USE OF DIFFERENTIATED INSTRUCTION BY TEACHERS OF MATHEMATICS IN MEETING THE DIVERSE NEEDS OF PUPILS IN SELECTED SECONDARY SCHOOLS IN CHOMA DISTRICT.

BY

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A dissertation submitted in fulfillment of the requirements for a degree of Master of Education in Mathematics Education

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DECLARATION

I, Chuumbwe Chikuni, hereby declare that this dissertation represents my own original work and that it has not been previously submitted for a degree at this or any other university.

Signature…….

CERTIFICATE OF APPROVAL

Examiner 1…….....Signature…….Date…….....

Examiner 2…….....Signature…….Date…….....

Examiner 3…….....Signature……..... Date……....

Chairperson Board of

Examiners.....Signature.....Date.....

Supervisor..... Signature.....Date.....

ABSTRACT

The purpose of this study was to investigate the use of differentiated instruction to meet the diverse needs of pupils by teachers of mathematics in four selected secondary schools in Choma District.

The sample comprised 178 respondents from four selected secondary schools of which 18 were teachers of mathematics and 160 Grade eleven pupils. Forty pupils from each school participated in the study. Simple random sampling was used to select schools and pupils while purposive sampling was used to select the 18 teachers of mathematics. The study used a combination of qualitative and quantitative data collection methods. The research instruments that were used in the study include questionnaires and an observation checklist which were designed by the researcher. There was a questionnaire for pupils and a questionnaire for teachers of mathematics to complete. Statistical Package for Social Sciences (SPSS 16.0) was used to analyse quantitative data from questionnaires using descriptive statistics basically in form frequency tables and histograms. Qualitative data obtained from open-ended questions and an observation checklist was analysed by coding and grouping the emerging themes.

The findings of the study revealed that most teachers of mathematics rarely attended to the diverse needs of pupils in the classroom. From pupils' responses and classroom observations, teachers never grouped pupils either according to their interests or abilities. Teachers of mathematics mainly taught their pupils as a unit not as individuals. Teachers rarely considered the benefit of assessment for learning and focused mainly on end of term and promotional examinations. However, in few cases where teachers of mathematics attempted to differentiate instruction, the study revealed group work, recap strategy, question and answer sessions, homework and remedial work, pupil demonstration and appropriate high level questions to fast learners as some of teaching strategies used by teachers. The study further revealed that in few cases where teaching used the differentiated instruction methods, the major challenges were over-enrolment, insufficient time, abnormal workload, managing the gap between slow and fast learners, pressure from stakeholders to cover the syllabus, insufficient teaching and learning materials, pupils' poor mathematical background and pupils' negative attitude towards mathematics.

The study recommended that schools through the office of the head teacher should procure sufficient and appropriate teaching and learning materials. It also recommended that Ministry of General Education and Head teachers should focus more on assessment for learning. School administrators and management must control the enrolments to mitigate the challenge of over-enrolments. Finally the government must deploy and recruit more teachers of mathematics in secondary schools to reduce the teaching loads for serving teachers.

Key Words: Differentiated Instruction and Pupils' diverse needs

DEDICATION

This study is dedicated to my beloved wife Doris Muzembo Chuumbwe and our sons Kkomana and Malelo.

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1.1 Introduction

This chapter begins with a background to the study. It further presents the problem statement, the purpose of study, study objectives, research questions, and significance of study, limitation of the study, theoretical framework, operational definitions and ethical consideration.

1.2 Background

Mathematics plays an important role in our modern society as it forms a basis for both scientific research and industrial development (Hollands, 1990). It plays a central role in expanding and developing the fields of science and technology. Mathematics is also critical to the fields of economics, business and science (Fraser and Gilan, 1992). It is for such reasons that one of the particular objectives highlighted in the Ministry of Education (1996) education policy document is to promote extensive knowledge, skills and accurate understanding of mathematics at secondary school level. Despite government efforts focusing on improving pupils' performance in mathematics, the performance of pupils in mathematics has significantly been below satisfactory at both Grade 9 and 12. This has evidently come out strongly in final examination results. Since 1987, one-third of boys and two-thirds of girls have registered a total failure in mathematics while one-half of the boys and one-fifth of girls have obtained the equivalent of an O-level pass in mathematics (Ministry of Education, 1996). Examinations council of Zambia results have continued to record poor performance

in mathematics at Grade 12. A 3 year trend quality performance in Mathematics at Grade 12 as a country Zambia has been below 40 percent as shown in Table 1.

Table 1: A 3 year trend Overall pass vs quality performance in Mathematics for grade 12

year	Pass Percentage-Overall Grades 1-8	Pass Percentage-Quality Grades 1-6
2011	48.48	32.84
2012	51.26	36.69
2013	44.93	28.07

Source: Zambia Association of Mathematics Education (2014)

This unsatisfactory performance in mathematics is attributed to a variety of causes. Amoo (2002) contends that some of the causes of this poor performance in mathematics among pupils include poor learning, interest, and assimilation of mathematics ideas, concepts, principles, processes and teacher's failure to use appropriate teaching methods. One area that has received little attention in Zambia among the causes of poor mathematics performance among secondary school pupils is the instruction employed by teachers of mathematics when attempting to meet the diverse learning needs of learners in their classrooms.

In every class where teachers of mathematics go to, they always interact with diverse pupils. Variations in ability to perform calculations of given mathematical questions in mathematics in a single classroom are even greater. In one lesson, some pupils will

have readily available responses to a given question, others perform slowly but accurately and some who have failed so often even refuse to try to respond to questions (Tomlinson, 2005). In order to respond to this diversity among learners, educators in general and teachers in specific have attempted to implement strategies of differentiated instruction. It is important to note that there is evidence of this teaching strategy being used in some primary schools in Zambia (Adebayo and Shumba, 2013).

Adebayo and Shumba (2013) alludes that one of the aims of Primary Diploma by Distance Learning at Chalimbana University was to promote quality education provision and delivery through implementing differentiated instruction strategies. Adebayo and Shumba (2013) further state that efforts towards the implementation of differentiated instruction by teachers were evidenced in workshops by Provincial Education Officers to in-service teachers through Continuing Professional Development programs.

Differentiated instruction is a process where the teacher attempts to take into account his or her pupils' varying background knowledge, readiness, preferences in learning and interests, with a purpose of meeting their individual differences in the teaching learning process (Hall, Strangman & Meyer, 2003).

1.3 Statement of the problem

Despite efforts from government and teachers of mathematics in secondary schools to improve the performance of pupils in mathematics at both grade nine and twelve, the performance is still far from being satisfactory. Few pupils have performed well with the majority still significantly below satisfactory (Ministry of Education, 1996). In 2014, the Minister of General Education mentioned in his report to parliament that as a country we were very far behind in performance

in terms of mathematics and science. One question that needs to be answered is "why is the performance of few pupils extremely well, some at average and the rest being far from satisfactory?" McBride (2004) suggests that unsuitable teaching methods are directly linked to the dismal performance in mathematics in secondary schools. Tieso (2002) indicates that most learners have been failing to perform well in mathematics due to their teachers' use of the one-size-fits all teaching approach. Todd and Curlis (2003) argued that differentiated instructions particularly in mathematics lessons enable almost all learners to attain optimal levels of learning and academic success. Have teachers of mathematics taken into account the individual learning needs and differences among their pupils in their everyday classroom teaching? It is however not very clear how teachers of mathematics in secondary schools are using differentiated instruction strategies in their classroom practice to meet their pupils' individual learning needs to improve performance. .

1.4 Purpose of the study

The purpose of this study was to investigate the use of differentiated instruction by teachers of mathematics in meeting the diverse needs of pupils in four selected secondary schools of Choma District.

1.5 Research objectives

The objectives of this study were:

1. To determine if teachers of mathematics take into account their pupils' differing background knowledge, readiness, interest and learning preferences at all stages of teaching and assessment.

2. To identify different teaching strategies teachers of mathematics use to respond to the pupils varying interests, abilities and competencies.
3. To identify the challenges encountered by teachers as they try to differentiate instructions.

1.6 Research questions

To meet the above targets, the following were research questions:

1. To what extent do teachers of mathematics take into account their pupils' differing background knowledge, readiness, interest and learning preferences at all stages of teaching and assessment?
2. What teaching strategies and practices are teachers of mathematics using to respond to the varying needs of their pupils?
3. What challenges do teachers of mathematics encounter in the process of attempting to meet the diverse needs among their pupils?

1.7 Significance of study

The findings of this study are anticipated to contribute to the existing body of knowledge. The findings are also hoped to create a basis for teachers of mathematics to attempt to use differentiated instructions to meet the needs of pupils and eventually improve performance. It is also hoped that the findings of this study will make lecturers of mathematics education endeavour to incorporate differentiated instructional strategies.

1.8 Limitation of the study

In this study, one of the limiting factors was the restriction of the study to four (4) Secondary schools in Choma district which may not give a broad and comprehensive general picture of the whole district. Moreover, some schools had very few teachers of mathematics and eventually in these schools random sampling became impossible as all teachers automatically became participants of the study.

1.9 Theoretical framework

Differentiated instruction is a teaching approach that is guided and supported by quite a number of theories. Hall (2004) alluded that differentiation in instruction is recognised as a compilation of many theories and practices. Differentiated instruction is directly linked to Gardner's theory of multiple intelligences which states that each person has several unique and distinct intelligences in his or her brain system. Gardner suggested that when teachers know how students learn and what intellectual level they are, teachers can easily and efficiently meet students' individual needs. This theory further suggests that we need to scrutinise our attitudes towards mathematical learning so that each learner can learn in a more relaxed environment. Multiple intelligences in some instances actually are used as a method of differentiating instruction (Gardner, 2006). Gardner's theory is actually in some instances used to identify individual differences.

Differentiating instruction according to Tomlinson (1999) demands for flexibility in adjusting teaching and learning activities to meet the learners where they are in terms of their individual abilities to enable them succeed in their learning. From this statement, it is clear that differentiated instruction is also linked to Vygotsky's theory called "Zone of Proximal Development" which he defined as "the distance between the actual developmental level as determined by individual problem solving and the level of potential development as determined

through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p.86).

This study therefore is strongly guided by constructivist theory of learning. This theory views the learner as a unique individual with unique needs and background. It also suggests that the responsibility of learning should reside increasingly in the learner. This theory encourages teaching strategies that incorporates, hands on approach, observing and assessing pupils abilities and progress, and engaging students throughout the process of teaching and learning (Bredo, 1997).

Heuser (2000) in his mathematics and science workshops involving learner-centred teaching stated that when pupils are exposed to the type of teaching that take into account their individual learning needs, they develop deeper understanding of the subject and easily get motivated to construct their own knowledge. Differentiation is the way of teaching that makes the curriculum relevant to all the pupils regardless of their individual learning needs.

When a teacher gives the same kind of material or content to pupils, their comprehension to the material will vary depending on their respective background, intellectual strengths and individual learning needs (Moran, Kornhaber & Gardner, 2006). This suggests that the pupil is a determinant of the methods teachers of mathematics should employ if learning is to be meaningful and relevant to each pupil.

The theories discussed in the preceding section are entirely based on cognitive learning. They all put the teachers' knowledge and the learner's thinking and mental abilities in the process of effective teaching and learning. It is very clear that no two individuals think exactly the same

way at the same time, therefore no two individuals can learn the same way at the same time with exactly equal retention.

1.10 Operational definitions

In this study, the following terms were defined as follows:

Readiness: A set of what a learner already knows and understands better in line with what the teacher intends to teach on that particular day (Tomlinson & Edison, 2003).

Learning styles: These are cognitive, affective and physiological traits that serve as relatively stable indicators of how a learner perceive, interact with and responds to the learning environment or ways in which pupils learn(Keef,1982).

Content: What is intended to be taught and learnt (Benjamin, 2006)

Process: Methods of delivering content or the how of teaching (Benjamin, 2006)

Product: This is evidence of learning and retention of content among pupil (Benjamin, 2006)

Differentiated instruction: This is a teaching strategy by which teachers help all students regardless of their abilities to reach their full potential of learning by adapting the instruction to the needs of each learner (Tomlinson, 1995).

1.11 Ethical consideration

The researcher obtained permission from the school administration through the office of the headteacher. In this study the participants were treated with respect as consent was obtained from them before the study. Informed consent demands that a respondent in the study participates in the study knowingly, voluntarily, intelligently and in a clear and manifest way gives his or her

consent (Arminger, 1997). To achieve informed consent from the respondents, the researcher explained the purpose of the study and the importance of the findings were clearly stated before they accepted to be part of the study. Respondents in the study were assured that there would be no harm physically, mentally or socially that would be caused by the findings of the study. Confidentiality and anonymity is another critical ethical issue in research. Mugenda (2011) described anonymity as keeping secrets of respondents' background by refraining from referring to them by names or divulging any sensitive information given in confidence. In this study, confidentiality and anonymity were guaranteed as numbers not names were used to identify respondents throughout the study. Schools in the study were represented by pseudo names to ensure privacy.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This literature reviewed is on differentiated instruction in general and in teaching mathematics in particular. It begins by giving a brief history of differentiated instruction. It further focuses on major differences in academic needs among learners, the concept of differentiated instructions, strategies of differentiating instruction in mathematics teaching, evidence of differentiated instructions effectiveness in the teaching of mathematics and some of the challenges and barriers that have been prominent in the quest of using differentiated instruction.

2.2 History of differentiated instruction

Differentiated instruction has its roots in the one room schoolhouse where teachers began to differentiate instruction to meet the various needs of their learners (Anderson, 2007; Tomlinson, 2001) .It dates as far back as 1600s when a teacher was responsible for teaching a wide range of learners with diverse abilities without a special kind of attention to specific learners. It's around this very time when educators began to notice widening gaps among learners in terms of learning and understanding concepts (Chapman and King, 2005). By 1899, these gaps had become even more prevalent as achievement tests were also introduced.

2.3 Major differences among learners and the need for differentiated instruction

Meir (1995) asserts that contemporary classrooms are more characterised by academic diversity than never before, for this reason, he further mentions that teachers can no longer ignore this variance among learners as doing so would significantly reduce their pupils' access and retention of the intended curriculum content. Sapon-shevin (2000/2001) supports this assertion by mentioning that in a single classroom a teacher will find advanced learners and underachievers, pupils with diverse background knowledge in the subject, some are intrinsically motivated and others are not and more noticeable are pupils' varying levels of readiness, interests and learning modes.

Gorham (1986) also added that in a single class, some pupils perceive information concretely and process it reflectively while others perceive information abstractly and process it actively. It is important to indicate that the Zambian classroom may not be different from this scenario. This demands that teachers of mathematics vary their teaching strategies to accommodate this variance among learners. An assumption that students in the same grade have the same cognitive abilities and potential and that they can learn in exactly the same way is neither true nor valid. Gorham (1986) further argues that making this assumption our pupils will not learn and their cognitive ability may even drop sharply.

Some scholars (Strickland 2007; Tomlinson 2001) have argued that if today we teach the way we taught yesterday, we would rob our children's future. We have more diversity among learners than before in our classrooms hence the need for differentiated instruction. In the same vein Tomlinson (2001) further argues that in many classrooms the approach to teaching is more on teaching a class of pupils as opposed to the pupils themselves, which is more unitary than

individual. Due to these assertions, Tomlinson (2001) suggested that teachers needed to migrate to better methods of teaching that were responsive to learners if they were to meet their teaching and learning objectives in any mathematics lesson.

2.4 The Concept of Differentiated instruction

Hall, Strangman and Meyer (2003, p.3) defined differentiated instruction as " the recognition of students' varying background knowledge, readiness, preferences in learning and interests, and reacting responsibly to maximise each student's growth and individual success by meeting each students where he or she is and assisting in the process." Reed (2004) suggests that differentiation is a process of modifying or adapting the teaching according to different ability levels of students in a heterogeneously grouped classroom. This suggest that in the teaching process teachers need to take keen interest in identifying varying academic needs among their learners to determine the kind of teaching strategy appropriate to each learner in their classrooms.

Tomlinson (2001) concluded that differentiated instruction is a method of teaching where teachers get to realise that classrooms are places where they (teachers) need to show their understanding of teaching and learning. She also mentions that the best practice of teaching is that which works for the benefit of each individual learner. This implies that teachers should stop teaching their pupils as a unit but instead focus their attention on the pupils' individual differences. Therefore, in the teaching of mathematics, teachers need to realise that considering variance among pupils in terms of abilities, skills, pre-requisite knowledge and their desire to learning the subject in the teaching-learning process is an important step to better teaching.

Consequently, teachers must vary instruction techniques throughout the process of teaching to benefit each pupil.

Murray and Jorgensen (2007, p.4) defined differentiated instruction for mathematics as "a plan for the learning needs of all the students, providing them with opportunities they need to reach their full potential and become mathematically proficient." This suggests that when teachers of mathematics are going to use differentiated instruction in their classrooms they should take time to consider their pupils' individual academic needs and by all means attempt to reach out to these needs. When instructional approaches are varied in the process of teaching, pupils are given an opportunity to learn in ways that best challenge their potentials.

On the other hand differentiated instruction includes a strategic way of varying what learners should learn (content), the process of delivering this content and the method of assessment to reach out to the pupils' various levels of interests, readiness and learning preferences. Such an approach would be more appropriate in mathematics lessons where it is evident that students are mathematically diverse (Turville, 2007).

Shuman and Armitage (2005) contended that many pupils in mathematics lack the ability, desire and excitement to solve authentic problems. In a study by Shuman and Armitage (2005), teachers were given opportunities to be learners using active inquiry-oriented approaches later on transfer this approach to their classrooms in order to create learner-centred and motivating teaching and learning experiences. This resulted in vibrant learning as it boosted the ability, interest and motivation among learners to solve authentic problems. The study by Shuman and Armitage (2005) concluded that the goal of each teacher should be student outcomes. Langa and Yost

(2007) suggested pupils' interest, readiness and preference of learning styles as the three key areas that need to be considered in differentiated instruction.

The first aspect that is considered in the process of differentiating instruction is the readiness levels of learners. This is directly linked to Vygotsky's (1978) theory called "Zone of Proximal Development (ZPD)". This theory suggests that teachers should provide tasks that are slightly beyond the learners' ZPD to promote independent learning. Byrnes (1996) argues that instruction should always be slightly above the learner's mastery level as presenting material below ZPD which he called 'mastery level brings no academic growth. On the other hand presenting material well beyond the ZPD will cause confusion and frustration among learners. Considering varying levels of interest among pupils in teaching specific subjects such as mathematics, is another important aspect of differentiating instruction. Considering interests of learners in teaching creates a positive attitude towards learning and helps learners to use their full potential in accomplishing tasks. The learners' level of interest determines their level of enjoying cognitive tasks, their self-determination and their desire to continue learning (Kronberg et al, 1997).

To accommodate the diversity of learners in a mathematics classroom through differentiating instruction is to consider the varying learning preferences among learners. This must be in line with their (learners) readiness and interest. Gorham (1986) contends that students differ in their preference for and ability to process various kinds of instructional information. Learning styles elements include conditions under which an individual learner is most comfortable and prefers to learn. It also includes factors which a teacher must recognise and have a detailed understanding of how information is processed and stored among their learners.

Tomlinson (2001) classified three areas that need to be differentiated in the teaching process. These are content, process and product. Content is what pupil need to learn, process includes methods of delivering this content and product is evidence of learning from the pupils. A fourth area sometimes called environment which aids process come out independently.

Tomlinson (2005) explains that content does not only comprise what should be taught, but how student access the material taught. She further explains that content should relatively remain constant across learners with teachers varying how students get access to address learner' needs. Differentiating content includes curriculum compacting, re-teaching and reinforcing and by using manipulative. Heacox (2002) argued that teachers can differentiate content by providing learners with the opportunity to choose a subtopic within a main topic.

Anderson (2007) referred process differentiation to how the learners get to understand and assimilate facts, concepts and skills. Differentiating process includes tiered activities at various levels of simplicity, varying pace of completing tasks, multiple options of expression and giving learners alternative topics on which to focus and allowing their preferred modalities of learning.

Product differentiation includes offering learners a variety of pathways to express their mastery of common learning goals. Differentiated assignments should offer learners an appropriate clear criterion for success that focuses on real-world relevance and application. It must promote creative and critical thinking (Jensen, 1998).

Heacox (2009) also identified classroom environment as another area that needs consideration when it comes to differentiation of instruction. Tomlinson (2005) argues that learning environment involves routines, procedures, physical arrangements of the classroom as well as the

overall mood that exists among the students and between the students and teachers. She considered it as an important factor to differentiation within the teaching instruction.

2.5 Strategies of differentiating instruction in mathematics teaching

Differentiating of instruction is never uniform as it is dependent on the type of needs in that particular classroom. Oberdorf and Taylor-Cox (2011) argued that formative assessment drives mathematics instruction and starts the process of intervention. It helps to identify instructional needs and the needed direction in teaching. Popham (2008) alluded that assessment provide information to teachers about their pupils' areas of need that require adjusting to suit instructional practice. It is important to understand that in the process of differentiating instruction in all subjects including mathematics, assessment of pupils' academic needs is the starting point.

Another important item in differentiating instruction is setting goals with the learners. A model of goal setting in teaching help each student to realise that he or she is in command and is capable of identifying what to do to avoid time wastage and self-defeat. This implies that even before the beginning of a learning task, students are already aware of their worthwhile effort to the task at hand. It is important to note that through this very model students tend to have a good sense of determining the probability for success in the task (Wlodkowski, 1978)

As previously stated, Tomlinson (2005) suggested that differentiating instructions differ from one classroom to another depending on diversity of learners. As such, differentiating of instruction can be administered to an individual, a small group of pupils with similar needs or even a whole class activity.

2.6 Effectiveness of differentiated instruction in the teaching of mathematics

There is enough evidence suggesting the effectiveness of the differentiated instruction in teaching of mathematics (Beecher &Sweener 2008, Hodge 1997, Papanastasiou, 2002, Lewis & Bates, 2005). Tieso (2002) concluded that teachers using differentiated instruction in mathematics classes increased students' levels of participation, interest and eagerness to learning. She examined the effects of differentiation of instruction within class grouping on achievement in mathematics. After a pre-test and post test measure, she found that students with distinct needs who received differentiated instruction scored significantly higher scores than those who did not receive.

Heuser (2000), in his mathematics and science workshops on differentiated instruction, concluded that this method is the answer to meeting diverse needs of learners. He noted that pupils learn best when they are actively engaged in mathematics learning and when they are given an opportunity to interact with the teacher and their peers in the classroom. He further argues that pupils develop deeper comprehension of mathematical concepts when they are given a platform of constructing their own knowledge. Hodge (1997) in his study also concluded that students who were prepared for tests using differentiated instruction showed statistically significant gains in their mathematics scores.

Dunn et al. (1995) revealed that instructional interventions designed to meet the learning needs of the students led to a statistically significant difference in achievement for such students over others not being accommodated. Many scholars (such as: Anderson, 2007; Benjamin 2002; Smith III, 2010) have advocated for differentiated instruction as it is research-based and should no longer be an option but a must.

Reed (2004) indicated that differentiated instruction provides one method by which students in a heterogeneously grouped mathematics classroom with wide range of individual interests and abilities can reach their full potential of learning. Smith (2010) also argued that when teacher differentiate mathematics instruction, they provide their students with varied opportunities to learn and grow. Lawrence-Brown (2004) also alluded that differentiated instruction does not only bring about efficient and effective learning of mathematics to students, it also creates a sense motivation among students as students begin to view themselves as successful mathematicians.

Gillies (2000) argues that by differentiating mathematics instruction, learners gain better understanding of their classmates needs, their point of view and also a better perception of problems. It is on this basis that the National Council of Teachers of Mathematics (2000) suggested a shift a shift away from the traditional methods of teaching mathematics which focused on each individual learner with a pencil and paper to interactive discussion based mathematics classroom.

Grimes and Slavin (2009) concluded that a differentiated mathematics instruction based of learners' readiness levels meets the needs of learners below the grade level as well as those who are above the class average performance. They further indicated that differentiated instruction is correctly applied to the mathematics lesson, it ensures learners success. Tomlinson (2001) concluded that differentiated instruction raises the bar of all learners as it is effective for all students.

2.7 Barriers to effective differentiation in teaching mathematics

Like other avenues of teaching, differentiated instruction has its own barriers. Carolan and Guinn (2007) asserted that in the quest of differentiating instruction, teachers have insufficient time for its activities. Rodriguez (2012) noted that differentiated instruction lessons are time consuming because teachers requires more planning and analysis time in that all cannot get done effectively within short allocated time on the school timetable. Within the allocated time teachers of mathematics still have a syllabus to cover with high expectations of results and above they normally have huge workload.

(VanSciver 2005: 39) further alluded that "differentiated instruction is time consuming, resource intensive and complex". This indicates that implementing differentiated instruction demands a lot dedication and intrinsic motivation in the teacher.

Affholder (2003) opines that lack professional resources and support from the administration and government is also a barrier to effective application of differentiated instruction. Rodriguez (2012) argues that differentiated instruction to be a success, teachers of mathematics must be supported by the school administration by providing them with ongoing staff development and training tailored to meet the needs of both teachers and pupils.

Teachers' attitudes have also been included in the list of barriers to effective differentiating of instruction. Tomlinson (1995) noted that there is a fear among teachers of lacking the knowhow of assessing readiness levels of their learners and how to devise appropriate learning strategies. Teachers also have a fear of lacking teacher models to talk about this method of instruction.

2.8 Summary of literature review

The reviewed related literature indicates that differentiated instruction is not a new concept as this teaching approach has been in existence even before the 20th century. One-room schoolhouse is an example of differentiated instructions by teacher in attempting to meet the various individual needs of their pupils (Anderson, 2007).

The reviewed literature further indicates that there is need of employing the principles of differentiating instruction in teaching of mathematics as our contemporary classrooms are characterised by academic diversity. There is need for teachers of mathematics to migrate to better teaching approaches like differentiated instruction where a teacher embraces and appreciates learner variance. Literature review indicates that using differentiated instruction promotes pupils' access and retention of the intended content. Tomlinson (2001) argued that if we teach today the way we taught yesterday, we rob the children's future.

Reviewed literature has also outlined the various strategies and stages of differentiating instruction in mathematics teaching. It classified the stages as content, process and product. Content are what pupils need to learn, process includes methods of delivering and product is evidence of learning. Reviewed literature also indicates important ingredients of an effective differentiated instruction in a mathematics classroom such as formative assessment, goal setting with pupils, administrative support as well as a special recognition that differentiating instruction differ from one classroom to another depending on diversity of learners.

Researchers in this reviewed related literature have not only focussed their attention on the effectiveness and benefits of differentiated instruction, they have also reviewed barriers to effective differentiation in teaching mathematics. Among the many barriers to effective differentiation in mathematics teaching highlighted in reviewed literature are insufficient time to

carry out differentiated instruction activities, lack of professional resources and support from administration and government. The other barrier to effective differentiation of instruction in mathematics was teachers' attitudes mainly caused by lack of knowhow of devising appropriate learning strategies.

It is however important to note that most of this reviewed literature is from outside Zambia. This in itself suggests that there is little research on the subject of differentiated instruction in Zambia resulting in the knowledge gap in this area. This gap prompted me to undertake a study that focused on whether teachers of mathematics in secondary schools accommodated the various individual learning needs of their pupils. It specifically aimed at investigating the extent to which teachers of mathematics in secondary schools use the practice of differentiated instructions in meeting the varying needs of their pupils.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents methods of research which were used in the study. It discusses the research design, research site, target population, sample population and sampling procedure, research instruments, data collection procedure and data analysis.

3.2 Research design

In order to fulfill the purpose of the study, the researcher used a descriptive survey. Orodho (2003) defines descriptive survey as a method of collecting information by interviewing or administering a questionnaire to a sample of individuals. It can be used when collecting information about people's attitudes, opinions, habits or any variety of educational and social issues (Orodho and Kombo). This descriptive survey combined both qualitative and quantitative approaches. It is however important to note that it was more qualitative and partly quantitative. This helped in discovering information or data which could have possibly been missed if one research paradigm was used. It is also important to note that preference was given to descriptive survey as it accommodated a variety of data collection instruments which generated large amount of data concerning the stated problem. There is a strong argument by researchers that integration of quantitative and qualitative methods yields richer data and validity than using a single method (Creswell, 2003; Kombo & Tromp, 2006). It is important to state that descriptive design was used to describe the state of affairs as it exists. Descriptive survey design describes what we see, hence reveals the actual picture of the situation through emerging trends from the

study. It also enables the researcher to obtain in-depth information of one's findings to the larger population (Leedy, 1993; Maree, 2007).

3.3 Research site

The research was conducted in Choma District the administrative capital of Southern Province of Zambia

3.4 Target population

This study targeted all secondary school teachers of mathematics and all grade eleven learners in Choma Districts of Southern Province of Zambia. Grade elevens were selected on the basis of being less busy in the third term of the Zambian school calendar, for being more mature in reasoning and their capability of responding in writing and having had a longer period of interaction with their teachers which was very significant in the study.

3.5 Sample and sampling procedure

Table 2: Gender of Respondents

Gender	Learners	Teachers of Mathematics
Male	67	12
Female	93	6
Total	160	18

Table 2 shows that the majority of pupils in the study were girls 93(58%) out of 160 while 67(42%) were boys. Table also shows that out of 18 teachers of mathematics that took part in the study 12(67%) were males and 6(33%) were females. This shows the dominance of male teachers in the departments of mathematics in secondary scho**o**ls

Table 3: Age distribution of the learners in the study

Age	**Numbers of Learners**
14-17	130
18-20	29
0ver 21	1

Table 3 shows that the ages of pupils ranged from 14 to 21 with the majority 81% being in the age range of 14 to 17 years.

3.4.3 Teachers' professional qualification

Respondents were asked to indicate their highest professional qualification attained. Figure 1 shows their highest qualifications

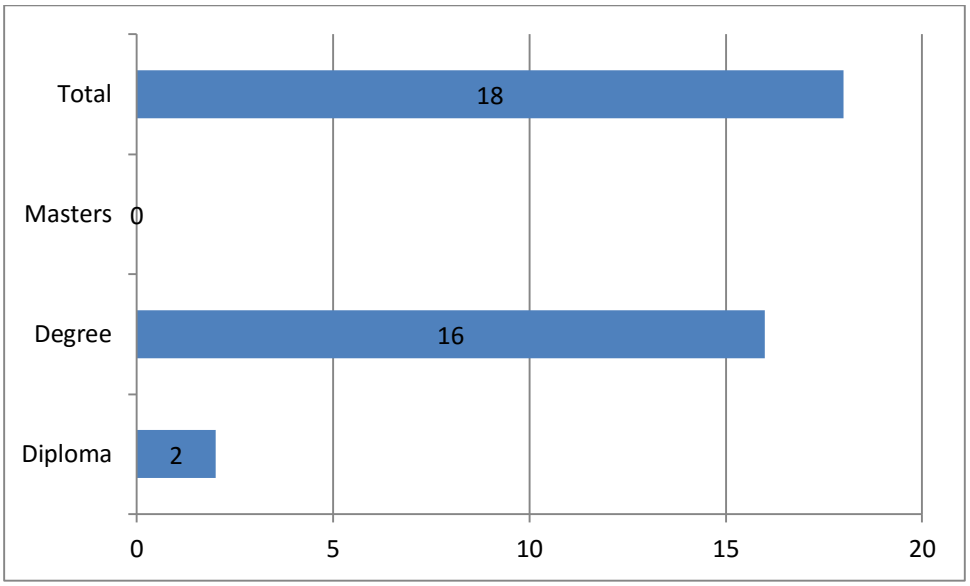

Figure 1: Teachers highest professional qualifications attained

Figure 1 indicates that there is a larger number of graduate teachers than diploma holders in various departments of mathematics in secondary schools.

Table 4: Teachers' teaching experience

Respondents were asked to indicate the years devoted to teaching of mathematics at secondary level. Table 4 indicates the numbers of years they had devoted to the teaching of mathematics at secondary level.

Teachers' teaching experience

Experience of teaching mathematics	**Number of teachers**
1-5 years	8
6-10 years	6
11-15 years	2
Over 15 years	2

Out of 18 respondents 8(44%) and 6(33%) had taught between 1 to 5 years and between 6 to 10 years respectively at a secondary school level. On the other hand, 2(11%) and 2(11%) had spent between 11 to 15 years and over 15 years respectively teaching at secondary school level. This indicates that majority of teachers had less than 10 years teaching experience at secondary school level.

Choma district has twelve secondary schools. However in this study, the sample was drawn from four schools that were simple randomly selected. Each of the 12 secondary schools was assigned a name tag using the first 12 letters of the alphabet from A to L and was placed in a bag. The name tags were thoroughly shaken and four name tags were picked at random from the bag successively. The schools that were represented by the four name tags provided the sample for the study. The study had a total sample population of 178 respondents broken down as follows 18 teachers of mathematics and 160 pupils. Purposive sampling was used to select the 18 teachers of mathematics from the four respective secondary schools. Purposive sampling was ideal to select teachers as it involves selecting cases based on specific purposes (Kombo and Tromp, 2010). Random sampling was used to select a class of 40 pupils that completed a questionnaire from one class per school and eventually that was the same class that was observed by the researcher. Random sampling was ideal in the selection of pupils as it gave equal chance of being selected for each pupil. It is also important to note that this sampling only applied when a selected teacher of mathematics participating in the study had more than one grade eleven classes.

3.6 Research instruments

In order to achieve the objectives of this study, two sets of questionnaires and an observation checklist were used.

3.6.1 Questionnaire for teachers

A questionnaire for teachers of mathematics (see Appendix 1) was designed by the researcher and used to obtain an in-depth insight and information of what teachers of mathematics claimed to be their current classroom practices in line with meeting the individual learning needs of their pupils. Teachers were given enough time to complete the questionnaires after a pilot test of questionnaire. The questionnaire had both open-ended and close ended questions. Open-ended questions gave respondents room for personal opinions and understanding on the subject under the study. The key questions included; whether teachers of mathematics were aware of the diverse needs among their pupils, whether teachers attempted to meet these diverse learning needs among their pupils and if they attempted what strategies did they use to meet these needs and finally what challenges did teachers of mathematics face in their quest to respond to the diverse learning needs of their learners.

3.6.2 Questionnaire for pupils

A questionnaire designed by the researcher (see Appendix 2) for pupils to complete was also one of the instruments used in this study. It aimed at supplementing and comparing their responses to teachers' responses as well as classroom observations. Just like the questionnaire for teachers, it also had closed and open-ended questions. It is important to note that these questionnaires were self-administered to the selected respondents. The key questions in the pupil's questionnaire were similar to those in the questionnaire for teachers of mathematics. The major questions were;

whether their teachers of mathematics provided regular assessments in class, whether their teachers provided individual attention to both slow and fast learners, whether teachers of mathematics provided them with a platform of choices of what and how to learn in a mathematics lessons and also to state some of the problems their teachers face in the process of trying to meet pupils' individual learning problems.

3.6.3 Observational checklist

The other instrument which was used was an observation checklist (see Appendix 3) where the researcher personally observed the teaching practices that teachers of mathematics were actually using. This observation checklist had a list of some specific teaching strategies that characterised the variety of ways teachers of mathematics in secondary schools could meet the needs of learners in their classes. This helped to validate data which was obtained through questionnaires.

3.7 Procedures for data collection

Primary data was obtained using questionnaires for teachers of mathematics and pupils and through lesson observations. An observation checklist was devised with a list observable teaching strategies that charecterised differentiated instruction in a secondary school mathematics class. A researcher observed a total of 4 teachers of mathematics 1 from each of the 4 selected secondary schools. This was done after seeking permission from school managers of the respective schools. Questionnaires were designed by the researcher and were distributed to the participants when he went in the field. Two sets of questionnaires were prepared; one for the 18 teachers of mathematics and 160for grade 11 pupils. It's important to note that all the distributed questionnaires were received back.

3.8 Data Analysis

A mixed kind of approach was used to analyse the collected data. This approach allowed for the concurrent analysis of both quantitative and qualitative data. Data collected were analysed as follows:

3.8.1 Quantitative data

The Statistical Package for Social Sciences was used to analyse quantitative data from questionnaires. Data from questionnaires of teachers of mathematics and pupils was coded and the Statistical Package for Social Sciences was used was used to come up with the descriptive statistics basically in form frequency tables and histograms.

3.8.2 Qualitative data

Qualitative data obtained from questionnaires and from an observation checklist were analysed by using the constant comparative method of qualitative analysis which involves breaking down the data into discrete units and coding them into categories. Similar responses were coded and grouped into emerging themes. At the end, descriptive analysis using of statistical comparisons in terms one measure of central tendency called mode was used to analyse the grouped categories.

CHAPTER FOUR

PRESENTATION OF FINDINGS

4.1 Introduction

This chapter presents the findings of the research from the questionnaires which were administered to teachers and pupils and lesson observations undertaken to investigate the extent to which teachers of mathematics employed practices of differentiating instruction to meet individual learning needs of their pupils in classrooms in four selected secondary schools in Choma district.

4.2 Findings from pupils

4.2.1 Pupils views on whether teachers of mathematics are doing enough in meeting their individual learning needs in mathematics

Respondents were asked to indicate whether their teachers were doing enough in meeting individual needs of their learners. Their responses are indicated in Figure 2.

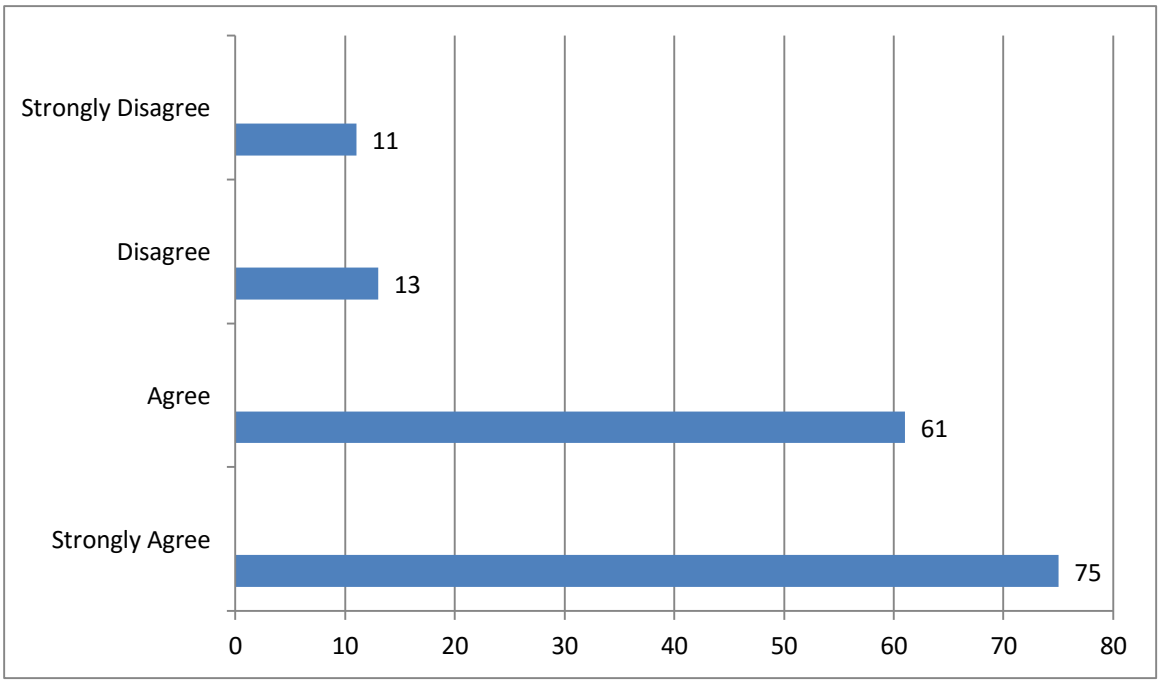

Figure 2: Pupils views on whether teachers were doing enough to meet their needs

Figure 2 shows that 75 (47%) strongly agreed, 61(38%) agreed, 13(8%) disagreed and 11(6.9%) strongly disagreed out of 160 that their teachers were doing enough to meet their individual needs in mathematics. From the pupils' point of view, most teachers of mathematics were doing fine in the area of meeting the needs of their pupils.

4.2.2 Pupils' views on whether teachers of mathematics regularly give homework and exercises

Respondents were asked to indicate how much they agreed or disagreed to the assertion that their teachers of mathematics provided them with homework and exercises regularly. Their responses are shown in Figure 3

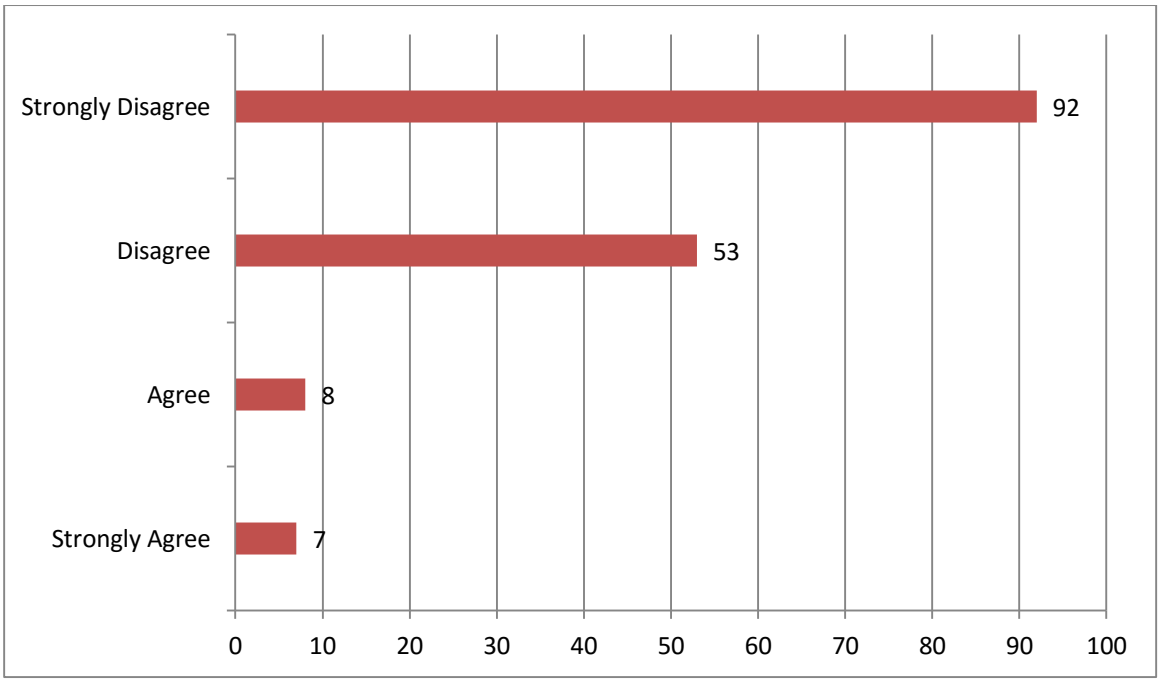

Figure 3: Pupils views on how frequent teachers of mathematics provided homework and exercises

Figure 3 shows that majority of pupils 92(58%) strongly agreed, 53(33) agreed that teachers of mathematics regularly gave homework and exercises to their pupils while 8(5%) disagreed and 7(4%) strongly disagreed. This suggests that most teachers of mathematics have been implementing the home work policy and regularly provided class exercises. Providing homework and class exercises regularly are very vital activities in differentiation of mathematics instruction as they act as everyday indicators of individual progress among pupils.

4.2.3 Pupils' views on whether teachers of mathematics give a test at the beginning of each school term

Respondents were asked to indicate whether their teachers of mathematics provided some form of assessment (test) either at the beginning of each school term. Their responses are shown in Figure 4**.**

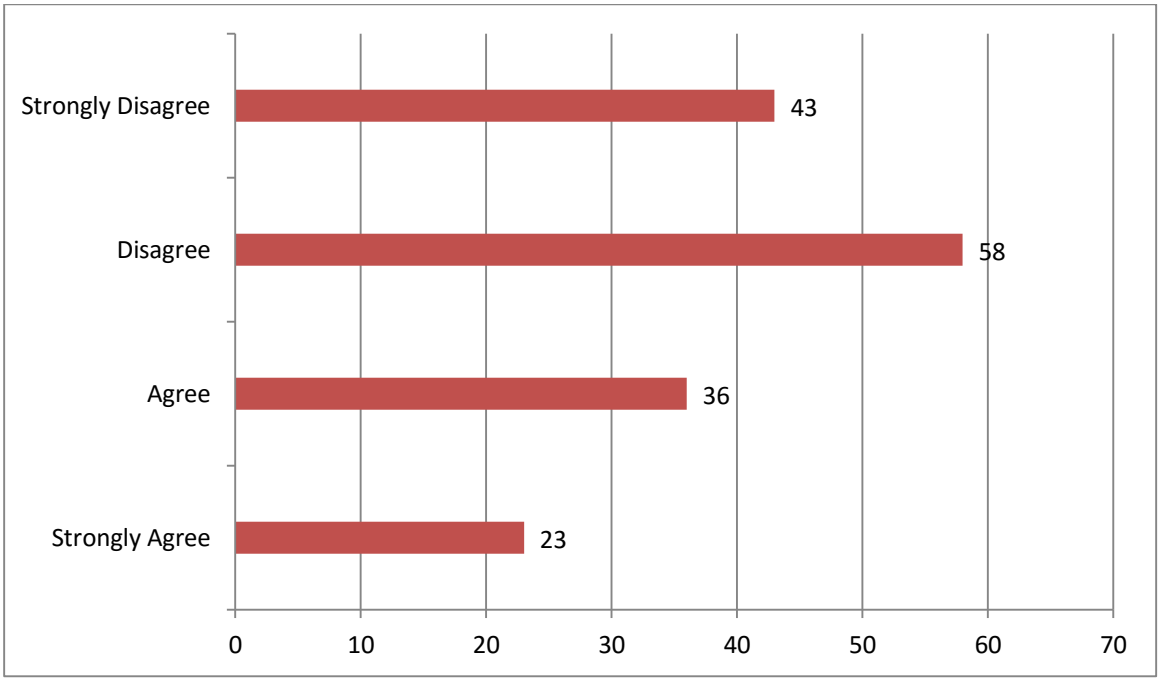

Figure 4: Pupils' views of whether teachers provide any form of assessment either at the beginning of each school term

Figure 4 shows that 43(27%) strongly disagreed, 58(36%) disagreed to the assertion that teachers of mathematics provided a test either at the beginning of each school term. It also shows that 23(14%) strongly agreed and 36(23%) agreed to it. This indicates that majority of teachers of mathematics in secondary schools begin each school term without any form of assessment of their pupils. An assessment the beginning of each term is very important for teachers to understand the level of ability and readiness for each individual pupil. This provides the teacher of mathematics with necessary information to use in the process of planning as well as delivering a lesson in class.

4.2.4 Pupils' views on whether teachers of mathematics provide extra work to fast learners

Respondents were asked to indicate whether teachers of mathematics provided extra work to fast learners in class. Figure 5 indicates their views.

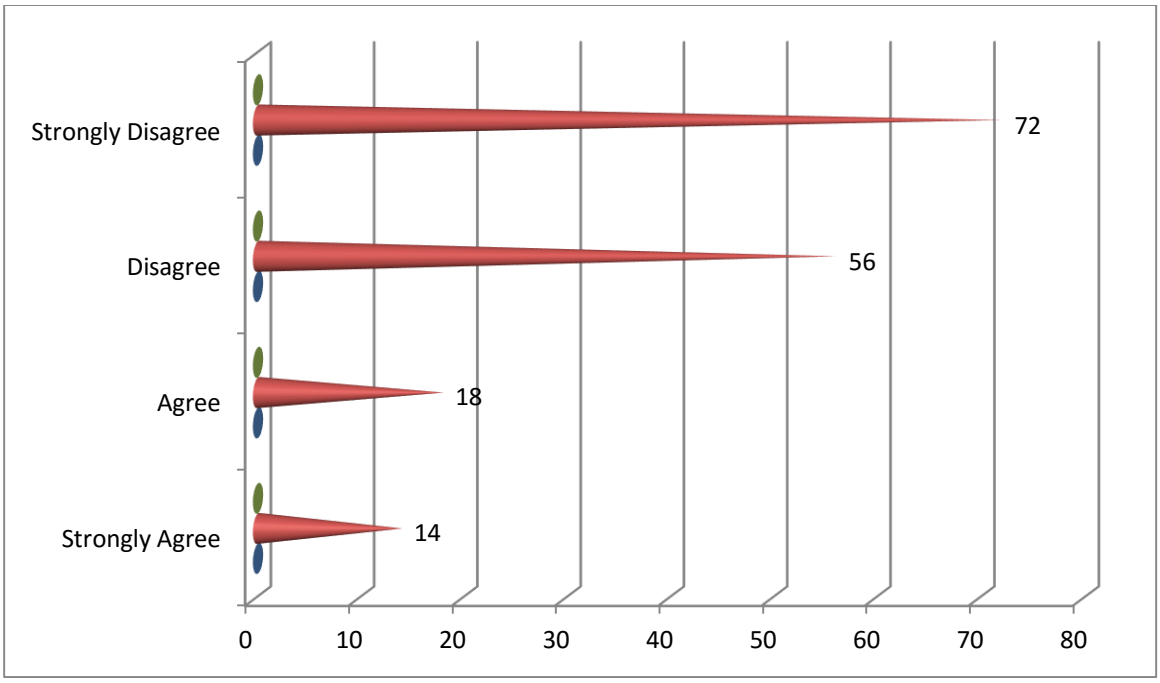

Figure 5: Pupils' views on whether teachers of mathematics provided extra work for fast learners.

Figure 5 indicates that the majority of pupils 72(45%) strongly disagreed, 56(35%) disagreed that teachers of mathematics provide extra work to their fast learner. Figure 5 further shows that

14(9%) strongly agreed and 18(11%) agreed that teachers provided extra work to their fast learners. It's apparent from Figure 5 that majority of teachers of mathematics in secondary schools paid little or no attention to the needs of fast learners.

4.2.5 Pupils views on whether teacher of mathematics provide individual attention to slow learners

Respondents were asked to indicate how much they agree or disagree to the fact that teachers of mathematics provided attention to slow learners in their classrooms. Their views are indicated in Table 5.

Table 5: Pupils views on whether teachers of mathematics provide individual attention to slow learners

Response	Frequency	percent
Strongly Agree	34	21
Agree	57	36
Disagree	40	25
Strongly Disagree	29	18
Total	160	100

Table 5 shows that out of 160 respondents, 34(21%) strongly agreed, 57(36%) agreed, 40(25%) disagreed and 29(18%) strongly disagreed that teachers of mathematics provided individual attention to learners that appeared to be slow in learning and understanding of mathematics.

4.2.6: Pupils' views on whether teachers of mathematics give special recognition to pupils who provide a correct response during a lesson.

Pupils were asked to indicate the extent to which they agreed or disagreed to the assertion that their teachers of mathematics provided special recognition to pupils that gave them correct responses during lessons. Their views or responses to the assertion are shown in Table 6

Table 6: Pupils' views on whether teachers of mathematics give special recognition to pupils provide a correct response during a lesson

Response	Strongly Agree	Agree	Disagree	Strongly Disagree	Total
Frequency	23	77	44	16	160
Percent	14	48	28	10	100

Table 6 indicates that 77(48%) respondents agreed, 44(27%) disagreed and 23(14%) strongly agreed and the rest 16(10%) strongly disagreed to the assertion that teachers of mathematics provided special recognition to pupils who provided them with correct responses during the lesson. It is apparent from Table 6 that most teachers of mathematics in secondary schools provide a special recognition to their pupils whenever they (pupils) provided them with a correct response.

4.2.7 Pupils' views on whether teachers of mathematics vary time allocation for each learner to complete a task

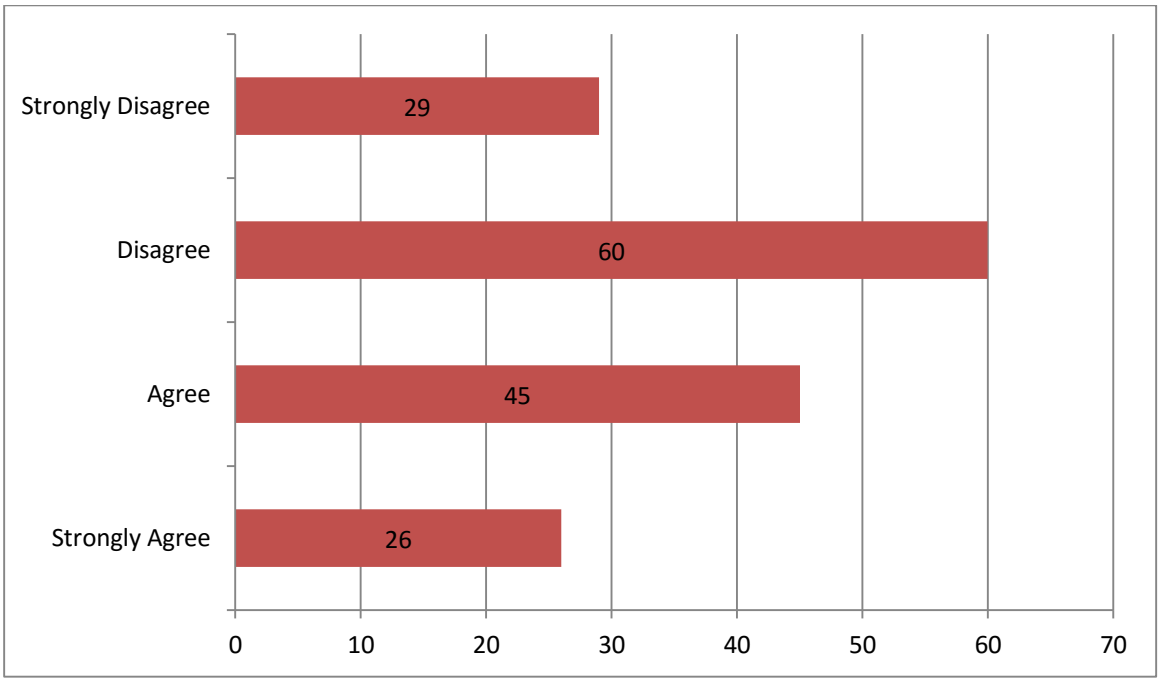

Figure 6: Pupils' responses on whether teachers of mathematics varied time allocation on completing tasks among their learners

Figure 6 indicates that 29(18%) strongly agreed, 60(38%) agreed, 45(28%) disagreed and 26(16%) strongly disagreed to the assertion that teachers of mathematics varied time allocation for each learner to complete a task in a single lesson. From Figure 6, it can be concluded that a considerable number of teachers of mathematics from the pupils' views never varied time allocation among their pupils to complete their tasks within the lesson.

4.2.8 Pupils' views on whether teachers of mathematics encourage pupils to work with other pupils in our mathematics lessons

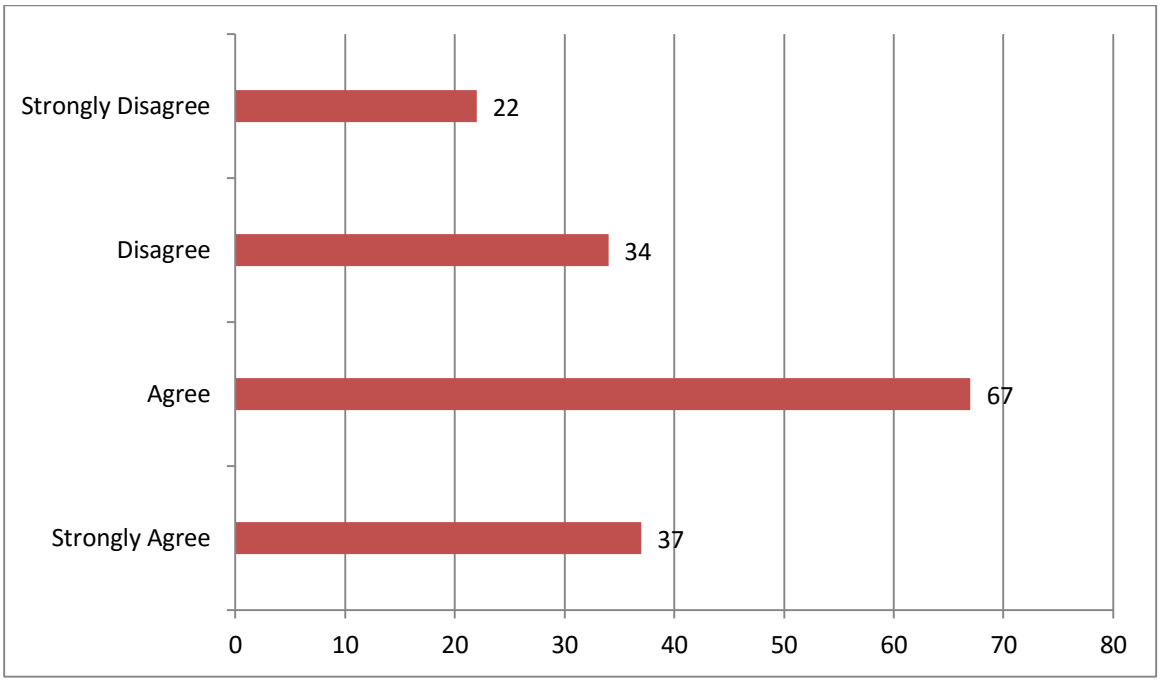

Figure 7: Pupils' views on whether teachers of mathematics encouraged cooperative learning in class

Figure 7 shows that 67(42%) pupils out of 160 agreed, 37(23%) strongly agreed while 34(21%) disagreed and 22(14%) strongly disagreed to the above statement. This indicates that majority of teachers of mathematics encouraged cooperative learning

4.2.9: Pupils' views of whether their teacher of mathematics provide them with an opportunity to choose what to learn and how to learn during mathematics lessons

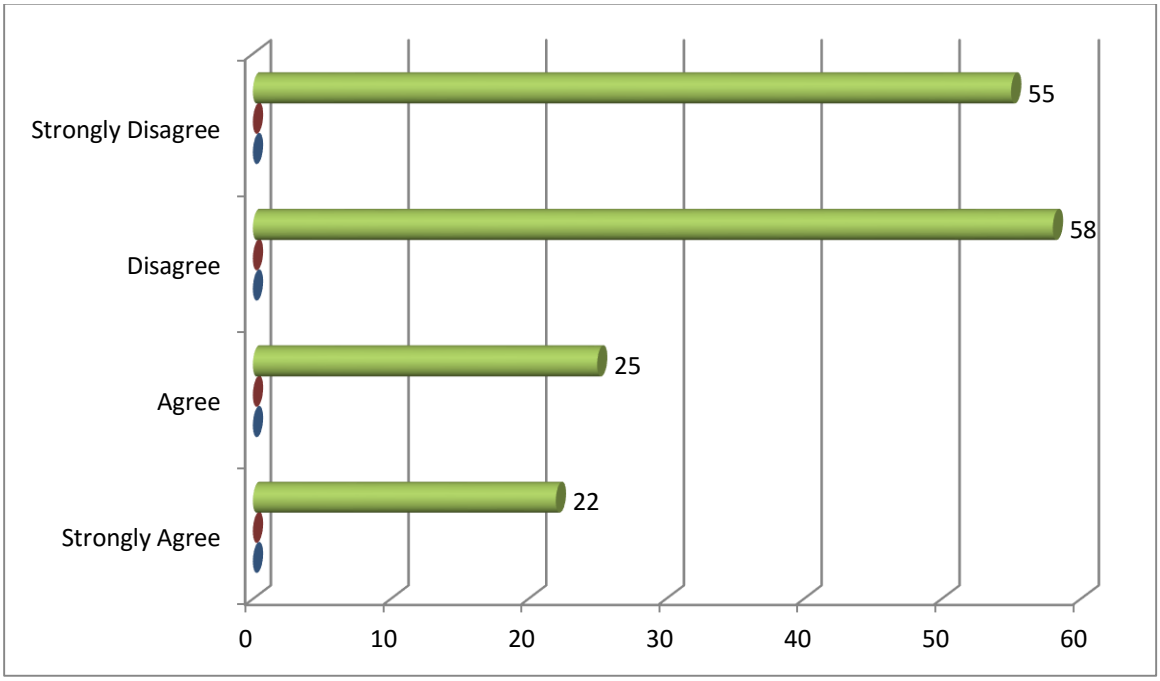

Figure 8: Pupils' responses on whether their teachers of mathematics provided them with an opportunity to choose what to and how to learn

Figure 8 shows that the majority of pupils disagreed 58(36%) and 55(34%) strongly disagreed that they had choice on what to learn and how to learn in mathematics while 25(16%) agreed and 22(14%) strongly disagreed. This suggests that majority of the teachers of mathematics in secondary schools rarely provide a platform for pupils to choose what to learn and how to learn it.

4.2.10 Teachers of mathematics use of different teaching methods and approaches to solve a single mathematical problem

Pupils were asked whether their teachers of mathematics employed a variety of teaching methods or approaches to solve a single mathematical problem. Their responses are shown in Figure 9.

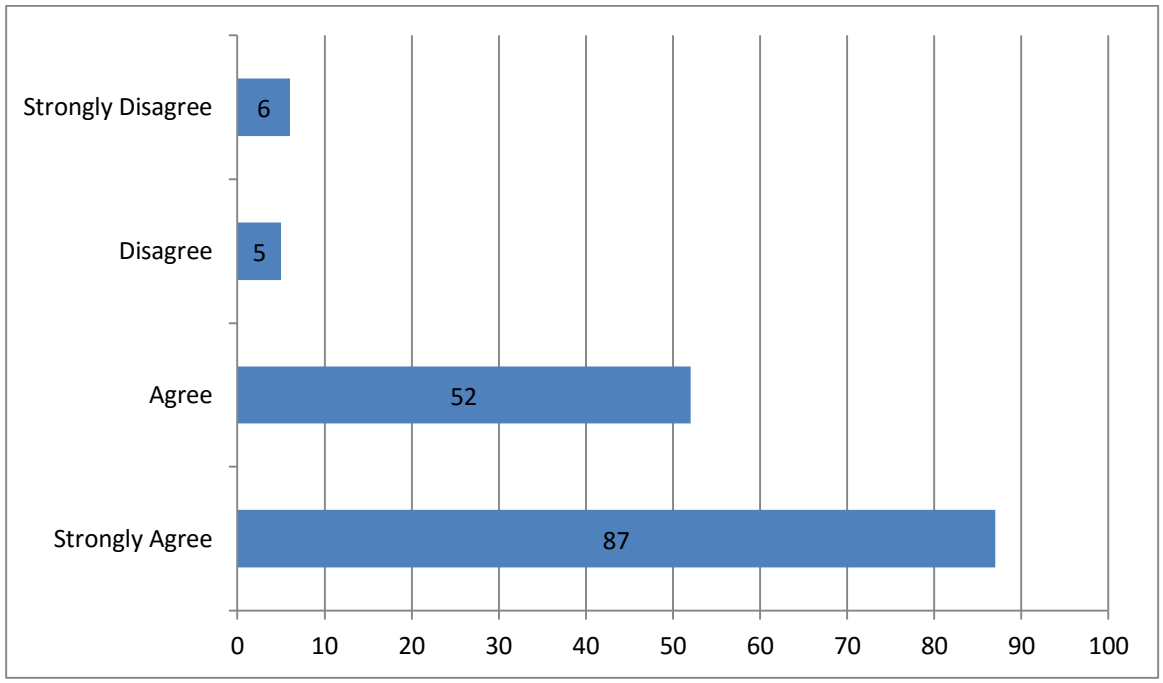

Figure 9: Pupils' views on whether teachers of mathematics use different teaching methods and approaches to solve a single mathematical problem

Figure 9 indicates that out of 160 respondents, 87(54%) strongly agreed 52(33%) who agreed, 16(10%) strongly disagreed and t 5(3.1%) disagreed. From Figure 9, most pupils indicated that their teachers of mathematics provide a variety of approaches in solving a single mathematics problem in a lesson.

4.2.11: Teachers of mathematics provide pupils with an opportunity to ask questions during and after the lesson

Pupils were asked whether their teachers of mathematics provided them with an opportunity to ask questions during lessons. Their responses are shown in Figure 10 below.

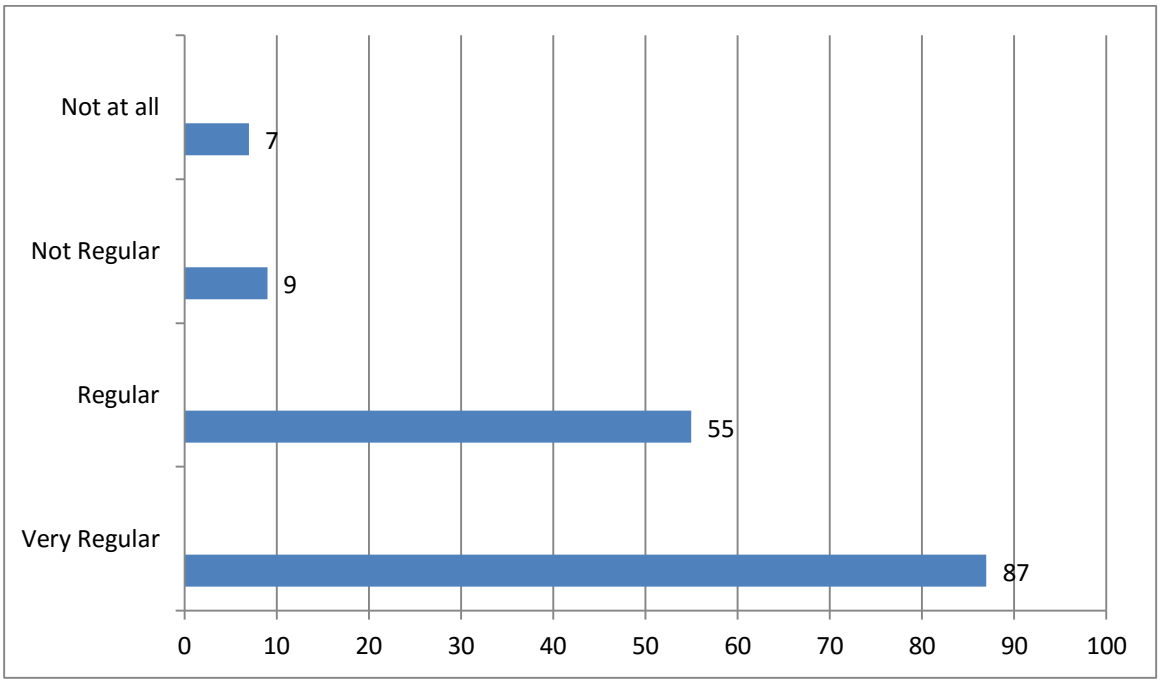

Figure 10: Pupils views on whether teachers of mathematics provided them with an opportunity to ask questions during and after the lesson

Out of 160 pupils, more than half, 87(56%) strongly agreed while 55(34%) agreed that teachers of mathematics provided an opportunity for questioning to pupils in their lessons. Figure 10 further indicates that out of 160 respondents, 9(5.6%) and 7(4.4%) disagreed and strongly disagreed respectively that teachers provided a platform for questioning. From Figure 10, more than 80% of respondents (pupils) indicated that most teachers of mathematics provided them with an opportunity to ask questions during and after the lesson.

4.3 Findings from teachers

4.3.1 Teachers' opinion on pupils individual learning differences

Respondents were asked whether there were differences in the way their pupils learnt and understood mathematical concepts. Their responses are indicated in the Table 7.

Table 7: **Teachers' opinion on their pupils individual learning differences**

Response	**Frequency**	**percentage**
Yes	18	100
No	0	0
Total	**18**	**100**

Table 7 shows that out of 18 respondents, 18(100%) indicated that there were differences in the way their pupils learnt and understood mathematical concepts in their classrooms**.** This indicates that most teachers are knowledgeable and aware of the learning variance and comprehension differences among their learners.

4.3.2 Are teachers of mathematics doing anything to meet their pupils' individual learning needs?

This question was posed to teachers of mathematics and their responses are shown in Table 8

Table 8: Teachers of mathematics' responses on whether they were doing something to meet the individual learning needs of their learners

Response	Frequency	Percentage
Yes	**16**	**89**
No	**02**	**11**
Total	**18**	**100**

Table 8 indicates that out of 18 respondents, 16(89%) agreed that they were making efforts in their classrooms to meet individual needs among their learners while 2(11%) did not make any effort despite noticing the differences among learners. This indicates that being aware of individual differences among pupils, most teachers of mathematics take time to attend to individual needs of their learners.

4.3.3 Assessment at the beginning of each school term

Respondents were asked whether they provided some form of assessment at the beginning of each school term. Their responses are indicated in the Table 9

Table 9: Teachers of mathematics responses on the frequency of assessment at the beginning of the term of academic year

Response	Frequency	Percentage
Yes	13	72
No	05	28
Total	**18**	**100**

From Table 9, it is indicated that out of 18 respondents, 13(72%) provided some form of assessment at the beginning of each school term while 5(28%) did not.

4.3.4 How often teachers of mathematics assess pupils with regard to their individual learning needs

Respondents were asked how regular they assessed their pupils with regard to their individual needs. Figure 11 indicates their responses.

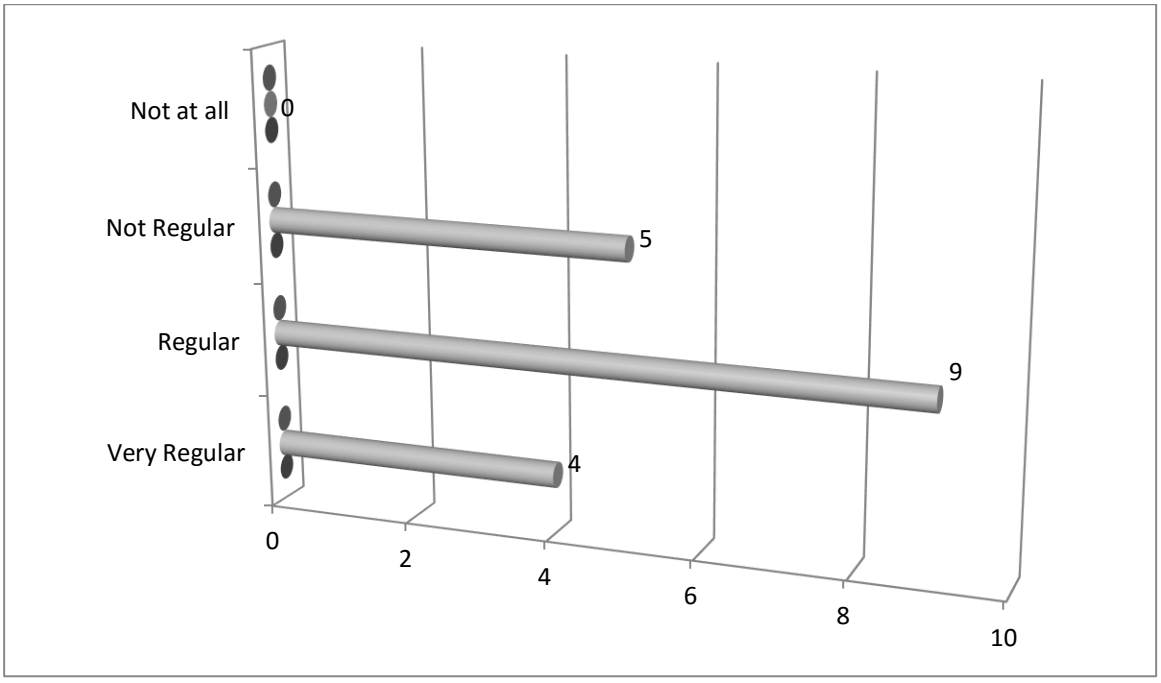

Figure 11: How often teachers of mathematics assess pupils with regard to their individual learning needs

Figure 11 indicates that out of 18 respondents, 9(50%) were regular in assessing their learners with regard to their needs, 4(22%) were very regular and 5(28%) were not regular in assessing the needs of the learners in their classrooms. It is apparent that almost all teachers of

mathematics regardless of the frequency provide some form of assessment at the beginning of each school term.

4.3.5 Teachers' use of flexible grouping strategy

Respondents were asked to indicate whether they were using flexible grouping strategy to meet the needs of their learners. The responses are shown in Table 10.

Table 10: Teachers of mathematics' use of flexible grouping work in meeting the needs of their learners

Response	**Frequency**	**Percentage**
Yes	**15**	**83**
No	**3**	**17**
Total	**18**	**100**

Table 10 shows that out of 18 respondents, 15(83%) indicated that they were using flexible grouping strategy to meet the needs of their learners while 3(17%) indicated that they were not using flexible grouping strategy.

4.3.6 How regular teachers of mathematics gave homework and remedial work to their pupils

Respondents were asked to indicate how regular they provided homework and remedial work to their pupils. Figure 12 shows their responses.

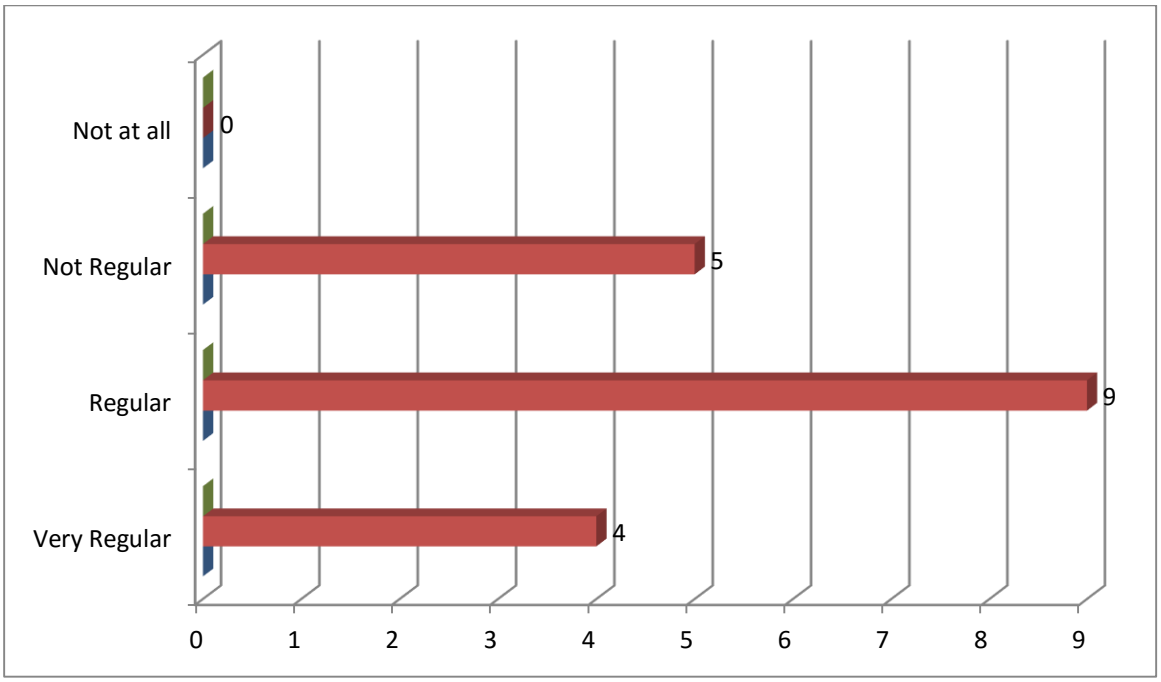

Figure 12: Teachers' responses on the frequency of giving homework and remedial work to their pupils

Out of 18 respondents, 4(28%) indicated that they were very regular in giving homework and remedial work to their pupils, 9(50%) were regularly giving homework and remedial work to their pupils. It's also important to note that none of the 18 respondents indicated that they were not giving homework and remedial work at all.

4.3.7 Teachers' knowledge of skills needed to meet individual mathematical needs of pupils in their classroom

Teachers were asked whether they were well trained and well equipped with adequate skills needed to meet individual mathematical needs of pupils in their classrooms. Figure 13 shows their responses.

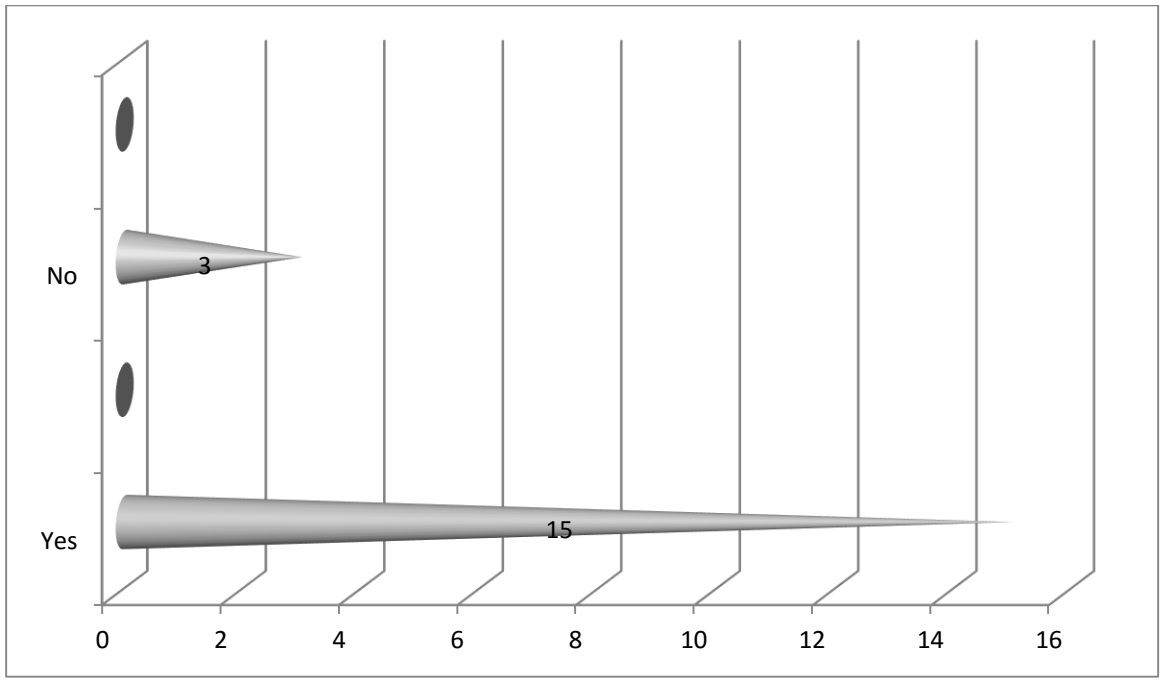

Figure 13: Teachers' views on their knowledge level of differentiating instruction

Out of 18 respondents 15(83%) agreed that they were well trained and equipped with the necessary skills needed to meet their pupils' mathematical needs while 3(17%) disagreed.

4.3.8 Administrative support to teachers of mathematics towards the implementation of differentiated instruction

Teachers of mathematics were asked to state how supportive administration was towards implementation of activities that were aimed at meeting individual needs of pupils in school. Figure 14 shows their responses.

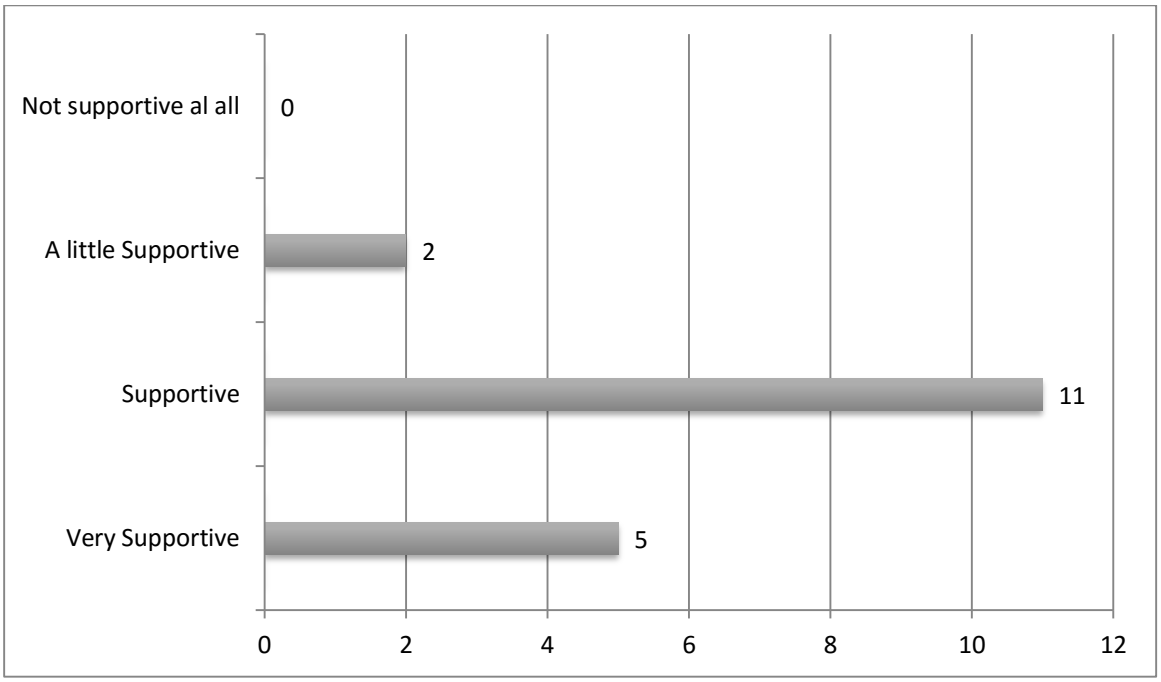

Figure 14: Teachers' views on administrative support towards meeting the needs of learners

Figure 14 shows the views of the teachers on whether the school administration was supportive towards meeting individual learners' mathematical needs. Out of the 18 respondents, 5(28%) and11 (61%) agreed that the school administration was very supportive and supportive respectively towards programs aimed at meeting the learners needs in mathematics. Of the 18, 2(11%) indicated that administration was just a little supportive to the learners with mathematical difficulties.

4.3.9 Teaching strategies used to meet the learning needs of fast learners

Respondents were asked to indicate the teaching strategies they were using to meet the needs of fast learners. Their responses are indicated in Table 11.

Table 11: Teaching strategies used by teachers of mathematics in meeting the needs of fast learners in their classes

Teaching strategy	**Frequency**	**Percentage**
Giving higher order or challenging questions	10	50
Giving pupils extra work	3	15
Pupils teach their friends	3	15
Allow pupils to demonstrate their understanding of specific mathematics concepts	2	10
Provide pupils with guidance and counselling	1	5
Responding to pupils' inquisitive questions	1	5
Total	**20**	**100**

Table 11shows that out of 20 responses, 10(50%) indicated that they used higher order or challenging questions, 3(15%) used peer teaching and 3(15%) used giving of extra work respectively as strategies of meeting the needs of fast learners.

4.3.10 Strategies teachers of mathematics use to meet the individual mathematical learning needs of their learners

Respondents were asked to state the teaching strategies that they had been using to meet their learners individual mathematical needs. Table 12 shows some strategies they indicated.

Table 12: Teaching strategies used by teachers of mathematics to meet the mathematical learning needs of their learners

Teaching strategy	**frequency**	**percentage**
Group work	7	**22**
Individual tasks/ Extra work	6	**19**
Remedial work	4	**13**
Regular assessment	4	**13**
Pupil demonstration	3	**13**
Use of visual aids	3	**9.4**
Question and answer sessions	3	**9.4**
Discussion	1	**3.1**
Recap strategy	1	**3.1**
Total	**32**	**100**

Table 12 shows that out of 32 responses, 7(21.9%) indicated that they used group work teaching strategy, 6(19%) used individual tasks or extra work, 4(13%) used remedial work, 4(13%) used regular assessment, 3(9.4%) used pupil demonstration, 3(9.4%) use visual aids, 3(9.4%) used

question and answer methods to meet the individual mathematical learning needs of their learners.

4.3.11 Challenges faced by teachers as they try to meet the individual needs of their learners

Respondents were asked to state some challenges they face when attempting to reach out for their pupils' individual mathematical differences in their classrooms. Table 13 shows the challenges they faced.

Table 13: **Challenges teachers face in the quest of differentiating instruction in their mathematics classrooms**

Challenges	**Frequency**	**percentage**
Over-enrolment	8	**25**
Lack of cooperation among some pupils due to their negative attitude towards mathematics	8	**25**
Limited time to attend to slow learners due to reduced number of Periods in the week allocated for mathematics	7	**22**
Pupils' poor mathematical background	3	**9.4**
Managing the gap between the slow and fast learner	3	**9.4**
Insufficient teaching/learning materials	2	**6.3**
Desire by stakeholders to cover the syllabus as directed by the supervisors	1	**3.1**
Total	32	**100**

Out of 32 responses 8(25%) indicated over-enrolment and 8(25%) indicated pupils' lack of cooperation due to their negative attitude towards mathematics as challenges in the process of meeting individual needs of learners in their classrooms.Table13 further revealed that 7(22%) indicated limited time as a challenge due to the inadequate number of periods allocated for mathematics per week in some schools. This was followed by 3(9.4%) who indicated Pupils' poor mathematical background and 3(9.4%) who suggested managing the gap between the slow and fast learners respectively as some of the challenges teachers of mathematics face in the quest of differentiating instruction in their mathematics classrooms.

4.3.12 Suggestions from teachers of mathematics on how best to respond to the challenges of meeting the diverse learning needs of their learners

Respondents were asked to suggest measures to be put in place to accommodate the aspect of meeting individual needs in mathematics among their pupils within and outside the classroom. Table 14 shows their responses.

Table 14**: Teachers' suggestions on overcoming the challenges of meeting the needs of their learners**

Suggestions	**frequency**	**percentage**
Reduced class enrolment	**11**	**33**
Schools to buy sufficient and appropriate teaching and learning materials	**7**	**21**
Employing more teachers of mathematics to reduce the teaching loads	**7**	**21**
Encourage pupil participation during the lesson	**3**	**9.1**
Revert back to compulsory seven periods of mathematics per week	**3**	**9.1**
Introduce and re-introduce mathematics clubs	**3**	**9.1**
Promoting group and peer teaching during lessons	**2**	**6.1**
Provide remedial work	**2**	**6.1**
Intensify on homework policy	**2**	**6.1**
Regular assessment not just at the end of the school term	**1**	**3**
Motivate and encourage positive attitude toward mathematics among pupils.	**1**	**3**
Reduce extracurricular activities to accommodate pupil individual attention.	**1**	**3**
Encourage parental involvement	**1**	**3**
Total	**33**	**100**

Table 14 shows that out of 33 responses, 11(33.3%) respondents suggested the need for reduced enrolment of pupils per class, 7(21.2%) suggested the need for schools to procure sufficient teaching and learning materials in the mathematics departments, 7(21.2%) indicated the need for the government to employ more teachers of mathematics to reduce the teachers' workload , 3(9.1%) suggested the need to revert to the old number of periods(7) per week, 3(9.1%) suggested the need to introduce and re-introducing mathematics clubs, 3(9.1%) indicated the need for teachers to encourage pupil participation during mathematics lessons

4.4 Findings from Classroom observations

Four teachers of mathematics, one from each school, were observed with the help of their respective Heads of Department. Each teacher was observed twice in an 80 minutes period. Table 15 shows the demographic characteristics of the teachers that were observed.

Table 15: Demographic characteristics of mathematics teachers whose lessons were observed

Teacher	gender	Grade taught	qualification	Teaching experience in years
1	M	11	Degree	19
2	F	11	Diploma	8
3	M	11	Degree	6
4	M	11	Degree	3

Table 16: Teaching strategies observed from the four teachers of mathematics

	Teaching strategies under observation	**Always**	Once in a while	**Never**
1	Arranges pupils in ability groups	00	00	04
2	Uses a variety of learning styles	00	02	02
3	Encourages independent learning	01	01	02
4	Establishes learning centers or stations within the classroom	00	00	04
5	Pays attention to pupils feedback	02	01	01
6	Always asses pupils' prerequisite knowledge of the topic or area	02	02	00
7	Group students according to their readiness and interest levels	00	00	04
8	Provides a platform for pupils to demonstrate their understanding of mathematical concepts and ideas after each lesson	00	03	01
9	Provide individual attention to slow learners	00	02	02
10	Provide special attention/activities to fast learners`	00	01	03

Table 16 indicates that all the 4 teachers never arranged pupils in ability groups. Table 16 also indicates that all the 4 teachers observed neither established learning stations within the classroom nor did they group their pupils according to their readiness and interest levels. Of the 4 teachers observed, 2 once in a while used a variety of learning styles and 2 teachers never varied the learning styles. Table 16 also indicates that of the 4 teachers, 2 once in a while encouraged independent learning and the other two teachers never encouraged independent learning during the lesson. It is also noted from Table 16 that 2 out of 4 teachers always paid attention to their pupils' feedback and once in a while one teacher equally paid attention to her pupils' feedback during the lessons. On the part of assessment of prerequisite knowledge, 2

teachers once in a while and 2 teachers always conducted it. Table 16 also indicates that 3 out of 4 observed teachers of mathematics once in a while provided a platform for pupils to demonstrate their understanding of mathematical concepts and ideas during the lesson. Table 16 also indicates that 2 out of 4 teachers once in a while paid attention to slow learners and the other 2 teachers never paid attention at all to the needs of slow learners. When it came to the needs of fast learners only 1 out 4 observed teachers of mathematics once in a while paid attention while the other 3 never attempted to pay attention to fast learners.

4.5 Summary of the findings

The study has shown that most secondary school teachers of mathematics in Choma district rarely attempt to identify the varying needs among their pupils in classrooms. Most of them use more of summative than formative assessment. Responses from most pupils indicated that no form of assessment was given at the beginning of school term. The study has however shown that both teachers of mathematics and their pupils agreed to the assertion that no two pupils could learn and understand mathematical concepts in the same way.

The study also shows that teachers of mathematics were well aware of a variety of strategies and practices to use to meet the varying needs of their pupils. The teaching strategies highlighted in the study included giving regular homework and remedial work for slow learners, individual attention ,regular formative assessment, varied time allocation to complete tasks among pupils, cooperative learning through group work, use of different approaches to solve a single mathematical problem. Other teaching strategies and practices specifically for fast learners included giving high order or challenging questions, providing a platform for them to demonstrate their understanding on specific mathematical concepts, responding to their

inquisitive questions, giving extra work and providing them with guidance and counselling. Despite this knowledge, the study indicates that teachers of mathematics in Choma district rarely applied the indicated teaching strategies and practice in their classrooms, instead, they mainly taught a class as a unit.

The study revealed several challenges faced by teachers as they try to meet the individual and diverse needs of pupils. Over-enrolment, pupils' poor mathematical background, limited time, desire by stakeholders to cover the syllabus, pupils' negative attitude toward mathematics and insufficient teaching and learning materials were the major challenges indicated by the respondents. Despite these challenges the, responses from teachers shows that there is overwhelming administrative support towards programs aimed at meeting the diverse needs of pupils.

CHAPTER 5

DISCUSSION OF FINDINGS

5.1 Introduction

This chapter discusses the findings of the study that was undertaken to investigate the extent to which teachers of mathematics used differentiated instruction to meet the pupils' varying individual needs in their classrooms in four selected secondary schools of Choma District. The findings are discussed according to the objectives of the study. The objectives of the study were: to determine if teachers of mathematics take into account their pupils' differing background knowledge, readiness, interest and learning preferences at all stages of teaching and assessment; to identify different teaching strategies and practices teachers of mathematics have used to respond to the pupils' varying interests, abilities and competencies; to identify the challenges that has been faced by teachers as they try to differentiate instructions.

5.2 Consideration of pupils' differing background knowledge, readiness, interest and learning preferences at all stages of learning and assessment by teachers of mathematics

Tomlinson (2005) stated that teacher' awareness and recognition of diversity of needs among their pupils and consequently the need to teach proactively and differently to meet their varying needs is a key to differentiated instruction. This study found that all the teachers of mathematics in the study were well aware of the individual learning differences among their pupils (Table 7). This is in line with Villegas and Lucas (2002) who indicated that almost all teachers are aware that our contemporary classroom are now characterized by an increase in learner diversity. Teachers of mathematics indicated that no two individuals of either the same age or grade could

exactly perceive, organise, learn and retain information the same way or at the same rate. Each learner is different from the rest and must be accorded his or her preferred learning style.

Antoniou and James (2014) assert that adequate and regular assessment is critical to a successful implementation of differentiated instruction. Assessment is arguably the most powerful element of teaching and learning. However, from the analysis of responses from pupils with reference to Figure 4, this study found that most teachers of mathematics never provided any form of assessment at the beginning of each school term. It is a common practice among teachers of mathematics to always align assessment merely grading a test or a quiz (Cambell and Evans, 2000). Assessment for learning helps teachers to identify what pupils can and cannot do and in response determine what activities and experiences needed to be planned to develop pupils' thinking.

Berry and Williams (1992) indicated that pupil-centred activities in teaching are one of the key solutions to meeting the diverse needs of learners in a mixed-ability class. They further alluded that pupil-centred activities can be achieved by occasionally including learners in the choice of the area of discussion and the media to work with. However, the study revealed that most teachers of mathematics in secondary schools rarely provide a platform for pupils to choose what to learn and how to learn during mathematics lessons as figure 8 indicates. Allowing pupils' options in mathematics instruction enhances motivation and learning among pupils. Teachers of mathematics need to provide choice in their learning as this result in positive motivation and performance outcome.

Fast learners in mathematics have diverse needs just like the slow and average learners. Unfortunately in regular schools, high ability learners are not being challenged and their learning

needs are rarely met (Johnson and Sher, 1997). The study found that teachers of mathematics in secondary schools paid little or no attention to fast learners compared to the slow learners (Table 16). They were treated like the average learners without modification of any form neither in the content nor in process of learning. As indicated in Figure 5, very few teachers of mathematics provided extra work to fast learners in class. Most teachers of mathematics seem to have a myth that fast learners can make it on their own. They (teachers) seem to dismiss the needs for fast learners and stick to grade level instruction with only few modifications just for slow learners. This is in line with Reis et al. (2004) who indicated that fast learners were rarely attended to in regular classrooms as they were not exposed to appropriately challenging learning tasks.

This study further revealed that teachers of mathematics provided some form of attention to slow learners as recorded in Table5. For example, Figure 6 indicates that teachers of mathematics varied time allocation on completing tasks among their pupils. This is in line with Henningsen and Stein (1997) who argued that effective teachers of mathematics ensures regardless of their abilities that tasks help all learners to progress and that the tasks promote high mathematical thinking. Mathematical tasks must go beyond practicing algorithms and that learners must be given sufficient time to struggle with important ideas. Appropriate level tasks in mathematics promote mathematical thinking and reasoning abilities among learners (Watson and De Geest 2005).

Hill, Sleep, Lewis and Ball (2007) stated that teachers must make content accessible to all learners by representing ideas or procedures in multiple ways. The study revealed that most teachers of mathematics in secondary schools use different teaching methods and approaches to solve a single mathematical problem as Figure 9 indicates. Teaching by nature requires a variety of methods during a lesson delivery as it enables carrying every learner along (Esu, 2003).

However, this is contrary to Houtveen and Van de Grift (2001) who indicated that majority of teachers in schools just used the same instruction to teach all learners regardless of their individual learners varying abilities.

Effective asking and answering questions by teachers across all subject areas are central to the process of learning and to effective teaching. Questions posed during lessons help the teacher to identify the pupils' needs, capture their attention, arouse their curiosity and promote active learning (Tiberius, 1990). The study also revealed that teachers of mathematics provided pupils in their respective classrooms with an opportunity to ask questions during and after the lesson as Figure 10 indicates. Most teachers of mathematics gave special recognition to pupils who provided correct responses and from observation no ridicule was shown to those who gave wrong answers during the lesson as Table 6 indicates. Teachers of mathematics never interrupted pupils' answer even when it was heading towards an incorrect conclusion.

Further, the study revealed that teachers of mathematics in secondary schools regularly paid attention to pupils' feedback during and after the lesson. Tiberius (1990) argues that the voice tone and non-verbal cues when posing questions have a strong influence on how pupils interpret the purpose of questions posed. It is important for teachers of mathematics to ask questions seeking knowledge which are not interrogative in nature.

Generally, the study revealed that most teachers of mathematics in secondary schools are not differentiating instruction in their everyday teaching. It was revealed that teachers of mathematics rarely take into account their pupils' differing background knowledge, readiness levels, interests and learning preferences at all stages of teaching and assessment. Even when teachers of mathematics are aware of the diversity of needs among their pupils, they still teach as

if pupils of the same age and class have the same level of readiness and cognitive abilities. Teachers of mathematics teach pupils using a uniform approach without varying neither time to complete task nor complexity of tasks.

The concept of formative assessment in secondary schools is not systematic as teachers seem to have limited assessment strategies such as the usual exercises and homework. From this study, it was revealed that most teachers of mathematics in secondary schools teach the average pupils leaving the slow learners struggling and on the other hand fast learners remain bored and mentally unchallenged. Tomlinson (1999) opined that our schools are structured in such a way that all pupils in the same classroom can do their classroom tasks and activities within the same amount of time. The length of an academic year is same for every learner regardless of their diverse academic capabilities.

5.3 Teaching strategies and practices teachers of mathematics have used to meet the varying needs of pupils

There are several teaching strategies that teachers of mathematics in secondary schools are using to meet the diverse needs of pupils. This section discusses the various teaching strategies that were revealed in the study.

Students working in small flexible groups tend to learn more of what is taught and retain it longer than when the same content is presented in other instructional formats. Flexible grouping actually an instructional method that is usually used to address the diverse learners' needs and increase motivation (Beckman, 1990). The study revealed that most teachers of mathematics in secondary schools used group work strategy to meet the needs of their learners according to Table 6. This set of responses is however contrary to what was noted from all the classroom

observations, as Table 16 indicates, there was no single period during the observations when a teacher of mathematics either arranged his or her pupils in ability groups or did he or she group pupils in their readiness and interest levels. In all classroom observations, there was no evidence of established learning centres or stations within the classroom.

The study revealed that most teachers of mathematics are aware of the various teaching methods necessary to meet the needs of learners even when they don't put them to use in their various classrooms. This agrees with the assertion by Tomlinson (2005) that majority of teachers agree with the rationale behind differentiated instruction, they just feel unprepared for it and lack sufficient time to proactively adjust instruction.

It important to note that even when group work has been regarded by many scholars (Tobin, 2008; Tomlinson, 2000) as an effective method of meeting the diverse needs in classrooms, Kulik and Kulik (1992) contrary indicated that there is no correlation between ability grouping and learner achievement across all ability levels.

The study also revealed that teachers of mathematics in secondary schools regularly gave homework and remedial work to their learners as Figure 3 and Figure 12 indicates. Teachers of mathematics gave their pupils group and individual tasks to complete after the lesson. This is supported by Schumitz and Perels (2011) who found that eighth grade students who daily received self-regulation support during homework performed better than their peers on post-test. It is however contrary to Wolf (2001) who argued that the achievement of pupils in mathematics who didn't receive any form of extra school instruction was better than those who underwent private after school instruction or tutoring.

Within everyday activities of the classroom, teachers need to collect information about how each pupil learn, what each pupil seem to know and able to do and he or she is interested in. This data is vital to teachers when it comes to determining particular activities and decision which are aimed at meeting the needs of their learners. The study revealed that in attempting to meet the diverse individual needs of learners in classrooms, teachers of mathematics used question and answer method of teaching as shown in Figure 10. Teachers of mathematics accorded their pupils an opportunity to ask questions during and after lessons. This agrees with William (2007) who indicated that teachers of mathematics use a wide range of both formal and informal assessments to monitor the progress of learning, to identify strengths and weaknesses of their pupils and to determine what can be done to meet their pupils' needs. Adedoyin (2010) argued that the technique of using open questions in lessons help all ability levels of pupils to be involved in the process of learning as it helps the teacher to identify the areas of need and gaps among learners.

Teachers need to start where pupils are in terms of proficiencies, competences, interests and experiences if they are to design lessons appropriate to levels of challenges for their pupils (Houssart, 2002). The study revealed that teachers of mathematics use recap strategy of teaching as one of the methods of meeting the diverse learning needs of their pupils. Most teachers of mathematics assess their pupils' prerequisite knowledge of the topic or area to be covered on that particular day by asking few questions on the previous lesson. For slow learners, teachers find ways to reduce complexity of task without falling back on repetition and without compromising the mathematical integrity of the activities.

Regular or traditional instruction is often not challenging and can eventually turn away the fast learners. Gavin et al (2007) argued that more challenging mathematics with fast learners was

associated with gains in outcomes over the period of time. Van Tassel-Baska, Zuo, Avery and Little (2002) pointed that there is a direct link between the use of advanced content across content areas in regular classrooms with higher outcomes by fast learners. The findings of the study also indicated that teachers of mathematics gave high order or challenging mathematics questions to fast learners as shown in Table 11. It's important to note that even when this strategy of meeting the needs of fast learners has been revealed, observations in the study show no evidence of it being utilised by the observed teachers of mathematics. Johnson and Sher (1997) argued that fast learners in schools are not being challenged and eventually their learning needs are not being met.

Others strategies that teachers use to meet the needs of fast learners, as Table 11 indicates, include allowing the fast learners to demonstrate their understanding of specific mathematics concepts, responding to their inquisitive questions during and after the lesson, giving them extra work, giving them a platform to teach their friends and also providing them with proper guidance and counselling. Teachers' modes of instruction are mainly traditional and inappropriate for fast learners as they are repetitive and lack the required curricular depth proportional to the needs of fast learners.

It is important to note that most of these teaching strategies were simply cited by respondents and not necessarily implemented. This indicated that teachers of mathematics in secondary schools are aware of the various teaching strategies that could be used in their classrooms to meet the diverse learning needs of their pupils. This is supported by George and McEwin (1999) who opined that there are few teachers in high schools who are differentiating instruction in their classrooms and this is neither because they do not believe in the practice nor do they not know how to implement it, it is mainly due to lack of enthusiasm to implement it and that they enjoy

the usual traditional approach of teaching a unit of pupils. The study indicated that most teachers of mathematics focused much on teaching than learning.

5.4 Challenges faced by teachers of mathematics in the quest of differentiating instructions to meet the needs of pupils

When a class is overcrowded, delivery of instruction by teachers of mathematics is affected. It becomes difficult for teachers to attend and support each pupil's learning needs in a mathematics class (Addiba, 2004). In this study, over-enrolment emerged as a major challenge to meeting individual learning needs of pupils by teachers of mathematics in secondary schools as Table 13 indicates. The teacher-pupil ratio is high (1:50) on average such that finding time to reach for each individual learner is almost impossible. This is in line with the assertion by Brabo (2014) that class size has a negative impact on pupils learning. He indicated that a bigger class size does not allow teachers to engage their pupils cognitively. He further indicated that in large classes it is difficult to deliver specific positive feedback for all pupils. Most teachers indicated that it was difficult for teachers to motivate learners and actively engage pupils in learning when a class size passes a certain point in terms of number of pupil.

The study further indicates that limited time has been a major challenge especially after the government introduced career pathways in secondary school curriculum and this forced some secondary schools to reduce the number of periods allocated for mathematics per week on the school time table from the usual 7 periods to 6 periods. This agrees with VanSciver (2005) who contends that meeting the needs of diverse learners is time consuming. Majority of teachers indicated that they had a desire of providing individual attention to their pupils but lacked time.

Data collected indicated that most teachers of mathematics besides being overloaded on the teaching periods were also involved in co-curricular activities such as sports, clubs and school maintenance. Therefore, teachers of mathematics were lacking time to address the individual learning needs of their pupils. Teachers of mathematics need time for planning and making work-material needed for differentiated instruction.

The study also revealed that the desire by stakeholders to cover the syllabus as directed by supervisors has also been a challenge to meeting the diverse learning needs of learners to teachers of mathematics in secondary schools. Instead of spending sufficient time on the needs of learners, teachers of mathematics teach a class as unit especially after the government of Zambia decided to bring promotional examinations much earlier than some years ago. This is in line with Overmayer (2010) whose contention was that challenge of covering the syllabus while accommodating the diverse needs among pupils created an almost impossible situation. This creates a situation where many pupils move through the mathematical curriculum with deficiencies. This also agrees with Black et al., (2003) who argues that pressures exerted by external assessment and testing are rarely consistent with good formative practices which are critical in the process of addressing the diverse learning needs of students.

The other challenge that emerged in this study is the aspect of managing the gap between the slow and fast learners. Teachers indicated lack of knowledge on how to strike a balance between the two groups of learners. From an observation conducted, most teachers seem to concentrate much on average learners leaving the two extreme groups unattended. This is supported by Hess (2001) who indicated that a mixed-ability class can seem uncooperative. Fast learners get bored easily and this can destabilise their learning in the same lesson that slow learners will enjoy. He further indicated that planning a lesson and making work-material can take time for the teacher

as the planned material may be too easy or too difficult for the pupils. This often makes teachers feel inadequate and unable to meet the diverse needs of learners in class.

Lemmer (2003) contends that one of the attributes to poor quality of education is shortage of teaching and learning materials such as text books. Insufficient teaching and learning materials in schools was another challenge to meeting the needs of individual learners in mathematics classroom that was revealed by this study. For instance, the number of textbooks in the departments visited was not sufficient. The average textbook pupil ratio in the schools under the study was about 1:15. This is line with what Oakes and Saunders (2002) stated that the shortage of teaching and learning materials had a serious negative impact on meeting needs of especially slow learners.

This is also in line with VanSciver (2005)'s contention that teaching resources is one of the opposition to meeting the diverse needs of learners. It is however contrary to Steele (2007) who observed that it is not always lack of sufficient resources that affect the teaching of mathematics to pupils with diverse needs but it may also be due to teachers' inefficiency in the use of the available resources. Makori and Onderi (2013) also argues that mere provision of teaching and learning facilities and resources is not enough to guarantee academic achievement among learners with diverse needs, what matters most is when these facilities and resources are correctly and properly put to use in a differentiated classroom.

Mwamwenda (1995) argues that most failures in schools are more attributed to active resistance by learners than insufficient or inadequate instruction. A negative attitude towards mathematics creates unnecessary anxiety among learners and this inversely damages their self-esteem and desire to attempt to understand and improve mathematical skills. The study revealed lack of

cooperation from some pupils due to their negative attitude towards mathematics as another challenge to effective implementation of differentiated instruction. Gal and Ginsburg (1994) argue that a positive attitude and belief towards mathematics from learners promotes active learning and comprehension of mathematics. Aiken (2000) argued that positive attitude and intrinsic motivation towards the learning of mathematics significantly lessen the challenges in learning of mathematics.

The other challenge that was revealed by the study was pupils' poor mathematical background. Pupils proceeded to secondary school without grasping foundation mathematics which posed a challenge to teachers of mathematics in terms of progressing to subsequent topics in junior and later senior syllabus. This is in line with Mohamed (2010) who linked under achievement in mathematics in secondary schools to poor or lack of understanding of mathematics in early stages. Pupils' weaknesses in mathematics at lower stages hinder their progress in learning mathematics at higher levels of mathematics.

Rodriguez (2012) pointed out that successful implementation of differentiated instructions requires that teachers are supported by administrators through provision of ongoing staff development and training tailored towards meeting the diverse needs of pupils. It is however important to note that despite the challenges teachers of mathematics faced in the quest to meet the diverse needs of their learners; Figure 14 indicates that most teachers of mathematics enjoyed good administrative support. The respective school administrations were supportive towards programs aimed at meeting the learners' needs in mathematics. However, this is contrary to the assertion by Van Tasel-Baska and Stambagh (2005) that there was lack of differentiation in schools because teachers are not supported or encouraged by school leadership to value and guide the strategies of meeting the diverse needs of pupils.

Administrators must foresee potential barriers to effective differentiation of instruction and provide the necessary accommodations to ensure differentiated instruction is well implemented. Administrators should be certain to provide teachers of mathematics with the vital resources and training experiences aimed at increasing their knowledge and experience of addressing the diverse mathematical needs of learners (Gregory and Chapman, 2007).

Teachers' knowledge and experience is statistically a significant factor to a successful implementation of differentiated instruction (Adlam, 2007). This study indicated that teachers of mathematics in secondary schools were knowledgeable about how to meet the diverse needs of their pupils. Teachers of mathematics indicated that they were well trained and equipped with the necessary skills needed to meet their pupils' mathematical needs as Figure 13 indicates. However, this is contrary to what Starko and Shack (1989) alluded that teachers have seldom received training on how to meet the diverse needs of learners in their classroom

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter concludes the study and makes recommendations in line with the findings of the study.

6.2 Conclusion

The study established that teachers of mathematics were well knowledgeable and aware of the diverse needs and learning differences among their pupils. The study established that most teachers of mathematics used more of summative assessment than formative assessment which is directly linked to learning and identification of learning needs among pupils. It was established that pupils' interests and choices on what to learn and how to learn were not accommodated as teachers of mathematics seemingly taught a class as a unit. It was established that fast learners seldom received special attention compared to the slow learners. The study revealed that teachers of mathematics gave a special recognition to correct responses as well as a special feedback even when responses were not to their expectations. It is also important to note that from this study, it was revealed that most teachers used a variety of teaching approaches to present a single concept in a lesson.

With regard to the teaching strategies teachers of mathematics used to meet the diverse needs of their pupils, this study indicated several methods. The study indicated group work as one of the strategies that was used to meet the diverse needs of learners. However, from classroom observations, there was never a single time when pupils were grouped either according to their

interests or abilities. There was more of whole group or classroom approach. Other teaching strategies established by the study were homework and remedial work, question and answer method, recap strategy for assessing prerequisite knowledge and also use of high order and challenging questions to fast learners.

The study further established several challenges teachers of mathematics encountered in the process of attempting to meet the diverse learning needs of their pupils. The challenges teachers faced were; over-enrolment in classes, insufficient time due to abnormal workload and other extra-curricular activities, and pressure from stakeholders to cover the syllabus as their main interest is in results from promotional examinations. Other challenges established by the study included insufficient teaching and learning materials in schools, managing the gap between the slow and fast learners, pupils' poor mathematical background and pupils' negative attitude towards mathematics.

6.3 Recommendations

In view of the findings and conclusions, the following recommendations are made:

i. Schools must procure sufficient and appropriate teaching and learning materials for both teachers and pupils. Teachers' guide and a variety of text books must be made available in various departments of mathematics as this will aid the process of meeting the diverse learning needs of pupils in classrooms.
ii. The Ministry of General Education should consider increasing the number of periods of learning mathematics per week having increased the number of topics in the revised curriculum. This will create more time for teachers of mathematics not only to

sufficiently cover the syllabus but also ensure that they meet the diverse needs of their pupils.

iii. The Ministry of General Education must consider deploying more teachers of mathematics in secondary schools to reduce the teaching loads of serving teachers. When a teacher of mathematics has for instance 18 periods per week, he or she will have enough time and energy to offer remedial work which is an important strategy of meeting pupils' individual mathematical needs.

iv. The head teachers should emphasize on the need for formative assessment or assessment for learning. They should ensure that teachers of mathematics in secondary schools are availed with variety of assessment strategies in classrooms other than the usual quizzes and tests. Government should ensure that these assessments are closely monitored by the district education officials as well as by the school management. The issue of hearing statements of bad performance in mathematics only after promotion examinations is not helpful to the needs of pupils compared to assessment for learning.

v. Secondary schools administrators and management should control the enrolments in their respective schools to mitigate the challenge of over-enrolment to meeting the diverse learning needs of pupils in classrooms.

6.4 Suggestions for future research

i. A small sample size of teachers of mathematics was used in this study and therefore the findings may not be generalised to a wider context. Future research on the teachers of mathematics' use of differentiated instruction in secondary schools should be conducted using a similar research design but to a large sample population perhaps covering more than one district.

ii. A study to investigate why differentiation seem to be a very unpopular practice in secondary school classrooms among teachers of mathematics even when teachers are aware of the increasing academic diversity among the pupils should be considered.

iii. A study should be conducted to investigate teachers of mathematics' use of diagnostic and formative assessment data in their everyday lesson planning and delivery.

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Appendix 1

Questionnaire for Teachers

Dear respondent

This questionnaire was designed to provide information on whether teachers of mathematics in secondary schools take into account individual differences among their pupils and also to determine the strategies they use to reach out for these individual differences in the teaching learning process. It is highly anticipated that your sincere response to this questionnaire will provide the researcher with relevant information for the study. Your school and specifically members of the department of Mathematics have been selected for this study. Therefore, you are humbly requested to respond to this questionnaire as sincerely and honestly as possible as you and your responses will be accorded maximum confidentiality within and outside your school.

Thank you for your time and cooperation in responding to this questionnaire.

Part 1: Respond to the following questions by indicating optional choices where appropriate in boxes.

1. Gender

A. Male

B. Female

2. Highest educational qualification attained

A. Diploma

B. Degree

C. Masters Degree

3. Numbers of years of teaching mathematics at secondary school level

Part 2. Use the provided instructions to respond to the following questions

4. Do you think your pupils have differences in the way they learn and understand concepts in the teaching learning process?

A. Yes

B. No

5. If your answer to question '4' is yes, is there anything you are doing to meet your pupils' individual and group learning differences?

A. Yes

B. No

6. What are some of the teaching strategies that you have been using to meet these individual and group needs of your pupils?

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7. Do you give an assessment either at the beginning of each year or each term to identify the differences among your pupils?

A. Yes

B. No

8. If yes, how often do you assess your pupils with regard to their individual needs?

A. Very often

B. Often

C. Once in a while

9. Is there a time that you provide some kind of choice to your pupils with regard to what and how they should learn?

A. Yes

B. No

10.If yes, please explain how

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11. How regular do you give homework and remedial work to your pupils?

A. Very regular

B. Regular

C. Not regular

C. Not at all

12. Do you at any time provide special attention to pupils that seem to be slow in learning mathematics?

A. Yes

B. No

13. Please explain your response to the above answer

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14. Do you at any time provide special attention to pupils that seem to be fast in learning mathematics?

A. Yes

B. No

15. Please explain

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16. Do you at anytime of teaching employ group work by making use of pupils who have mastered the content or topic to help others?

A. Yes

B. No

17. Do you provide a platform for your pupils to demonstrate what they have learnt in either one lesson or after a certain period of time? If yes, how often?

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18. Do you think you are well trained and well equipped with adequate skills needed to meet individual mathematical needs of pupils in your classroom?

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19. How supportive is the administration towards implementation of activities that are aimed at meeting individual needs of pupils?

A. Very Supportive

B. Supportive

C. A little bit supportive

D. Not supportive at all

20. What are some of the challenges you face when attempting to reach out for these individual differences among your pupils?

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21. What measures do you suggest should be put in place to accommodate the aspect of meeting individual needs in mathematics within and outside the classroom?

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Thank you very much for your valuable time and effort in completing this questionnaire

Appendix 2

Questionnaire for pupils

Dear respondent

This questionnaire was designed to provide information on whether teachers of mathematics in secondary schools take into account individual differences among their pupils and also to determine the strategies they use to reach out for these individual differences in the teaching learning process. It is highly anticipated that your sincere response to this questionnaire will provide the researcher with relevant information for the study. Your school and specifically your classroom have been selected for this study. Therefore, you are humbly requested to respond to this questionnaire as sincerely and honestly as possible as you and your responses will be accorded maximum confidentiality within and outside your school.

Thank you for your time and cooperation in responding to this questionnaire.

Part1. Respond to the following questions by ticking in the provided boxes

a). Gender 1.Male 2.Female

b). Age

Part 2. Use the provided instructions to answer the following questions

2. .Are there differences in the way each of you as pupils learn and understand mathematics?

A. Yes

B. No

3. If your answer to question 2 is yes, do you think your teacher is doing enough to meet these differences among his or her pupils?

A. Strongly agree

B. Agree

C. Disagree

D. Strongly Disagree

4. Your mathematics teacher gives your class exercises or homework regularly?

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

5. Your teacher provide a test at the beginning of each term or each academic year

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

6. Your teacher provides extra work to very good pupils during the lesson

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

7. Your teacher regularly provides pupils an opportunity to choose what to learn in each mathematics lesson.

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly Disagree

8. Your teacher provides individual and group attention to pupils that seem to be lagging behind during and after a mathematics lesson.

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

9. Your teacher often show recognition or praises to you or any other pupil after giving a correct response in the mathematic lesson.

A. Never

B. Sometimes

C. Often

D. Very often

10. My teacher of mathematics vary time allocation to me or some other pupil(s) to complete a task in a single lesson.

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

11. My teacher encourages me to work with other pupils during mathematics lessons.

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

12. My teacher gives me choices of what and how to learn in a mathematics lesson

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

13. My teacher provides different methods or approaches of solving a single mathematics problem.

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

14. My teacher of mathematics provides regular opportunities for questioning and answering in each lesson.

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

15. My teacher has an excellent ability of helping pupils that are not good and those that are very good in mathematics.

A. Strongly Agree

B. Agree

C. Disagree

D. Strongly disagree

16. What do you think are some of the problems your teacher faces in the process of trying to meet pupils individual problems?

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Appendix 3

An Observation Checklist

	Teaching strategies under observation	**Always**	**Once in a while**	**Never**
1	Arranges pupils in ability groups			
2	Uses a variety of learning styles			
3	Make use of cooperative group learning			
4	Encourages independent learning			
5	Establishes learning centres or stations within the classroom			
6	Pays attention to pupils feedback			
7	Always asses pupils' prerequisite knowledge of the topic or area			
8	Group students according to their readiness and interest levels			
9	Provides a platform for pupils to demonstrate their understanding of mathematical concepts and ideas after each lesson			
10	Provide individual attention to slow learners			
11	Provide special attention/activities to fast learners`			

Appendix 4

LETTER TO DEBS

Choma Secondary School,

P.O. Box 630139,

Choma.

The District Education Board Secretary,

Ministry of Education, Science, Vocational Training and Early Education,

P.O. Box 630035.

Choma.

RE: PERMISSION TO CONDUCT RESEARCH AT SELECTED SECONDARY SCHOOLS IN CHOMA DISTRICT.

I am a postgraduate student at the University of Zambia in the School of Education pursuing a Master of Education in Mathematics Education in the Department of Mathematics and Science Education.

I am writing to your office to seek permission to conduct a research at selected secondary schools in Choma District.

The purpose of the study is to investigate the use of differentiated instruction by teachers of mathematics in meeting the diverse needs of pupils in four selected secondary schools of Choma District. Anonymity and confidentiality for participants and their respective schools will be guaranteed throughout the study.

Your positive response will be highly appreciated.

Yours sincerely

Chuumbwe Chikuni.

Appendix 5

LETTER TO HEADTEACHERS

Choma Secondary School,

P. Box. 630139,

Choma.

The Headteacher

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Choma.

Dear Sir/Madam,

RE: REQUESTING PARTICIPATION OF YOUR SCHOOL IN THE STUDY

I am a postgraduate student at the University of Zambia in the School of Education pursuing a Master of Education in Mathematics Education in the Department of Mathematics and Science Education.

I would like to request participation of your school in this study by allowing me to administer questionnaires to teachers of mathematics and 40 grade 11 pupils and also to conduct lesson observations of one teacher of mathematics at least twice. The purpose of the study is to investigate the use of differentiated instruction by teachers of mathematics in meeting the diverse needs of pupils in selected secondary schools of Choma District. Anonymity and confidentiality for participants and your school will be guaranteed throughout the study.

Yours sincerely

Chuumbwe Chikuni