and consequences. *Asian EFL Journal Quarterly, 8*(4), 8-34.

Akin, S., Yildirim, A., & Goodwin, A. L. (2015). Classroom management through the eyes of elementary teachers in Turkey: A phenomenological study. *Educational Sciences: Theory and Practice, 16*(3), 771-797.

Akinsola, M. K., & Olowojaiye, F. B. (2008). Teacher Instructional Methods and Student Attitudes towards Mathematics. *International Electronic Journal of Mathematics Education, 3*(1), 60-73.

Akoto-Baako, H. (2018). *Perceived Influence of large class size and psychological classroom environment on students' academic performance.* (Doctoral dissertation, University of Cape Coast).

Ali, H. H., & Jameel, H. T. (2016). Causes of poor performance in mathematics from teachers, parents and student's perspective. *Am Sci Res J Eng Technol Sci (Asrjets), 15*(1), 122–36.

Aliu, E (2015). *Class size and learning environment.* Ibadan: College Press.

Al-Jarf,R.,(2006).The effect of eLearning on teaching English as a foreign language to Saudi college students. *Education and Psychology Journal, 26,* 215-242.

Allen, D. & Tanner, K. (2005). Infusing active learning into the large-enrolment biology class: seven strategies, from the simple to complex. *Cell Biology Education, 4*, 262-268.

Al-Makahleh, A.A. (2011). The effect of direct instruction strategy on mathematics achievement of primary 4th and 5th grade students with learning difficulties. *International Education Studies, 4940*,199-205.

Amriyah, C. & Mahmudi, K. (2015). The correlation Between Discipline and Learning Achievement of Students at MINurul Amal, Meneng Building, Tulang Baway Regency. *Skilled Journal, 4*(1), 52.

Ananga, E. D, & Tamanja, E. M. J., (2017). *Managing the Effect of large class sizes on quality education in Ghana*. Education International Report.

Andrade, & G. J. Cizek, (Eds.). *Handbook of formative assessment* (pp. 344–351). New York, NJ: Routledge.

Andrade, H. L. (2013). *Summing up and moving forward: Key challenges and future directions for research and development in formative assessment*. New York: Routledge.

Andrews, T. L. (2015). *The use of goal setting and progress self-monitoring with formative assessment in community college to increase academic achievement and self-efficacy* (Doctoral dissertation, Temple University). ProOuest.

Anigbo, L. C. (2016). Factors affecting students' interest in mathematics in secondary schools in Enugu State. *International Journal of Education and Evaluation, 2*(1), 22- 28.

Aoumeur, H. (2017). The impact of class size on teaching and learning English as a foreign language: the case of the department of English at Abdel Hamid ibn badis university. *Arab World Research*, 349-361.

Arias, J., & Walker, D. (2004). Additional Evidence on the Relationship between Class Size and Student Performance. *Journal of Economic Education, 4*(3), 311-329.

Aslam, H. D., Sulerman, Q., Zulfigar, Z., Shafaat, M., & Sadiq, R. (2014). Analyzing the perceived effectiveness of Academic leadership in Schools. *International Journal of learning and Development, 4*(1), 71- 84.

Ayeni, G. & Olowe, M. O. (2016). The Implication of Large class size in the teaching and learning of business education in Tertiary Institution of business education in Ekiti State. *Journal of Education and Practise, 7*(34), 65.

Bacon, K., & Matthews, P. (2014). Inquiry-based learning with young learners: a Peirce-based model employed to critique a unit of inquiry on maps and mapping. *Irish Educational Studies, 33*(4), 351–365.

Bader, M., Burner, T., Hoem Iversen, S., & Varga, Z. (2019). Student perspectives on formative feedback as part of writing portfolios. *Assessment & Evaluation in Higher Education, 44*(7), 1017-1028.

Baranovskaya, T. (2017). Assessment and Evaluation Techniques. National Research University Higher School of Economics. *Journal of Language & Education, 4*(5), 30-38.

Barkley, E. F., Major, C. H., & Cross, K. P. (2014). *Collaborative learning techniques: A resource for college faculty*, (2nd Ed). San Francisco, CA: Jossey-Bass.

Benbow, J., A. Mizrachi, D. Oliver & L. Said-Moshiro, (2007). *Large classes in the developing world: What do we know and what can we do?* New York: American Institute for Research under the EQUIP1 LWA.

Bennett, R. E. (2014). Formative assessment: A critical review. *Assessment in Education: Principles, Policy & Practice, 18*(1), 5–25.

Benton, S. L. & Pallett, W. H. (2013). *Class size matters: Essay on importance of class size in higher education.* Retrieved from alkakdfmeojreoirjei

Blatchford, P. (2003). A systematic observational study of teachers' and pupils' behavior in large and small classes. *Learning and Instruction, 13*, 569-595.

Blatchford, P. (2011). The issue of class size for young children in schools: What can we learn from research? *Oxford Review of Education, 24*(5), 411-428.

Blatchford, P., Edmonds, S., & Martin, C. (2003b). Class size, pupil attentiveness and peer relations. *Journal of Educational Psychology, 73*(1), 15-36.

Blatchford, P., Russell, A., Bassett, P., Brown, P., & Martin, C. (2007). The effect of class size on the teaching of pupils aged 7-11 years. *School Effectiveness and School Improvement, 18*(2), 147-172.

Boadu, G. (2015). Effective teaching in history: The perspectives of history student- teachers. *International Journal of Humanities and Social Sciences, 3*(1), 38-51.

Booze M., Manoney M. (2001). The effect of class size on the long-run growth in reaching ability and early adult. Outcomes of the Christ Church, Health and Development Study, Department of Economics, Yele University.

Bosser U, Lundin M, Lindahl, M and Linder C, (2015). Challenges faced by teachers implementing socio-scientific issues as core elements in their classroom practices: *European Journal of Science and Mathematics Education, 3,* 2.

Brown, H. D. (2001). *Teaching by principles*. White Plains: Addison Wesley Longman, Inc.

Bryman, A., & Bell, E. (2007). *Business research methods*, (2nd Ed.). Oxford: Oxford University Press.

Budinski, K. G. (2014). *Preparing and Delivering Technical Presentations*. USA. ASTM International Press.

Bukoye, R. O. (2019). *Utilization of Instructional materials as tools for effective academic performance of students: Implications for counselling. A* paper presented at the 2nd Innovation and Creative Education and Teaching International Conference (ICETIC2018), Badajoz, Spain.

Burkman, J. R. (2002). Do I really have to ?Use acceptance of mandated technology. *European Journal of Information System ,114*-283-295.

Bûsljeta, R. (2013). Effective use of teaching and learning resources. *Czech polish Historical and pedagogical Journal, 5*(2).

Butler, J. & Griffin, L. (2010). *More Teaching Games for Understanding: Moving Globally*. USA: Champaign, Illinois.

Buyukkarci, K., & Sahinkarakas, S. (2021). The Impact of Formative Assessment on Students‘ Assessment Preferences. *The Reading Matrix: An International Online Journal, 21*(1).

Cakmak, M. (2009). The perceptions of student‘s teachers about the effect of class size with regard to effective teaching process. *The Qualitative Report ,14*(3), 395-408.

Carpenter, (2006). Effective teaching methods for large classes. *Journal of Family & Consumer Sciences Education. 24*(*2*), 13-23.

Cassady, L. (2014). *Visual materials enhance learning.* Retrieved from: http://www. ehow.com/info_8246564_visual-materials-enhance learning. Htm

Chepkonga, M. C. (2017). Influence of learning facilities on provision of quality education in early childhood development centers in Kenya. *International Journal of Education and Research, 5*(6), 15-26.

Collier-Meek, M. A., Johnson A. H., Sanetti, L. H. & Minami, T., (2019). Identifying critical components of classroom management implementation. *School of Psychology Review 48*(4), 348–361.

Collins, N. M. (2015). *The impact of assessment for learning: Benefits and barriers to student achievement* (Doctoral dissertation, Cardinal Stritch University). ProOuest.

Costley, K. C. (2014). *The Positive Effects of Technology on Teaching and Student Learning. Technical Report.* Arkansas Tech University.

Craig, J., Ault, M. & Niileksela, C. (2011). The Influence of Technology Rich Learning Environments: A Classroom-based Observational Study. In M. Koehler & P. Mishra(Eds). *Proceedings of Society for Information Technology& Teacher Education International Conference 2011* (pp. 4304-4311). Chesapeake, VA: AACE. CRDD (2010). *Mathematics Syllabus for Senior High Schools,* Ghana Education Service, Accra, Ghana.

Creswell, J. W. & Clark, P. (2011). *Designing and Conducting Mixed Method Research*. (2nd Ed), Sage Publications Angeles.

Creswell, J. W. (2008). *Research Design: qualitative, quantitative, and mixed methods approach* (2nd Ed.). London: Sage Publications.

Creswell, J. W. (2009). *Research Design: Qualitative, quantitative and mixed methods approach* (3rd Ed). Thousand Oaks, CA: Sage.

Creswell, J. W. (2012). *Educational research: Planning Conducting and evaluating quantitative and qualitative research* (4th Ed). Boston, MA: Pearson.

Cuseo, J. (2007). The empirical case against large class size: adverse effects on the teaching, learning and retention of first- year students. Journal *of Faculty Development ,21*, 5 -21.

Dalal, A.B.(2013).The effect of large class size on teaching and learning in Saudi secondary schools.*English Language Teaching*

Davidson, N., Major, C. H., & Michaelsen, L. K. (2014). Small-group learning in higher education— cooperative, collaborative, problem-based, and team-based learning: an introduction by the guest editors. *Journal on Excellence in College Teaching, 25*(3&4), 1-6.

Dharmadasa, K.H. and Gorrell,J.1988.*Sri Lanka teachers' description of stressful school events* ,Hammond ,LA: Southeastern Louisiana University .Unpublished manuscript.

Dimyati, R. & Mudjiono, I., (2013). *Learning and Learning.* Jakarta: Rineka Cipta, p.10.

Docherty, P. ,Harry, T. ,Forman R., Mckenzie, J. (2010). Extending the principles of intensive writing to large macroeconomics classes. *The Journal of Economics Education 41*(4),370-382.

Donnelly, K. (2019). *Cram school: Two-thirds of primary school pupils stuck in overcrowded classrooms.* Retrieved from https://www.independent.ie/irish- news/education/cram-school-two-thirds-ofprimary-school-pupils-stuck-in- overcrowded-classrooms-38316566.html.

Ehrenberg, R. G. Brewer, D. J., Gamoran, A., & Wilms, (2001). Class Size and Student Achievement. *Psychological Science in the Public Interest*, *2*(1), 1-30.

Eisenman, G., Edwars, S., Cushman, C. (2015). Bringing reality to classroom management in teacher education. *The Professional Educator, 39*(1), 1-11.

Enu, J. A., Agyeman, O. K., & Nkum, D. (2015). Factors influencing students' mathematics performance in some selected colleges of education in Ghana. *International Journal of Education Learning and Development, 3*(3), 68-74.

Erdogan, M., & Kurt, A. (2015). Science Direct A Review of Research on Classroom Management in Turkey. *Procedia-Social and Behavioral Sciences, 186*(2), 9– 14.

Erdogan,M.,Kursun, E., & Sisman, T.G. (2010). A qualitative study on classroom magagement and classroom discipline problems, reasons and solutions: A case of information technologies class. *Educational Science :Theory and Practice,10*(2),881-891.

Esmonde, I., (2017). *Ideas and Identities: Supporting Equity in Cooperative Mathematics Learning, 5*(1).

Faraz A. (2012). Class size: Effects on students' academic achievements and some Remedial measures. *Research in Educational, 87(*1), 95-98.

Felder, M. & Brent R. (2001).Effective strategies for cooperative learning. *Journal of Cooperation and Collaboration in College Teaching, 10*, 69-75.

Fink, A. (2010). *Conducting Research Literature Review: from the Internet to Paper* (3rd Ed). Sage Publications.

Finn, J. D., Pannozzo, G. M., & Achilles, C. M. (2003). The ―why's" of class size: student behavior in small classes. *Review of Educational Research, 73*(3), 321- 368.

Fisher, A., Exley, K., & Ciobanu, D. (2014). *Using technology to support learning and teaching.* London: Routledge, Taylor & Francis Group.

Fox, R. (2011). ―Constructivism Examined." *Oxford Review of Education, 27* (1), 23–35.

Fraenkel, J., & Wallen, N. E. (2000). *How to design and evaluate research in education* (2nd Ed.). New York: McGraw- Hill, Inc.

Fritz, A. Haase, V. G., & Rasanen, P. (2019). *International handbook of mathematics learning difficulties.* (Eds.).Cham, Switzerland: Spriger.

Garwood, J. D. & Vernon-Feagans, L., (2017). The family life project key investigators. Classroom management affects the literacy development of students with emotional and behavioral disorders. *Exceptional Children, 83* (2), 123–142.

Garwood, J. D., (2016). Classroom management for rural students with or at risk for emotional and behavioral disorders: A longitudinal study across early elementary school. *Humanities and Social Sciences, 76*(9).

Giridharan, K., & Raju, R., (2016). Impact of Teaching Strategies: Demonstration and Lecture Strategies and Impact of Teacher Effect on Academic Achievement in Engineering Education, *International Journal of Educational Sciences, 14*(3), 174-186.

Gordon, V. Habley, W. & Grites, T. (2008). *Academic Advising: A Comprehensive Handbook Jossey-Bass Higher and Adult Education.* National Academic Advising Association (U.S.): John Wiley and Sons.

Grabinger, R. S. & Dunlap, J. C., (1995). –Rich environments for active learning: a definition". *ALT-J, 3* (2), 5-34.

Granberg, C., Palm, T., & Palmberg, B. (2021). A case study of a formative assessment practice and the effects on students' self-regulated learning. *Studies in Educational Evaluation, 68* (100), 955.

Grant, S. G., Swan, K., & Lee, J (2017). *Inquiry-based practice in social studies education: Understanding the inquiry design model. New* York, NY: Routledge.

Grant, S. G., Swan, K., & Lee, J. (2017). *Inquiry-based practice in social studies education: Understanding the inquiry design model.* New York, NY: Routledge.

Graue, E., Hatch, K., Roa, K., & Oen, D., (2007). The wisdom of class size reduction. *American Educational Research Journal ,44*(3),670-700.

Greene, J. A., Copeland, D. Z., Deekens, V. M., & Yu, S. B. (2018). Beyond knowledge: Examining digital literacy's role in the acquisition of understanding in science. *Computers and Education, 117*(5), 141–159.

Guba, E., & Lincoln, Y. S. (1982). Epistemological and methodological bases of naturalistic inquiry. Educational *Communication and Technology Journal 30,* 233-52.

Hachem, H., & Mayor, P. (2019). *Overcrowding in schools: Why is it a huge Issue?* Retrieved from https://patch.com/michigan/dearborn/over crowding-schools- why-it-huge -issue.

Hamilton, C. (2014). *Communicating for Results: A Guide for Business and the Professions*. USA: Wadsworth Cengage Learning.

Handi, M. J., & Arante L.T., (2015). Barriers in teaching English in large classes: *voice of an Indonesian English Language teacher. African Perspectives of Research in Teaching & Learning, 5* (2), 221-262

Harfitt, G. (2012). An examination of teachers ̲perceptions and practice when teaching large and reduced-size classes: Do teachers really teach them in the same way? *Teaching and Teacher Education, 28*(1), 132-140.

Haron, H. N., Harun, H., Ali, R., Salim, K. R., & Hussain, N. H. (2015). Self regulated learning strategies between the performing and nonperforming students in statics. *Proceedings of 2014 International Conference on Interactive Collaborative Learning, ICL, 8*(3), 802–805.

Hattie, J. (2005). The paradox of reducing class size and improving learning outcomes. *International Journal of Educational Research, 43*(1), 387-425.

Hayes, U. (2016). Helping teachers to cope with large classes. *ELT Journal, S, 1*(7), 31-38.

Herron, J. (2010) Implementation of technology in an elementary mathematics lesson: The experiences of pre-service teachers at one university. *SRATE Journal, 19*(1).

Hess, N. (2001). *Teaching Large Multilevel Classes.* Cambridge: CUP.

Hoffman, G., L. (2016). *Pupil-teacher ratios and academic performance: An experimental analysis" Unpublished PhD.* Thesis, University of Kansas USA.

Horning, A. (2007). The Definitive Article on Class Size. *Journal of the Council of Writing Program Administrators*, *31*(1-2), 11-34.

Hornsby, D. J., & De Matos Ala, J., (2013). *Promoting student engagement and deep learning approaches in large classes.* In Hornsby, David, Osman, Ruksana, and De Matos Ala, Jacqueline (Eds). Large Class Pedagogy: Interdisciplinary Perspectives for Quality Higher Education. pp.71-88.

Jacob, O. A., Olawuyi, B. O. & Jacob, A. J. (2016). Relationship between class size and discipline of secondary school students in Yagba West of Kogi State, Nigeria. *Sky Journal of Educational Research*, *4*(1), 008-013.

Jarvis, T. (2007). *Class size and teacher effects on student achievement and dropout rates in university-level calculus.* Brigham Young University

Johnson, R. B., & Christensen, L. B. (2004). *Educational Research: Quantitative, Qualitative, and Mixed Approaches*. Boston, MA: Allyn and Bacon.

Joseph, G. (2013). *A Study on School Factors Influencing Students' Attitude Towards Learning Mathematics in the Community Secondary Schools in Tanzania: The case of Bukoba Municipal Council in Kagera Region.* (Masters dissertation). Retrieved from http://repository.out.ac.tz/919/.

Kamangar, F., & Islami, F. (2013). Sample size calculation for epidemiologic studies: principles and methods. *Archives of Iranian Medicine (AIM)*, *1*, 16(5).

Kerubo, I. P. (2016). *African Indigenous Education as Practiced by the Maasai of Kenya*. A research project presented in partial fulfillment for the award of Master Degree in History of Education. University of Nairobi. Kenya. Retrivedbfromnerepository.uonbi.ac.ke/.../Kerubo_ African %20Indigenous%2 0Education.

Khan, M., Zaman, T. U., & Saeed, A. (2020). Formative Assessment Practices of Physics Teachers in Pakistan. *Journal Pendidikan Fisika Indonesia, 16*(2), 122- 131.

King, C. (2018). Exploring the use of visual aids as tools to understanding subject specific terminology in life Sciences South Africa.Master of education Thesis.

Kiwanuka, H. N., Van Damme, J., Van Den Noortgate ,W., Anumendem, D. N., & Namusisi, S. (2015). Factors affecting mathematics achievement of first-year secondary school students in central Uganda. *S Afr J Educ, 35*(3), 1–16.

Koko, M., & Nkpolu-Oroworuko, P. H. (2016). *The effective use of school Instructional materials.* In ABEC ANNUAL Workshop. Retrieved from https://www. Researchgate.net/publication/329268141.

Kothari, C. R., (2004). *Research methodology: Methods and techniques*. New Age International Publishes.

Kuhlthau, C. C., Maniotes, L. K., & Caspari, A. K. (2015). G*uided inquiry: Learning in the 21st century*. ABC-CLIO.

Kweitsu, R. (2019). *Ghana's education sector: Key challenges hindering the effective delivery of education and the way forward*. Retrieved from eoprerpeojkeokeprkeokepkwpoke

Lamanauskas, V., & Vilkonienė, M. (2015). *European dimension in integrated science education (Training material for students).* Palacky University Press.

Lazear, E. (2001). ―Education Production". *Quarterly Journal of Economics, 111*(6), 777-803.

Lee, J., & Park, O. (2008). Adaptive instructional systems. In J. M. Spector, M. D. Merrill, J. van Merriënboer, & M. P. Driscoll (Eds.), *Handbook of research on educational communications and technology* (pp. 469-484). New York, NY: Taylor & Francis. Lipsky, D. K., & Gartner.

Leenkecht, M., Lisette, W., Martine, K., & Luke, F. (2020). Formative assessment as practice:the role of students‘ Motivation, Assessment and Education in High Education.

Leiyang, C. (2018). *Anger grows in China over school crowding.* Retrieved from https://www.economist.com/china/2018/09/13/anger-grows-in-china-over- school-crowding

Leong, K.E. (2013). Factors that Influence the Understanding of Good Mathematics Teaching. *Eurasia Journal of mathematics, Science & Technology education 9*(3)319-328.

Lipnevich, A. A., MacCann, C., Krumm, S., Burrus, J., & Roberts, R. D. (2011). Mathematics attitudes and mathematics outcomes of US and Belarusian middle school students. *Journal of Educational Psychology, 103*(1), 105.

Looney, J. W. (2015). Integrating formative and summative assessment: Progress toward a seamless system? *OECD Education Working Papers, 5*, 87-410.

MacMillian, J. H. & Schumacher, S. (2001). *Research in Education: A conceptual Introduction*. (5th Ed). Longman: Boston.

Makokha, R. N., & Wanyonyi K. M. (2015). The Utilization of Instructional Resources in Teaching Kiswahili Poetry in Secondary Schools in Kenya. *Intl J. of Academic Res. in Business and Soc. Sci, 5*(8), 10-18.

Mansyur, R., (2013). *Methodology of Religious Education*. Jakarta: Forum.

Marais, P. (2016). —We can‘t believe what we see”: *Overcrowded classrooms through the eyes of student teachers*. Department of Early Childhood Education and Development, School of Teacher Education, University of South Africa.

Maringe, F., & Sing, N. (2014). Teaching large classes in an increasingly internationalizing higher education environment: Pedagogical, quality and equity issues. *High Educ, 67*(13), 761-782.

Marshall, B. (2015). *Testing English: Summative and formative assessment in English.* Continuum.

Marzano, R. J., & Marzano, J. S., (2013). Building classroom management. *Educational Leadership, 61*(1), 6–13.

Marzano, R. J. (2003). *What works in schools: Translating research in action?* Alexandria, VA: ASCD.

Mathis, W. J. (2016). *The effectiveness of class size reduction*. University of West Georgia Distance & Distributed Education Center.

Meneses, J., Fàbregues, S., Rodríguez-Gómez, D. & Ion, G. (2012). Internet in teachers' professional practice outside the classroom: Examining supportive and management uses in primary and secondary schools. *Computers & Education, 59*(3), 915-924.

Miller, R. L. & Brewer J. D. (2003). *A-z of social research.* SAGE Publication Limited, London.

Ministry of Education (MOE) (2018b). *Education sector analysis.* Retrieved from https://sapghana.com/data/documents/Ghana-Education-Sector-Analysis-2018.pdf.

Ministry of Education (2018a). *Free Senior High School Implementation guidelines.* Accra, Ministry of Education.

Ministry of Education School Profile, (2018). *Primary education manuscript*. Accra: Ghana Co. Ltd.

Mokobia, M. O. & Okoye, N. S. (2011). Effect of class size on the teaching and learning of in secondary schools in Delta state, Nigeria. *Journal of Education and Policy, 3*(1), 1-7.

Molnar, A. (1999). Evaluating the SAGE Program: A pilot program in targeted pupil- teacher reduction in Wisconsin. *Educational Evaluation and Policy Analysis, 2*(1), 165–178.

Mugenda, O. & Mugenda, A. (2003). *Research Methods: Quantitative & Qualitative Approaches.* Nairobi, Rev Ed.

Mulryan-Kyne, C. (2010). Teaching large classes at college and university level: Challenges and opportunities. *Teaching in Higher Education, 15*(2),175-185

Mutisya, M. (2020). *Some Kenya schools are dangerously overcrowded. What must be done? Journal of Science, 6*, 34-40.

Mwirigi, S. F., & Muthaa, G. M. (2015). Impact of Enrolment on the Quality of Learning in Primary Schools in Imenti Central District, Kenya. *Journal of Education and Practice, 6*(27), 156-160.

Naiker, M., Sharma, B., Wakeling, L., Johnson, J. B., Mani, J. & Kumar, B. (2020). Attitudes towards science among senior secondary students in Fiji. *Waikato J Edu, 10*(15).

Ndethiu, S. M. Masingila, J. O., Connor, M. K. M. Khatete, D. W. & Heath, K. L. (2017). Kenyan Secondary Teachers and Principals' Perseptives and Strategies on Teaching and Learning with Large Classes. *Africa Education Review, 14*, 58-86.

Ngoboka, P. & Schultz, B. (2002). *The Effects of Class Size on Student Academic Performance in a Principles of Microeconomics Course.* Midwest Business Economics Association.

Ngussa, B. M., & Mbuti, E. E. (2017). The Influence of Humour on Learners' Attitude and Mathematics Achievement: A Case of Secondary Schools in Arusha City, Tanzania. *Journal of Educational Research, 2*(3), 170 -181.

Nwanneka, N. I. & Amaechi, O. N. C., (2012). Pupil-Teacher Ratio: Implication for Quality Education in Nigeria Primary Schools. *An International Journal of Arts and Humanities, 1*(1), 257-264.

Nyiam, T. A. (2012). *School plant maintenance programmers and their implication on students' academic performance in Northern Senatorial District of Cross River State, Nigeria*. Unpublished Thesis.

O'Sullivan, M. C. (2006). Teaching large classes: The international evidence and a discussion of some good practices in Ugandan primary schools. *International Journal of Educational Development, 26*, 24-37.

Ofori, R. & Dampson, D. G. (2011). *Research Methods and Statistics using SPSS*, Kumasi: Payless Publications Limited.

Oliver, R. M., & Reschly, D. J. ((2007). *Effective classroom management: Positive stratergies to enegage all students and promote a psychology of success*. An Francisco, CA: Jossey-Bass.

Osei-Mensah, F. (2012). *Factors that influence the performance in general knowledge in art of senior high school in Abura Asebu Kwamankese District in the Central Region* (Doctoral dissertation).

Osim, R. O. (2011). Teacher quality: its implication for task performance among secondary school teachers in cross river state Nigeria. *International J.Edu Admin.Planning and Res., 4* (2), 30-37.

Patton, M. (1990). *Qualitative evaluation and research methods (pp.169-186)*. Berverly Hills, CA :Sage.

Pedder, D. (2006). Are small classes better? Understanding relationships between small class size, classroom processes and pupils" learning. *Oxford Review of Education, 32*(2), 231-234.

Peter. D. Harry, T. & Ross, F. (2010).Extending the principles of intensive writing to large macroeconomics classes. *The Journal of Economics Education 41*(4), 370-382.

Phonapichat, P., Wongwanich, S., & Sujiva, S. (2014). An analysis of elementary school students' difficulties in mathematical problem solving. *Procedia-Social and Behavioral Sciences, 116*(1), 3169-3174.

Prasanthi, B., & Vas, V. (2019). Classroom Assessment Methods and Tools: A Review. *International Journal of Research and Analytical Reviews, 5*(6), 94-97.

Quarcoo-Nelson, R., Buabeng, I., & Osafo, D. K. (2012). Impact of Audio-Visual Aids on Senior High School Students' Achievement in Physics. *Eurasian Journal of Physics and Chemistry Education, 4*(1), 46-54.

Radem, A. (2009). *The effectiveness of lecture demonstration to enhance learning of chemistry.* In GupaBhown, M. (Eds), Chemistry education in ICT age. Dordrecht, Springer.

Ramayulis, U. (2014). *Methodology of teaching Religion*. Jakarta: Kalam Mulia. p. 165.

Ranasinghe,A. I. & Leisher, D. (2009). The benefits of integrating technology into the classroom. *International Mathematics Forum, 44*(40),1955-1961.

Recto, A. S. (2015). *Foundations of education. Manila.* Philippines. Rex Book Store.

Resnik, D. B. (2020).What is Ethics in Research ?Why is it Important? *National Institute of Environmental Health Science, 2*, 50-59

Roohi, F. (2012). *Role of mathematics in the development of society.* National meeting on celebration of national year of mathematics, organized by NCERT, New Delhi, December 20-22.

Ryan, G. & Bernard, H., (2000). *Data management and analysis methods*. In: Denzin & Y. Lincoln, eds. Handbook of qualitative research. Thousand Oaks: CA: SAGE Publication, p.769-802.

Sa'ad, T. U., Adamu, A., & Sadiq, A. M. (2014). The *causes* of poor performance in mathematics among public senior secondary school *students* in Azare metropolis of Bauchi State, Nigeria. *J Res Method Edu, 4*(6), 32.

Sarmah, A., & Puri, P. (2014). Attitude towards Mathematics of the Students Studying in Diploma Engineering Institute (Polytechnic) of Sikkim. *Journal of Research & Method in Education, 4*(6).

Shaen, R. J., Hayden, G., & Zydney, J. M. (2016). "Now" We Have an App for That. *Teaching Children Mathematics, 22*(8), 506-509.

Shamaki, T. A. (2015). Influence of learning environment on students' academic achievement in mathematics: A case study of some selected secondary schools in Yobe State-Nigeria. *Journal of Education and Practice, 6*(34), 40-44.

Sharma, B., Fonolahi, A., Bali, A., & Narayan, S. (2018). *The online mathematics diagnostic tool for transformative learning in the pacific.* In: A Singh, S. Raghunathan, E. Robeck, and B Sharma, editors. Cases on smart learning environments. Hershey, Pennsylvania: IGI Global p. 63–80.

Shilubane, H. N. (2010). University of Venda. Retrieved May 4,2015, from University of Venda web site: http://uir,unisa.ac.za/bitsream/handle/1050 0/ 1450/04 chapter3.pdf?sequence =5.

Shuaibu, A. A. (2003). *Effect of Class Size on Students' academic achievement in English Language presentation*. Unpublished M. Ed. Dissertation Ahmadu Bello University.

Sibiya, N. I., Gamede B. T., & Aleanya U. (2019). Classroom management challenges experienced by female educators in rural secondary schools in South Africa. *Gender and Behavior, 17*(2), 12894-12909.

Sinyosi, L. B. (2015). *Factors affecting grade 12 learners' performance in mathematics at Nzhelele east circuit: Vhembe district in Limpopo* (M.Ed. dissertation). University of South Africa. http://hdl. handle.net/10500/20245.

Siperto, J. (2017). *Secondary school teachers experience in managing large classes: The case of secondary schools in Buchosa district council Mwanza.* http://repository.out.ac.tz/1915/1/Dissertation%20%20BENJAMIN%20SIPERT O%20%20Final.pdf.

Sisiliya, K. (2013). *Efficacy of instructional methods and materials prepared and used in the selected schools of Manipur state.* Avinashilingam Deemed University for Women.

Slavich, G. M., & Zimbardo, P. G. (2012). Transformational teaching: Theoretical underpinnings, basic principles, and core methods. *Educational Psychology Review, 24*(4), 569-608.

Suleiman, Y., & Hammed, A. (2019). Perceived causes of students' failure in mathematics in kwara state junior secondary schools: implication for educational managers. *Int J Educ Stud Math, 6*(1), 19–33.

Syyeda, F. (2016). Understanding Attitudes towards Mathematics (ATM) using a Multimodal modal Model: An Exploratory Case Study with Secondary School Children in England. *Cambridge Open-Review Educational Research e- Journal, 3*(5), 32-62.

Talebi, S., Davodi, S., & Khoshroo, A. (2015). Investigating the effective component of classroom management in predicting academic achievement among English language students. *Procedia - Social and Behavioral Sciences, 205*(5), 591– 596.

Tety, J. L. (2016). *Role of Instructional Materials in Academic Performance in Community Secondary Schools in Rombo District*. Retrieved from: www. openuniversity.ac.tz.

Thornton, J. C. & Luthy, M. R. (2019). Using management principles to better acculturate students to classroom behavior: A professionalism statement. *Global Journal of Business Pedagogy, 3*(1), 105. Vaismorad.

Togunloju, T. (2015). *School factors as correlates of teacher productivity in secondary school in Osun State, Nigeria* (Ed). Unpublished M.Ed. Thesis Ado Ekiti, Ekiti State University.

Tomei, L. (2009). *Lexicon of Online and Distance Learning*, Rowman & Littlefield.

Toth, S. L. & Montagiga, G. L. (2002). ―Class size and Achievement in Higher Education. *A summary of current Research" College Student Journal, 5,* 125-129.

Tshabalala, T., & Ncube, A. C. (2016). Causes of poor performance of ordinary level pupils in mathematics in rural secondary schools in Nkayi district: Learner's attributions. *Nova Journal of Medical and Biological Sciences, 1*(1).

UNESCO Institute for Statistics (2018). Ghana: Making inclusive education a reality. Retrieved from http://www.iiep.unesco.org/en/ghana-making-in clusive-education-reality-4564.

UNESCO Institute for Statistics (2020*). Ghana: Student teacher ratio, primary school*. Retrieved from http://uis.unesco.org.

Ur, P. (1996). *A course in Language Teaching Cambridge*: Cambridge University Press.

Vandenberg, K. C. (2012). *Thesis submitted to Graduate school of Georgia Southern University*. Retrieval from: http://digitalcommons.georgiasouthern.edu/etd

WAEC, Chief Examiners Report, (2014). Retrieved from http://www.waecgh.org/examiners-report, (The West African Examination Council, Lagos, Nigeria) http://www.waecgh.org/examinersreport.

WAEC, Chief Examiners' Report, (2015). Retrieved from http://www.waecgh.org/examiners-report, (The West African Examination Council, Lagos, Nigeria) http://www.waecgh.org/examinersreport.

WAEC, Chief Examiners' Report, (2016). Retrieved from http://www.waecgh.org/examiners-report, (The West African Examination Council, Lagos, Nigeria) http://www.waecgh.org/examinersreport.

Watson Todd, R. (2006). Why investigate large classes? *rEFLections*, *9*(10),1-12.

Wiliam, D. (2016). What is assessment for learning? *Studies in Educational Evaluation, 37*(1), 3-1 4.

Woolfolk, A. (2010). *Educational psychology* (11th Ed.). Upper Saddle River, NJ: Merrill.

Xiaotian Li & Mengyan Li (2021). The effect of large and small size in compulsory Education in China. *Rangsit Journal of Educational Studies, 8(*1)

Yeh, C. Y., Cheng, H. N., Chen, Z. H., Liao, C. C., & Chan, T. W. (2019). Enhancing achievement and interest in mathematics learning through math-island. *Res Pact Technol Enhance Learn, 14*(1), 5.

Yelkpieri, N., Namale, H., Donkoh, H., & Dwamena, J. (2012). *Effects of large class size on effective teaching and learning at the Winneba campus of the UEW* (University of Education, Winneba), Ghana.

Yusuf, T. A., Onifade, C. A., & Bello, O. S. (2016). Impact of class size on learning, behavioral and general attitudes of students in secondary schools in Abeokuta, Ogun State, Nigeria. *Journal of Research Initiatives, 12*(2), 9-17.

Zhu, Y. Au., W., & Yates, G. (2016). University students‘ self-control and self-regulated learning in a blended course. *Internet and Higher Education, 30*(7), 54–62.

APPENDICES

APPENDIX A

RESEARCH QUESTIONS AN VARIABLES FRAMEWORK FOR DATA COLLECTION

S/N	Research Questions	Variable Type	Subjects/ Source of Data	Data Collection Techniques & Tools	Data Type
A.	What challenges do mathematics teachers encounter in teaching large classes in the Tema East municipality?	Mathematics teachers challenges in large. classes.	Teachers in sample	Teacher Questionnaire Appendix B (SECTION A) (1– 10) and Teacher interview SECTION B (1-9)	Quantitative & Qualitative
B.	What challenges do students encounter in learning in large mathematics classes in Tema central municipality?	Students' challenges in large classes	Students in sample	Students Questionnaire Appendix C (1– 15)	Quantitative
C.	How often do mathematics teachers use effective large class instructional techniques in Tema Central municipality?	Teachers' use of effective large class instructional techniques	Teacher in sample	Teacher Questionnaire Section D (11-21)	Quantitative

APPENDIX B

QUESTIONNAIRE FOR TEACHERS

SECTION B: Challenges teachers encounter in teaching in large Mathematics classes.

INSTRUCTION: The following are some challenges known to be associated with teaching large classes. Kindly answer the items by placing [√] in the box that best expresses the extent to which you agree with the statements.

NO.	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Poor classroom management resulting in noise					
2.	Ineffective students‘ control					
3.	Poor planning and assessment					
4.	Increase stress on teachers					
5.	Student show more disruptive behaviour					
6.	Student are less attentive in class.					
7.	Difficulty in proving timely feedback to students.					
8.	Difficulty in coverage of the curriculum					
9.	Class size affects students‘ academic performance.					

10. If there are other challenges that you encounter in large Mathematics classes, provide it below.

……

……

APPENDIX C

QUESTIONNAIRE FOR STUDENTS

UNIVERSITY OF EDUCATION, WINNEBA FACULTY OF SCIENCE EDUCATION DEPARTMENT OF MATHEMATICS EDUCATION

My name is Rhoda Botchway. I am an MPhil student at the University of Education Winneba. As part of my program, I am investigating mathematics teachers' instructional techniques and challenges in teaching in large classes.

Please, this study is strictly for academic purpose and as such, all information obtained through this medium shall be treated as confidential and used for the purpose for which it has been collected.

I would like you to honestly express your opinion on the questions to help the research. Thank you.

INSTRUCTION: Please indicate the correct option as honestly and as correctly as possible by putting a tick (√) on one of the options. For the questions that require your opinion, please complete the blank space.

SECTION A BACKGROUND CHARACTERISTICS OF STUDENTS

1. What is the name of your institution?.....
2. What is your Gender?
   i. Female ☐
   ii. Male ☐
3. Age A) 10-14yrs B) 15-19yrs C) 20-24yrs D) 25-29yrs
4. What is your course of Study? ……
5. How many students are in your class? …….

APPENDIX D

CHALLENGES STUDENTS ENCOUNTER IN LEARNING IN LARGE MATHEMATICS CLASSES

Below are some challenges students encounter in large Mathematics classes, kindly answer the following items by placing [√] in the box that best expresses the extent to which you agree with the statements.

NO.	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
6.	Large class increase the time teacher spend on handling non-instructional					
7.	Students absents themselves from large classes more.					
8.	There are more distractions by unserious students in large classes					
9.	Teachers spend more time controlling students rather than teaching.					
10.	Students are less attentive in large classes					
11.	There is limited physical space in large classes.					
12.	There is difficulty on the part of the teacher to know the names of students.					
13.	Difficulty on the part of teachers to give more attention to individual students in large class.					
14.	There is lot of noise in large classes which makes it difficult to understand lessons.					

15. If there are other challenges that you encounter in learning in large Mathematics classes provide it below:

……

……

……

……

APPENDIX E

INTERVIEW GUIDE FOR TEACHERS

UNIVERSITY OF EDUCATION, WINNEBA FACULTY OF SCIENCE EDUCATION DEPARTMENT OF MATHEMATICS EDUCATION

INTRODUCTION

My name is Rhoda Botchway. I am an MPhil student at the University of Education Winneba. As part of my program, I am investigating mathematics teachers' instructional techniques and challenges in teaching in large classes.

Please, this study is strictly for academic purpose and as such, all information obtained through this medium shall be treated as confidential and used for the purpose for which it has been collected.

I would like to therefore interview you to seek your opinion on some questions to help in the research.

Thank you.

PERSONAL DETAILS

i. Name of school ……..

ii. Circuit: ……..

iii. What is your age? ……

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

v. What is your highest qualification in mathematics? (Tick only one)

   a) Master's degree [ ]

   b) Bachelor's Degree [ ]

   c) Diploma/HND [ ]

vi. 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' [ ]

vii. Which tertiary education institution did you obtain your professional qualification in mathematics? ……

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

SCHOOL DETAILS

1. How many classes are in the school (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 classes

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

2. How many students are in your core mathematics class?

……

……

3. How many students are in your elective mathematics class?

……

……

4. How many core mathematics periods or classes do you attend per week?

……

……

5. How many elective mathematics periods or classes do you attend per week?

……

……

TEACHER PERCEPTION OF LARGE CLASSES AND TEACHER SUPPLY STATUS

6. Do you perceive your class as large?

Yes [ ] No [ ]

If yes, what are some of the challenges that you encounter as a teacher?

i. Classroom management – how? Please, explain.

……

……

ii. Planning and assessment – how? Please, explain.

……

……

iii. Student‘s participation in lesson – how? Please, explain.

……

……

iv. Assess instructional needs of students– how? Please, explain.

……

……

7. Do these challenges affect student‘s academic performances? – how? Please, explain.

……

……

……

……

8. What do you think will be an appropriate class size to help deal with these challenges? Please, explain

……

……

……

……

9. Do you think your school requires additional mathematics teachers?

i. Yes [ ]

ii. No [ ]

(b) If YES, to Question 9(a) above, briefly explain why you think so?

……

……

……

APPENDIX F

INSTRUCTIONAL TECHNIQUES USED IN LARGE CLASSES

The statements in the table below are mathematics teaching practices you use to create equitable opportunities for learning. Study them and use a scale of 1 – 5 (1 = Not at all, 2 = Sometimes, 3 = Neutral, 4 = Once in a while, 5= Always) to RATE how often you engage in the equitable and inclusive mathematics teaching practices. (Please rate EVERY practice according to the scale by ticking (√) the best option).

SN	*I do*	Not at all	Sometimes	Neutral	Once in a while	Always
11.	use different instructional techniques including activity and inquiry-based instruction in large classes					
12.	try to attract attention of all learners‘					
13.	use pair discussion strategy more than wide class teaching.					
14	share power in the classroom by allowing students to provide meaningful input in making decisions about classroom practices, curriculum, and assessment					
15.	Use formative assessment (formal and informal assessment procedure during teaching and learning).					
16.	use questioning to engage student participation in large classes					
17.	use of visual representations that enable my students to get involved in lessons					
18.	make use of demonstrations					
19.	Create a friendly atmosphere to encourage students to participate in class.					
20.	engage students in conversation about real-world problems and how mathematics can be used to examine them					

21) Please state any other instructional technique(s) that you use in large mathematics classes below.

……

……

……