

**TEACHERS' QUESTIONING TECHNIQUES IN
MATHEMATICS AT GRADE 11 LEVEL: THE CASE OF
FOUR SELECTED SECONDARY SCHOOLS IN
PETAUKE DISTRICT.**

BY

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FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF
MASTER OF EDUCATION IN MATHEMATICS EDUCATION**

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DECLARATION

I, Mkandawire Chidongo, hereby declare that this dissertation represents my own work and that it has not been previously submitted for a degree at this or any other University.

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CERTIFICATE OF APPROVAL

This dissertation of Mkandawire Chidongo is approved as fulfilling the requirements for the award of the degree of Master of Education in Mathematics Education of the University of Zambia.

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ABSTRACT

The study was conducted in Petauke district, which lies in the Eastern Province of Zambia. The study investigated teachers' questioning practices in mathematics at Grade 11 level in four selected secondary schools and used the findings to inform mathematics teachers. Although questioning is a central aspect of any classroom interaction, it is still an under-researched area in the Zambian classroom context.

The research employed a combination of both qualitative and quantitative methods to obtain rich information for in-depth analysis of the central issues under study. The study sample comprised 24 teachers of mathematics, 4 heads of mathematics department and 120 Grade 11 pupils (boys and girls), 80 were assigned to answer the questionnaires and 40 were involved in the focus group discussions from the four selected secondary schools in Petauke district. Four research instruments (observations, interview schedules, focus group discussions and questionnaires) were used to collect the necessary data in order to address the objectives of the study. Qualitative data collected were analysed using the constant comparative method, the software, Statistical Package for Social Sciences (SPSS) version 16 was used to perform a variety of statistical analysis to analyse quantitative data.

The key findings were that the majority of the questions which teachers of mathematics asked during mathematics lessons were in the low-cognitive level category. The predominance of lower levels questions asked by teachers of mathematics indicated also that questioning had been used in a narrow rather than a broader way. The majority of the pupils indicated that teachers' classroom questions had no effect on their learning of mathematics. The study also suggested that there was no significant difference in the way boys and girls perceived their teachers' classroom questions.

The study recommended that questions must be emphasised in the mathematics classroom and that questioning strategies should be intensively given during teacher preparation.

DEDICATION

This dissertation is dedicated to the following people in my life. First, I dedicate this to my darling wife Elizabeth, who has always remained at my side supporting my journey in every way possible. Second, to my children, Memory, Tiwonge and Mercy .I hope this work will inspire them to value education and to be committed to hard work necessary to pursue their own quest for lifelong learning. Last to my loving parents, brothers, sisters, nieces, nephews, sisters-in-law and brothers-in-law with deepest gratitude and veneration for they always believed in me.

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LIST OF ABBREVIATIONS AND ACRONYMS

CPD: Continuing Professional Development.

DEBS: District Education Board Secretary.

ZAME: Zambia Association for Mathematics Education.

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CHAPTER 1

INTRODUCTION

1.0 Background to the study

Classroom questioning is one of the most regularly employed teaching strategies. In fact, questioning is considered by many to be the most important tool that teachers have for helping pupils build an understanding and to encourage pupils to think about and act upon the material they are learning. It is one of the primary and most influential teaching skills that teachers can use (Cotton, 1989).

From the research literature, teachers' questions have been found to be an indispensable part of classroom interaction (Edwards and Bowman, 1996), which is important in that it enables teachers to gauge what pupils know and learn. Teachers' primary instructional strategies consist of using different types of questions to determine whether pupils understand what they are learning. However, according to Sahin, Bullock and Stables (2002), teachers use different kinds of skills during their teaching and that they may not always be aware of which skills help pupils learn and understand mathematics well. For instance, Voigt (1992) found that even though the teacher uses questions to elaborate certain meanings from pupils, the pupils may understand the questions differently. In other words, teachers ask many questions, but are not sure what their intentions are in asking questions or whether they are aware of why they are using particular questioning techniques.

One of the major duties of a mathematics classroom teacher is to promote thought and inspire inquiry in pupils and one effective way of doing this, is through proper questioning in the classroom. As Caram and Davis (2005) observe, when teachers'

questions are used effectively, they can enhance pupil learning by developing critical thinking skills, reinforcing pupil understanding, correcting pupil misunderstanding and providing feedback for pupils.

Caudron (1988) stated that teachers' questions constitute a primary means of engaging learners' attention, promoting verbal responses and evaluating learners progress. Therefore one of the measures to be taken for the improvement of teachers' questioning skills would be to assess how teachers ask questions in mathematics lessons. According to Croom and Stair (2005), classroom questions are best used as test tools to help indicate pupils' academic progress or to assess pupils' critical thinking. This view was supported by Vogler (2005), who also stated that questions can help to make connections to prior learning and can stimulate cognitive growth. Therefore good and skilled classroom questions which are well developed and structured can engage pupils in a true exploration of the content they are learning. It also allows them to demonstrate their understanding of the concepts, whereas unskilled classroom questions from teachers focus on short answers, low level questions which just check for pupils' knowledge (Danielson, 1996).

There are many reasons that cause pupils to have learning difficulties in mathematics. One of these is the role of the classroom teacher in making sure that the pupils develop adequate personal self-confidence and good character towards the learning of mathematics (Muijs and Reynolds, 2005). Teachers often fail to ask appropriate questions in the classroom because they tend to make the assumption that pupils already know something. For example, because some teachers do not possess a strong content knowledge or do not have a deeper understanding of mathematical

concepts, they have difficulties in preparing questions for learners (Danielson, 1996). Another problem related to teachers' questioning technique in mathematics is failure to match the questions they ask with pupils' ability (Hill and Fly, 2008). This is because, the questions teachers ask are often not well prepared and not effective in strengthening pupils' understanding of concepts in mathematics. Asking questions in mathematics lessons requires knowledge of the types of questions, strategies and the art of questioning. However, to the best of my knowledge, few studies of Zambian origin have been conducted on teachers' questioning techniques in mathematics. It is from this background that the study explored teachers' questioning techniques in mathematics at Grade 11 level.

1.1 Statement of the problem

Many teachers, including parents, the community, government, business groups and other stake holders in the education sector are alarmed by what they see as inadequate levels of pupil achievement in mathematics. Despite the efforts of teachers and the Ministry of Education, Science and Vocational Training and Early Education, through associations such as the Zambia Association for Mathematics Education (ZAME) and Continuing Professional Development meetings (CPD), performance in mathematics has continued to decline at Grade 12 level. Could inadequate classroom questioning techniques by mathematics teachers have anything to do with it?

1.2 Purpose of the study

The purpose of this study was to investigate teachers' questioning techniques in the mathematics classroom at Grade 11 level in four selected secondary schools in Petauke District.

1.3 Research Objectives

The objectives of the study were to:

1. explore the types and levels of questions teachers ask pupils during teaching and learning of mathematics.
2. determine whether pupils perceive their teachers' classroom questions as having any effect on their performance in mathematics
3. assess whether teachers of mathematics ask questions in the classroom that they intend to ask.
4. determine the factors that affect teachers' questioning during mathematics lessons.

1.4 Research questions

1. What are the types and levels of questions teachers ask their pupils during the teaching and learning of mathematics?
2. How do pupils perceive teachers' classroom questions on their performance in mathematics?
3. Do teachers ask the questions in the mathematics classroom that they intend to ask?
4. What are the factors that affect teachers' questioning in the mathematics classroom?

1.5 Significance of the study

The findings of this study would hopefully help teachers of mathematics to improve their questioning techniques in the classroom. The study would also help textbook writers and curriculum developers to include different levels of questionings in mathematics teaching and enable teacher educators to improve the questioning skills of student teachers of mathematics in secondary schools. Therefore, the findings of this study could enable mathematics syllabus designers, setters of mathematics final examination question papers, mathematics curriculum designers and text book writers to improve their questioning techniques. The results of the study might also indicate what teacher educators should do to improve the questioning skills of student teachers of mathematics.

1.6 Theoretical Framework

This study was guided by the learning theory based on Voigt (1992). Voigt's work was founded on the assumption that mathematical learning and teaching are linked through classroom interaction which requires negotiation of meaning. The term "negotiation of meaning" can be defined as the specific means of classroom interactions by which teachers and pupils form opinions, criticise, explain, test, refine ideas and procedures in mathematics lessons (Voigt, 1992). He believed that questions help teachers to encourage pupils to think about and develop mathematical concepts and procedures through the negotiation of meaning as a necessary condition of learning. One of his central concerns was to clarify the process by which the teacher and pupils developed a basis for mathematical communication through questioning. This theoretical framework can be shown diagrammatically in Figure 1 as follows:

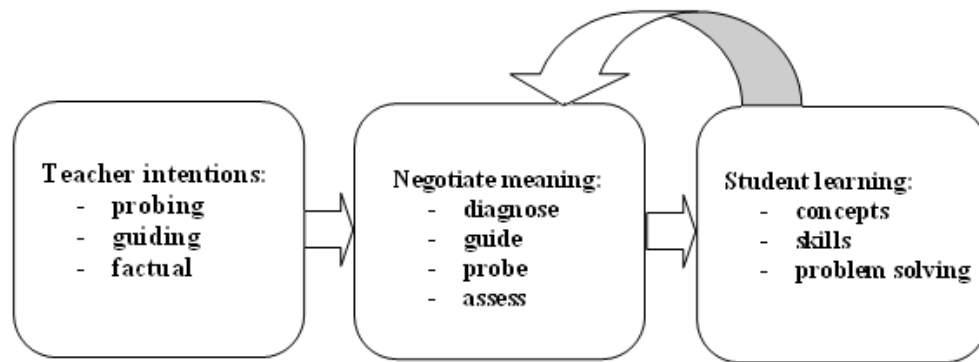


Figure 1: Argumentation in the mathematics classroom,(Sahin, 2007).

As shown in Figure 1, the theoretical model states that teachers have intentions to use various types of questions in order to negotiate meaning with pupils, which results in pupil learning. During the negotiation of meaning, questions serve several key functions: they allow teachers to diagnose pupils' prior knowledge or misconceptions, probe for understanding, guide pupil thinking, especially when there is a difficulty or misunderstanding and informally assesses pupil performance of learning goals in mathematics (Cobb, Wood, Yackel, and McNeal, 1992). Pupil learning can be classified into achievement of skills, concepts or solving problems and applying them to solve problems in real life situations. The types and purposes of questions have a direct relationship to pupil performance. It should be noted that unless questions are directly related to the mathematical learning goal, they are unlikely to lead to pupil learning that goal.

1.7 Operational definition of terms

- **Technique:** Procedure or skill required to achieve a certain goal.
- **Question:** a semantic class used to seek information on a specific subject (Lynch, 1991).
- **Intention of Teachers' Questioning:** Teachers' questions used to bring about mathematical reasoning from pupils (Voigt, 1992).

- **Diagnosis:** This term in this research meant the identification and characterisation of errors or misconceptions of pupils while they were involved in the mathematical solving process.

1.8 Limitation of the study

- The study would have been conducted in many schools in Eastern Province but due to financial constraints and time factor, it was confined to four selected secondary schools in Petauke District, Eastern Province of Zambia.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.0 Introduction

This section reviews the literature available on questioning. This literature focuses on history of questioning, use of questions in the classroom, the teacher's role in asking questions, categories of questions, teachers' beliefs about questioning, questions from pupils, different research on questioning and ends with a summary of the literature reviewed.

2.1 History of Questioning

Questioning within educational circles has been in existence for a long time. The earliest reported use of questions was during the time of Socrates, who used searching questions to make his students think, understand and justify their assertions (Newton, 2002; Harrop and Swinson, 2003). Since then questioning has been used to serve a variety of purposes. For example, to increase pupils' involvement, to focus attention on a particular issue or concept, to structure a task in order to maximise learning, to assess pupils' prior and current knowledge and to determine if tasks assigned have been understood and appropriately performed (Callahan and Clark, 1982).

Questioning in general refers to a problem or puzzle which is presented to a learner to answer. Seime (2002, P.10) defined a question as "a statement for which a reply is expected". From this definitions it can be generalised that the word question refers to any idea that requires a response from the learner. This role of questioning as an instructional tool has not diminished with the passage of time.

2.2 Use of questions in the classroom.

In today's world teachers face ever increasing pressures to create a learning environment that is both efficient and effective, particularly within assessment driven classrooms (Trinkle, 2009). This is also the case in Zambia, where teachers of mathematics are facing a challenge of how to create a conducive learning environment which is effective for learners to attain good achievements in the subject. Without considering a proper plan to use questions as a learning tool, teachers of mathematics and other subjects are likely to miss a powerful opportunity to create the type of dynamic and interactive dialogue that promotes an environment in which pupils actively analyse and process information to answer good questions. By using a variety of questions for different purposes, teachers of mathematics can extend and enrich high level, critical thinking and learning naturally within their classrooms. Higher level questioning and thinking help to establish the manipulation of information and ideas which, in turn, provides an opportunity to develop new ideas and understandings (The State of Queensland Department of Education, 2004).

The questions teachers ask and pupils' performance on high stakes assessments are connected, since the level of questioning reflects the level of thinking expected within the classroom (Beyer, 2000). A common observation of many classrooms is that teachers do most of the talking (Treffinger and Isakson, 2001). Efforts to improve questioning techniques must include an increased emphasis on providing the pupils enough time to think and to formulate adequate responses which require enough time to share these responses with their peers (Blosser, 2000; Wilen, Ishler and Hutchinson, 2000).

Marzano, Pickering, and Pollock (2005) state that questions help pupils connect what they are learning to what they already know. According to Weiss and Pasley (2004), questioning helps qualify, probe and challenge current ideas and expose misconceptions. Crockett (2004) pointed out that well planned questioning strategies encourage active participation in learning along with enhanced problem-solving and concept development. Thus questioning is a process teachers can improve on if they are willing to focus on types of questions and strategies for their use (Bogan and Porter, 2005). Therefore well-constructed questions which reflect higher order thinking can develop knowledge acquisition (Weiss and Pasley, 2004).

Knowing the purpose or goal of a question will help to determine the appropriate question to ask (Anderson and Krathwohl, 2000; Bloom, 1956). The use of effective questions can promote this type of learning environment (Costa, 2000). However, as noted by Hill and Flynn (2008), it is not as simple as just deciding to ask more questions during the course of a lesson. Teachers of mathematics need to reflect on the nature of the questions they use and actively plan to implement the use of questions as part of their lesson planning. Once teachers reflect critically on their prior practices, they should be able to develop a plan to use on questioning techniques (Hill and Flynn, 2008). To accomplish this, teachers need to consider what is to be learned and how the questions asked directly contribute to the goals of learning.

Clarke (2006) and Isoda (2006) explained that the level of questioning and the kinds of questions that could be asked will be able to extract pupils' ideas and their reactions towards what is being taught. Stigler and Hiebert (1999) observed that most

Japanese lessons are structured problem-solving ones and demanding problems are asked. Pupils are encouraged to discuss or to invent their own procedures and solutions (Miyakawa, 2006).

According to Perrott (1986), one of the common problems in questioning sequences is lack of understanding where to use lower order questions and higher order questions. This may be as a result of failure in planning a strategy how to present questions in the classroom. Problems in questioning sequences can be alleviated by planning a strategy that could facilitate question and answer exchanges. Agreeing with Perrot, Seime (2002) stated that without a strategy that specifies an objective or end in view as a goal, there really is no rational basis for developing or selecting a questioning strategy. If teachers are to teach logically, they must be knowledgeable about the process of framing questions, so that they can guide pupils in the learning process (Eggen, 2006).

According to Eggen (2006), good questions are clear, purposeful, brief, natural and adapted to the level of the class, sequenced and thought-provoking. Farrant(1980) agrees and observes that questions when used effectively help stimulate pupils to compare, conclude, infer, predict, apply, relate, design, generalise, probe and solve problems. What is more, questions provide a ladder up which the pupil climbs towards fuller and deeper understanding.

2.3 The teacher's role in asking questions

What impact do teachers have in asking and responding to questions in the classroom? A good facilitator of communication is one who is able to get pupils to explain things well that they can be easily understood (Reinhart, 2000). Pupils learn

to think mathematically by being in the presence of a relative expert who makes their thinking processes explicit by encouraging mathematical communication (Vygotsky, 1978). In order to ask appropriate questions, teachers need to be knowledgeable about the content of mathematics. These questions should provide opportunities for pupils to reinvent mathematical ideas through both exploration and refining of previous ideas (Martino and Maher, 1999). Likewise, tasks should make it necessary for pupils to analyse other tasks, find distinguishing features between tasks, and verbalise generalisations about tasks (Wolfram, 1997). Teachers must understand that questioning is a skill and like all other skills it must be practiced before it can be mastered to its best potential (Vogler, 2005). Effective communication requires teachers to ask good prepared questions, but also requires good listening to responses from pupils.

Wilén (1986) provided seven suggestions for effective questioning. These were summarised as follows: teacher to plan key questions, phrase questions clearly, adapt questions to pupils' ability, ask questions in a sequence, ask questions at a variety of levels, teachers to make up on responses and allow for think time. From Wilén, we learn that a teacher cannot employ innovative teaching strategies if the questions themselves are not being thoughtfully considered. For pupils to be successful, teachers need to incorporate all levels of Bloom's Taxonomy of the cognitive domain in their questions. This means pupils can be guided to reach higher levels of thinking and be able to tackle assignments, written tests and final examinations.

2.4 Categories of question

The foundational work of Bloom (1956) recommended the use of complex and critical thinking skills. The 1956 Bloom's model proposed classifications of thinking within the cognitive domain (Bradley, 2007). There are six levels of Bloom's Taxonomy of the cognitive domain and questions at each level require pupils to respond using a different kind of thought process. The levels are: knowledge, comprehension, application, analysis, synthesis and evaluation (Cooper, 1986). Knowledge level is the ability to recall previously learned facts. Pupils are required to define, recall, recognise and repeat something they had learnt. During this time, pupils are not asked to manipulate information but merely to remember it just as it was learnt.

According to Cooper (1986), knowledge questions are used to promote classroom participation. They are critical to all other levels of thinking and reasoning for the fact that pupils cannot be asked to think at higher levels if they lack fundamental information (Cooper, 1986). Why should teachers of mathematics use the Knowledge level? Quality questioning for knowledge focuses on identification and recall of information and allows the teacher to survey the knowledge level of an entire class and efficiently go on with the lesson.

Comprehension level is the ability to understand previously learned materials, facts and figures (Cooper, 1986). Comprehension questions require learners to select those facts that are relevant to answer the question by describing, comparing or contrasting. To answer comprehension questions, learners should go beyond the memorisation or recall of specific information, facts, ideas or procedures

(Cooper,1986). In the words of Cooper (1986), the pupil must demonstrate a personal grasp of the material by being able to rephrase it to give a description in his or her own words and to use it in making comparisons. Comprehension questions require pupils to interpret by making comparisons, showing relationships among ideas and provide information presented in the form of charts, graphs and tables (Perott, 1986; Kissock and Iyortsuun 1982). Why should teachers of mathematics use comprehension

questions? Comprehension questions are appropriate when pupils are required to work on organisation and selection of facts and ideas, for example when considering strategies such as think, pair and share which allows pupils to collaborate and share their understanding(Hill and Flynn, 2008).

Application level is the ability to apply acquired knowledge, understanding and skills to new situations or problems(Hill and Flynn, 2008). Pupils' learning can be enhanced not only by requiring them to memorise ideas or procedures and asking them to rephrase and relate what they have memorised but also by helping them to learn how to apply ideas to new situations. At the application level, pupils decide what information to use in order to solve given problems (Kissock and Iyortsuun, 1982; Perrott, 1986). In addition, questions at this level require pupils to apply a rule or process to a problem so as to determine the single correct answer to that problem (Cooper, 1986).

Why should mathematics teachers use application questions? Application level questions consider practical relevance of information, reflects a pupil's use of knowledge acquired which is appropriate when pupils need to practice using facts,

rules and principles. Giving pupils the opportunity to connect their learning through problem-based assignments offers opportunities to use application level questioning. When a pupil answers rather than commenting, the teacher can invite other pupils to connect or extend the previous answer given. Examples of application questions in mathematics include: to apply the knowledge learnt to solve a problem of real life situation, make up a puzzle game in mathematics using ideas from the content being learned and to apply mathematical ideas to solve other related problems in other subjects like physics or chemistry (Hill and Flynn, 2008).

Analysis level is the ability to identify, investigate and understand the component parts and structure of material (Perrot, 1986). Analysis means process of reducing a complex topic or substance into smaller parts to gain better understanding (Perrott, 1986). Analysis questions are higher level order ones which indicate cause and effect relationship (Perrott, 1986). Why should mathematics teachers facilitate the process of analysis? Analysis questions require pupils to separate a whole thing into components for a deeper understanding of content or a process and they are designed to help pupils analyse information so as to reach particular conclusions. Questions that lead pupils to cognitively process a complex idea into simpler more manageable parts helps the pupil to see relationships and generalise learning. Some topics in mathematics often require analysis questions to successfully complete an assignment or answer test questions in mathematics.

Allowing pupils to do work on graphical work that examine the constructs of a complex issue or idea are not optional where analysis is concerned within a classroom (Hill and Flynn, 2008).

Synthesis level is the ability to use acquired knowledge, understanding and skills to develop new ideas, techniques or solutions. They are higher order questions that require pupils to perform original and creative thinking (Cooper, 1986). Teachers should use questions to help pupils produce original communications, make predictions and solve problems. Synthesis is putting together information in a different way by reconstructing information in a new relationship or determining unique relationships. Synthesis-style questioning is useful because it helps pupils to understand or create the combination of ideas to form a new whole. They also help pupils to create plans, develop hypotheses, draw conclusions and get involved in problem solving type questions (Hill and Flynn, 2008).

Evaluation level is the ability to assess the value of material for a given purpose and to make appropriate decisions (Hill and Flynn, 2008). They are higher order questions because they require pupils to judge the merit of an idea, a solution to a problem, or an aesthetic work and also ask pupils to offer an opinion on an issue. Why should teachers of mathematics use evaluation questions? Evaluation is the ability to make judgments about the nature or quality of information which is a systematic determination of merit, worth, and significance of something or someone using criteria against a set of standards (Hill and Flynn, 2008).

Changes to the old Bloom's taxonomy were made as indicated in Figure 2. During the 1990's, a new group of cognitive psychologists, led by Lorin Anderson (a former student of Bloom) revisited the taxonomy and a number of changes were made. The names of the six major categories were changed from noun to verb forms. As the taxonomy reflects different forms of thinking and thinking is an active process, verbs

were used rather than nouns. The subcategories of the six major categories were also replaced by verbs and some subcategories were reorganised. The knowledge category was renamed as remembering. Knowledge is an outcome or product of thinking not a form of thinking. Consequently, the word knowledge was inappropriate to describe a category of thinking and was replaced with the word remembering. Comprehension was renamed as understanding and application as applying. Synthesis was renamed as evaluating and evaluation as creating.

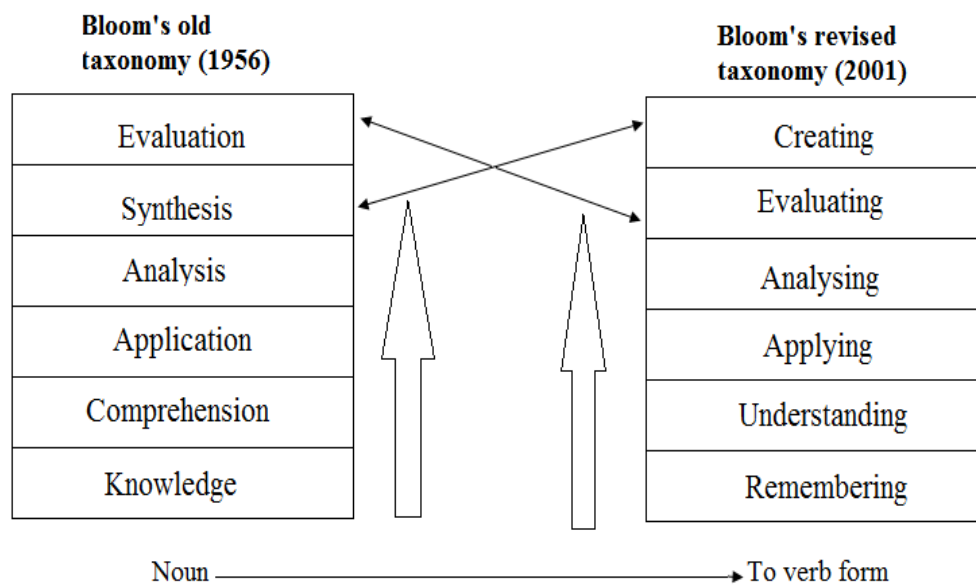


Figure 2: Showing changes in Bloom's taxonomy (Anderson, 2001)

The six types of questions can also be categorised into two levels: low order and higher order (Farrant, 1980). Ornstein (1995) defines low order questions as questions that emphasise lower cognitive processes of memorisation of facts or ideas and concrete information. This is useful for learners who have no prerequisite knowledge and need to experience simple questions before moving on to complex and more complicated and more abstract thinking materials. A factual question has only one expected answer which is drawn directly from the content of instruction and

deal directly with the information being learnt. Empirical questions are narrow and convergent questions involving recall of facts, observation and possible experimentation in which pupils need to match a piece of given information with their existing knowledge on the issue and their observation to arrive at a single predictable answer (Brown and Wragg, 1993).

High level thinking questions are types of open ended questions that extend knowledge beyond factual recall and repeating learned skills, but also push pupils to use previous knowledge to explore and develop new concepts and procedures (Arends, 1997). Teachers who encourage pupils to explain more about their thinking through the use of higher order questions promote learning because such questions push pupils to think more deeply about the topic being discussed (Krupa, Selman, and Jacquette, 1985). On the other hand, researchers like Martino and Maher (1999) stated a different function of the use of higher order questions. They observe that higher order questions can be used for pupil justification of solutions and re-examination of their original solutions. Therefore, pupils can provide more adequate explanation, justification or generalisation. From the above discussion, this means that asking higher order questions is a useful teaching method to help teachers explore what pupils are thinking. Teachers of mathematics need to be encouraged to plan and ask higher order questions in their mathematics lessons.

2.5 Questions teachers use

Educators know that questioning is a key aspect of teaching and learning process, as observed by Anderson and Krathwohl (2001). However, because questioning is used so often, teachers may not even realise the types or quality of the questions they use.

Stigler and Hiebert (2004) pointed out that it is not differences in class organisation, technologies, or even curriculum used in other countries that result in different levels of pupil achievement. It is the quality of questioning, clear connections and depth of thought expected that contribute to the gap in pupil achievement.

McGrail (1997) suggested that teachers needed to incorporate all levels of Bloom's Taxonomy into lessons, tests and assignments. By using a range of questions that appeal to all of the pupils it becomes more personal to them. Not only should Bloom's Taxonomy of the cognitive domain be addressed in assignments and tests but they should be included also in class exercises and projects to be done in mathematics. Studies show that teachers who use Bloom's Taxonomy of the cognitive domain on a regular basis in their lessons enable pupils to benefit and appreciate the levels of thinking. But why is it that many teachers are unable to do this on a regular basis? Why is it that few teachers consistently use the levels of Bloom's Taxonomy of the cognitive domain in their lessons?

Lack of knowledge of techniques of questioning in mathematics can make teachers change high level questions into low level category as noted by Good and Brophy (2003). This could happen when teachers answer the questions they ask or write solutions for learners without giving learners enough time to answer the questions. Teachers who like answering their own questions deny pupils the opportunity to answer questions and share ideas with their peers, discourage them from doing any thinking, making them not to be busy due to the minimal interaction in the classroom (Muth and Alvermann, 1992).

Elaborating on pupils' answers would undermine pupils' confidence in their ability to answer the teacher's questions and prevent them from using their creativity. Furthermore, the class would wait for the teacher's response because they perceive the teacher's answer to be the best answer (Burden and Byrd, 1994). Teachers who do not plan their questions before lessons and prefer to be spontaneous in their questioning have a tendency to ask a series of questions which may result in random and sometimes pointless questioning (Hewit and Whittier, 1997). Another point is that teachers' lack of knowledge of the taxonomy of questions may limit their ability to diversify their use of levels of questions according to the needs and objectives they set for the class (Gall, 1984).

However, Morgan and Saxton (1994) cautioned teachers not to rely on the taxonomy too much because according to them, as a structure, the taxonomy is not a constructive way of planning and asking questions. Morgan and Saxton explained that to follow the hierarchy of structure in the taxonomy from simple recall to the complex evaluation could distort the place of questions in teaching. For example the view that teachers should ask questions at higher levels only when they are sure that their pupils have understood and can perform at lower levels is unrealistic. They said that if teachers used this as the base of arguments they would perceive that their pupils were not ready, still weak in the subject and that the materials would be above pupils' level. This could result in depriving their pupils of exposure and practice of other cognitive levels. Lack of knowledge on a range of resources on questioning techniques available to teachers can lead them to emphasise more on one type of cognitive questions in their practice (Gall, 1984).

2.6 Teachers' beliefs about questioning

Morgan (1988) states that teachers' knowledge and beliefs about questioning underpin the way they ask questions. According to Hancock and Gallard (2004) belief is an understanding held by an individual that guides that individual's intentions for actions. The knowledge and beliefs that the teachers have can greatly affect their methods and the way they ask questions in the classroom. For instance, teachers' lack of knowledge of the subject matter know-how may make them to believe and hold firmly closely to textbooks or resources provided to construct questions (Carlsen, 1992).

Ornstein (1995) and Good and Brophy (2003) observed that when teachers have beliefs to depend heavily on teaching materials in constructing their questions, they may ask their questions in such a way that their pupils would be able to check and lift solutions from the books. As a result, this may limit the scope of knowledge for the pupils to what is given within the books, not extending it beyond the classroom and not enabling them as pupils to be creative or bringing in their life experiences to the learning situation. This may be common with mathematics teachers who like teaching by copying exactly how questions are phrased in pupils' textbooks. Teachers are supposed to be resourceful and enterprising enough as to look for sources beyond what is specified within the syllabus and textbooks.

Some teachers believe that teaching is about lecturing where the teacher's role is to transmit information whereas the pupil's role is to passively receive the information (Brookhart and Freeman, 1992; Cady and Rearden, 2007). This belief can make

some teachers not to allow pupils to participate in their lessons by asking questions while they are teaching and also can make them not to ask pupils questions.

Teachers who like asking more questions at one category level might reflect a belief that their pupils are not ready for questions in other categories and that their pupils need more questions of this type in order for them to pass their examination. This may imply that teachers' beliefs about their pupils' ability of low performance in mathematics may influence them to ask their pupils questions of lower order than higher order because they believe that their pupils cannot answer questions of higher order (Dillon, 1990; Dean, 1996). Teaching in this way may not help pupils to do well in their examinations.

2.7 Questions from pupils

Most of the literature on questioning approaches the topic from the perspective of what teachers do rather than what pupils do. Questioning is traditionally regarded as the privilege restricted to teachers, because the situation which is seen as normal in the classroom is for the teacher to ask questions and for pupils to answer them (Dillon, 1990). The teacher is seen as the all-knowing provider of knowledge and pupils are mere recipients of that knowledge. Pupils' views and ideas are not considered in the classroom or do teachers encourage them to do so. Pupils restrain themselves from asking questions to their teachers for a number of factors such as not wanting to embarrass the teacher, not wanting to expose their ignorance on certain issues and because they lack the art of asking questions (Gall, 1984; Thompson, 1989).

Kloss (1988) noted that teachers may resist letting pupils ask many questions because they feel that asking questions is a slower means of teaching. It is also true that teachers perhaps think that the importance of pupil questions would make a shift, in the view of the teachers, from one who acts as sole class authority to one who guides the process of teacher pupil interaction. Some teachers may be unable or unwilling to make this shift, because it limits their authority in the classroom.

2.8 Research on questioning

Different researchers from different countries have conducted research on questioning and focused on various aspects of classroom questioning which lead to different findings. The popular finding given in the literature was that higher level questions lead to greater cognitive growth (Dillon, 1982).

These views represented the school of thought of Gall (1984) and Andre (1979), who recommended that higher level thought provoking questions have positive effects on pupils' performance and thinking. Redfield and Rosseau (1981) carried out a review of research done by Winne in 1979. They concluded that use of higher level questions during instruction had a positive effect on students' achievement.

On a different note, another research was carried out which had different findings from those of Redfield and Rosseau on questioning concerning higher levels questioning. Hewitand Whittier (1997), stated in their findings that low level questions were beneficial in helping to improve the performance of disadvantaged and slow learners. They mentioned studies done by others which found that factual questions were preferred to more complex divergent questions in working with

disadvantaged and slow learners. They concluded that factual questions seemed to be the most useful for this type of pupils.

A review of more recent relevant research on questioning indicates the range of issues pertaining to questioning in the classroom including teachers' beliefs and practice (Sahin, Bullock and Stables, 2002). The other areas covered in recent research on classroom questioning include patterns of teachers' questioning within school classrooms (Hamilton and Brady,1991), learner strategy instruction in using higher order questions and teachers' underlying reasons for asking certain types of questions (Ayaduray, 1997).

A study on learner strategy instruction in learning history in Singapore was conducted by Ayaduray and Jacobs in 1997. The study was done to find out if pupils would be able to ask more higher order questions and provide more well explained responses during peer interaction. During the ten week period of the study, experimental-control design was used in which one class was exposed to higher order questions and their questions and responses were recorded during small group discussions before and after treatment. The other class was the control group. At the end of the research, the researchers found that after instruction, the treatment class asked significantly more higher order questions and provided significantly more elaborated responses. This study managed to achieve its objectives of making the experimental group ask more higher order questions and giving elaborated responses. From this study it was observed that pupils would also be effective questioners. I liked the ideas of the two researchers from this study of using the experimental control method and creating awareness among pupils of the importance for them to

acquire higher order thinking, guidance provided on practice and how this could be done instead of just imposing the ideas on them.

2.9 Summary of literature reviewed

The literature reviewed in this study has indicated that various cognitive levels of questions elicited different cognitive process of critical thinking. Questions are often divided into two categories: lower-level and higher-level questions. Lower-level questions are those asked at remembering stage, understanding and simple application levels of revised Bloom's taxonomy. Higher order questions are considered important for encouraging pupils to think critically in the classroom. Higher-level questions require analysing, creating and evaluation skills (Arends, 1994).

Higher order questions go beyond memory and factual information and require pupils' greater effort and time to think critically about cause and effect relationships to find the effective solutions for the problems in the complex situations. Higher cognitive-level questions are also called divergent questions. Lower order questions or factual questions, on the other hand, are those concerning knowledge of subject matter or recall of facts and specifics. These questions require lower cognitive process such as memorising facts and information, summarising information or paraphrasing. One of the common problems in questioning techniques in mathematics is lack of understanding where to use lower order questions and higher order questions. This could be as a result of failure in planning strategies on how to present questions in the classroom.

Most of the researches on questioning have been conducted on utilising one or two research instruments in particular observation and questionnaire. Therefore, this study incorporated a variety of research instruments including focus group discussions, interviews, observation and questionnaires. To the best of my knowledge, the combination of these research instruments have not been used in many previous studies and focus group interviews have been used on a small scale mainly in other studies with teachers but not with pupils.

One aspect that had been neglected by almost all existing research on questioning is what affect teachers' questioning techniques in mathematics. In this study, I focused on this issue by giving pupils an opportunity to voice their ideas and opinions pertaining to their teachers of mathematics on techniques of questioning through the focus group discussions. The other point is that limited research has been carried out in Zambia on teacher questioning techniques in mathematics using a combination of qualitative and quantitative approaches. This approach helped the researcher to get in depth data on what actually takes place in the classroom pertaining to teachers' questioning in mathematics at Grade 11 level. It is from these gaps identified in the literature reviewed that I felt that the current study on research on questioning techniques in mathematics at Grade 11 level was worth to carry out.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This section describes the methodology that was used to collect the data from four selected secondary schools in Petauke District, Eastern Province in Zambia. This includes the research site, research design, target population, sampling procedures, research instruments, data collection procedures and the methods that were used in the data analysis.

3.1 Research Design

The study used a combination of both qualitative and quantitative methods. Mixed methods researchers strongly believe that by mixing quantitative and qualitative methods the researcher will get richer data and stronger evidence than using a single method (Creswell, 2003).

Greene, Caracelli, and Graham (1989) argued that there are five justifications for combining quantitative and qualitative research:

1. *Triangulation*, which refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings. It seeks convergence, corroboration and correspondence of results from different methods.
2. *Complementarity*: It strives for elaboration, enhancement, illustration, clarification of the results from one method with the results from another.
3. *Development*: This seeks to use the results from one method to help develop or inform the other method, where development is broadly construed to include sampling and implementation, as well as measurement decisions.

4. *Initiation*: This seeks the discovery of paradox and contradiction, new perspectives of frameworks, the recasting of questions or results from one method with questions or result.

5. *Expansion*: This seeks to extend the breadth and range of enquiry by using different methods for different inquiry components.

Therefore, I chose the mixed methods approach which I felt would improve the focus of my research. I used a concurrent design in which the researcher converged quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. In this design the researcher collected both forms of data at the same time during the study and then integrated the information in the interpretation of the overall results (Creswell, 2003).

3.2 Research site

The research was conducted in Petauke District in the Eastern Province of Zambia. It lies in the south-west of Chipata, the regional headquarters for Eastern Province.

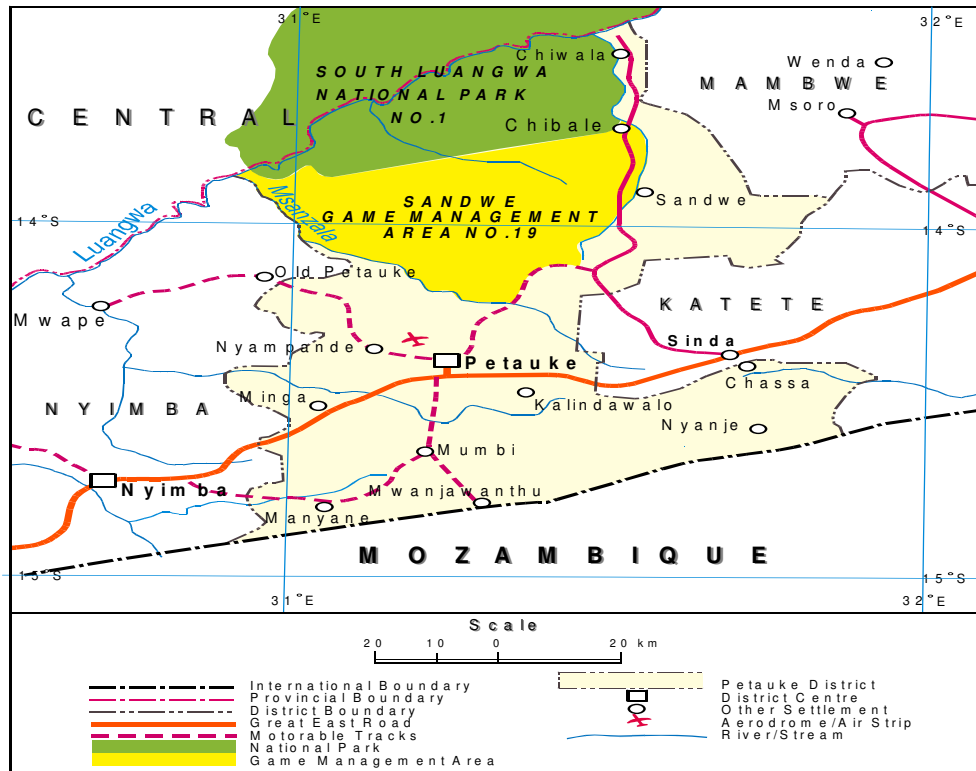


Figure 3: Location of Petauke District

Source: Basic Education Atlas of Zambia (1997).

3.3 Demographic features of participants.

The participants of the study were 20 mathematics teachers and 118 Grade 11 pupils from the four selected secondary schools in Petauke district. Among the teacher participants, 25% were females (5 teachers) with ages ranging between 26 and 42 years and 75% were male teachers (15 teachers) with ages ranging between 29 and 46 years. A total of 8 teachers (40%) had 2 to 5 years of teaching experience, 30% (6 teachers) had 6 to 10 years of experience and 30% (6 teachers) had 11 to 16 years of experience. Teachers who were selected for interviews and observations also held

different types of qualification. 75% (17 teachers) held a Diploma in Secondary Education from different higher learning institutions in Zambia and 10% (2 teachers) held a Bachelor of Arts with Education Degree from the University of Zambia and 5% (1 teacher) held a Bachelor of Education Degree in Secondary Education from the Open University.

As for the pupils, there were 52.6% (41 boys) with ages ranging from 16 years to 25 years and 47.4% (37 girls) with ages ranging from 15 years to 21 years. They were all from different Grade 11 classes from the four secondary schools selected for the study. In this study, the pupils were required to answer a questionnaire and participate in focus group discussions.

3.4 Target population

The target population consisted of 45 mathematics teachers and 1800 pupils in secondary schools in Petauke district.

3.5 Study Sample and Sampling Technique

There are ten secondary schools in Petauke district. To make the study manageable, four secondary schools were selected by using simple random sampling method. This was conducted by first obtaining a list of the ten secondary schools from the District Education Board Secretary's office. Then each of the 10 secondary schools was assigned with a different number from 01 to 10 and was placed in a bag. The numbers were thoroughly mixed and four numbers were picked at random from the bag one after another. The four different numbers represented the schools which were included in the study. The study sample comprised 24 teachers of mathematics, 4 heads of mathematics department and 120 Grade 11 pupils (boys and girls), 80 pupils were involved to answer the questionnaires and 40 pupils were involved in the

focus group discussions from the four selected secondary schools in Petauke District. Purposive sampling was used to select 24 teachers of mathematics to answer the questionnaire and to be observed. This was ideal because purposive sampling involves selecting cases based on specific purposes rather than randomly (Kombo and Tromp, 2010). The teachers who were given the questionnaires were those who were found within the school. Heads of mathematics departments were selected using the purposive sampling technique. This involves selecting cases based on specific purposes rather than randomly (Kombo and Tromp, 2010). The 120 pupils were picked using stratified random sampling technique (Wisker, 2001). This involved breaking down the target population into identifiable groups (strata) namely 'boys' and 'girls' and there after a simple random sampling technique was used to select 60 boys and 60 girls in each group (stratum).

3.6 Research Instruments

In order to achieve the objectives of this study, four data gathering instruments were used to collect the necessary data. These were classroom observations, questionnaires, interview schedules and focus group discussions (Kombo, 2010).

3.6.1 Classroom Observations

The purpose of classroom observations were to see and record teachers' questioning techniques and the types of questions they asked during mathematics lessons (see Appendix 5). To classify teachers' questions, revised Bloom's (2001) taxonomy of the cognitive domain outlined in Table 1 was used to illustrate the cognitive level of teachers' questions as a way to understand and report the observations. In the revised Bloom's taxonomy, questions are classified into six types: remembering,

understanding, applying, analysing, evaluation, and creating. Low level questions or fact questions are those concerning remembering of subject matter or the recall of facts and specifics. High level questions or thought questions are those requiring the pupils to analyse, evaluate or create. These questions require pupils' greater effort and time to construct the answers.

Table 1: Revised Bloom's taxonomy of the cognitive domain

QUESTION CATEGORY	BLOOM'S COGNITIVE DOMAIN	PUPIL ACTIVITY
LOWER ORDER	Remembering	Retrieving, recalling, or recognising knowledge from memory. Remembering is when memory is used to produce definitions, facts, or lists, or recite or retrieve material.
	Understanding	Constructing meaning from different types of functions be they written or graphic messages activities like interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
	Applying	Carrying out or using a procedure through executing, or implementing. Applying refers to situations where learned material is used through products like models, presentations, interviews or simulations
HIGH ORDER	Analysing	Analyzing: Breaking material or concepts into parts, determining how the parts relate or interrelate to one another or to an overall structure or purpose.
	Evaluating	Making judgments based on criteria and standards through checking and critiquing. Critiques, recommendations, and reports are some of the products that can be created to demonstrate the processes of evaluation.
	Creating	Creating: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to put parts together in a new way.

(Anderson, 2001).

3.6.2 Questionnaires

The purpose of the questionnaires was to find out the opinions of teachers and pupils about questioning techniques in the mathematics classroom. It was hoped that the questionnaires would help the researcher to gather indepth information about the research questions in order to supplement and triangulate the data which was obtained from classroom observations and interviews (see Appendix 2 and Appendix 4).

There was no time limit on teachers to fill the questionnaires. This was done to encourage teachers to address all the parts in the questionnaire and explain their answers. The questionnaire consisted of both open-ended and closed-ended questions in order to improve the quality of data collected. Open-ended questions gave the respondents greater freedom of expression as they offered the respondents an opportunity to qualify their answers thus reducing bias due to unlimited response ranges. Because of the fear of researcher/interviewee bias that could arise from open-ended questions, the questionnaire included closed ended questions that were quick to be answered.

3.6.3 Focus group discussions

Focus group discussions were conducted with four groups of pupils comprising of 10 pupils per group from each selected school. Therefore a total of 40 pupils were involved in order to answer the research questions. Focus group discussions were used to elicit pupils' perceptions, feelings, attitudes and ideas pertaining to their teachers' techniques of questioning in mathematics lessons (Marshall and Rossmann, 1995). There were semi-structured interview items with a few sub-questions for each

question to help the researcher obtain in-depth information from the participants (Morgan, 1997; Mertens, 1998; Fielding and Thomas, 2001; Patton, 1990). To elaborate more, the questions were posed in structured and open-ended types. The structured questions were hoped to help participants to stay focused on the issue, while the open-ended questions were to allow them the freedom to express themselves on the issue. The focus group discussions lasted approximately one hour for each group(See Appendix 3).

3.6.4 Interview schedules

Interviews were conducted with four Mathematics heads of department from the four selected secondary schools in order to help answer research questions. Data obtained from these interviews were used to answer research questions. Using the qualitative interview with the Mathematics heads of department enabled me to gather in depth information about teachers' questioning techniques in mathematics. Each question was followed by 'prompting' sub-questions to help the participants understand the question. The interview items were a combination of open-ended and structured questions. While the structured questions helped the participants stay on task, the open-ended questions allowed them to express their ideas and opinions on teachers' questioning(Appendix1).

3.7 Procedures for data collection

Both qualitative and quantitative primary data were collected using the questionnaire, class observations, focus group discussions and interview guides, which allowed for triangulation of results. A check observation list was prepared to record the type of questions asked in their lessons (Appendix 5).The researcher observed a total of 8

mathematics teachers on different days and times from the four selected secondary schools. To establish good rapport with teachers, the researcher had to contact and explain the methods and the purpose of collecting data in the classroom. Before this, the researcher had to get permission from the school administration. Questionnaires were developed and prepared by the researcher and were distributed to the participants when he went in the field. Two sets of questionnaires were prepared; one set was for the 80 pupils and the other for 24 teachers of mathematics from the four selected secondary schools.

Out of the 80 questionnaires distributed to pupils, 78 questionnaires were received back, which represented a response rate of 97.5%. Similarly, out of 24 questionnaires distributed to teachers of mathematics, 20 were returned which represented a response rate of 83.3%. The questionnaires for both teachers and pupils were written in English.

Focus group discussions were conducted at different times from the four schools the researcher visited in the field. Ten pupils per group from each selected school were interviewed. The focus group discussions with pupils were conducted in the afternoon in an arranged classroom in order to avoid lesson disturbances. Therefore a total of 40 pupils were involved in order to answer research questions and were encouraged to express their ideas and opinions freely.

The researcher conducted interviews with four Mathematics heads of department from the four selected secondary schools at different times. Data obtained from these interviews were used to answer research questions. The researcher had no difficulties

to meet the four heads of department to participate in the interviews because they were informed in advance. The interviews were conducted and the duration for each interview was 25 to 35 minutes. All the Mathematics heads of department prepared the venue for the interviews and chose time convenient for them to be interviewed.

3.8 Data analysis

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

3.8.1 Qualitative data

Qualitative data collected through interviews and questionnaires were analysed using the constant comparative method of qualitative analysis (Glaser and Strauss, 1967). The constant comparative method involves breaking down the data into discrete units and coding them into categories (Lincoln and Guba, 1985). Categories arising from this method generally take two forms: those that are derived from the participants' customs and language, and those that the researcher identifies as significant to the project's focus of inquiry (Glaser and Strauss, 1967). Using this constant comparative method, data were continually analysed and reanalysed for emerging conceptual categories, sub-components of categories, and interrelationships of categories and concepts.

The similar responses were grouped into categories. With each interview analysis, data were analysed as it fitted into existing categories and also for the existence of new categories. Later categories were analysed for various properties

that were comprised within them. Data were reanalysed for comparison of the units to the properties within the category.

Each interview was read line-by-line and tentative nodes (discrete categories) of data content were developed. Classroom observational data transcripts were analysed in the same manner as interview transcripts. As each interview for the four heads of department was read, data were assessed and placed into existing categories and where data did not fit into existing categories, new categories were developed.

The data within each conceptual category were reviewed for appropriateness of fit within the new content grouping. Data that were contrary to the information in nodes were placed in a separate node and reexamined to determine if there were reasons as to why the information would be different from that found in other interviews. As data emerged from the content categories, it was placed into themes which encompassed all of the data collected from the participants.

Data were analysed until saturation was reached. Saturation is the point at which data properties and categories have become rich with description and depth, and the addition of more data only serves to further illustrate what was already well established (Glaser and Strauss, 1967).

3.8.2 Quantitative data

The software, Statistical Package for Social Sciences (SPSS) version 16 was used to perform a variety of statistical analysis, including the computation of correlation and reliability. The statistical methods used to describe the overall characteristics of the data collected included descriptive statistics in which frequency tables, histograms, cross tabulations were used to explore the statistical relationships between variables.

Inferential statistics such as Chi-square test, t-test and ANOVA test were applied to explore the statistical relationships between variables. The Chi-square test was used to analyse categorical data, which is a nonparametric test which does not require the sample data to be normally distributed, although it relies on the assumption that the variable is normally distributed in the population from which the sample was drawn (Runyon, 1977).

The test for statistical significance of results were reported in bivariate tables and interpreting bivariate tables was integral to interpreting the results of a chi-square test. Bivariate tabular analysis was used to summarise the intersections of independent and dependent variables and to understand the relationship between those variables and the results were presented in contingency tables (Runyon 1977). The t-test was used to test statistical significance if there was any difference between the observed means of the two independent sample groups within the sample of the mathematics teachers who said they applied the taxonomy in their lessons and those who did not. The ANOVA test was applied as a statistical technique to compare the means of the data collected between the different groups. The purpose of the comparison was to determine whether or not the means of the three different groups of pupils were significantly different from each other.

CHAPTER 4

PRESENTATION OF THE RESEARCH FINDINGS

4.0 Introduction

The key findings of the study on teachers' questioning techniques in mathematics at Grade 11 level from the four selected secondary schools in Petauke district, Zambia are presented in this chapter. The findings are illustrated in text, tables and figures.

4.1 Research question 1: What are the types and levels of questions teachers ask their pupils during the teaching and learning of mathematics?

This section presents the findings on the types and levels of questions asked by mathematics teachers. The analysis is based on the data obtained from the sixteen observations sessions (two per a teacher) conducted with the eight teachers of mathematics. The results are recorded in table 2

Table 2: Results of observation on types of questions asked.

	T1	T2	T3	T4	T5	T6	T7	T8	TOTAL	%
Remembering	30	34	48	36	44	22	34	28	276	50.5
Understanding	16	14	12	12	20	16	22	18	130	23.8
Applying	08	10	12	10	18	16	26	10	110	20.1
Analysing	02	12	04	-	02	02	02	06	30	5.5
Evaluating	00	00	00	00	00	00	00	00	00	00
Creating	00	00	00	00	00	00	00	00	00	00
TOTAL	56	70	76	58	84	56	84	62	546	100

Based on the classroom observations, data collected and tabulated in Table 2 indicated that all the eight teachers (T1 to T8) focused on remembering,

understanding and applying type of questions as compared to analysing, evaluating and creating type of questions. From the total 546 questions asked by the teachers, 276 (50.5%) of the questions dealt with remembering, 130 (23.8%) were questions dealing with understanding, 110 (20.1%) were application questions, 30 (5.5%) were questions dealing with applying, 0% were evaluating questions and 0% were creating questions. The two types of questions, evaluating and creating were not applied by the teachers observed.

Following Bloom's classification of the cognitive domain, Table 3 shows the levels of the questions posed by teachers in class obtained from the sixteen observations.

Table 3: Levels of questions asked by mathematics teachers

	T1	T2	T3	T4	T5	T6	T7	T8	TOTAL	%
Low level questions	54	58	72	58	82	54	82	56	516	94.5
High level questions	02	12	04	00	02	02	02	06	30	5.6
TOTAL	56	70	76	58	84	56	84	62	546	100

Overall, the low level questions exceeded the high level questions. A total of 516 (94.5%) of questions were classified as low level questions and 30(5.6%) questions were classified as high levels questions.

Table 4 displays data on what type of questions teachers of mathematics usually ask pupils during mathematics lessons.

Table 4: The nature of questions asked by male and female teachers

	Questions of lower order	Questions of higher order	Total
Female teachers	3	2	5
Male teachers	12	3	15
Total	15	5	20

Table 4 represents the responses from the teacher's questionnaire about what type of the questions teachers asked during mathematics lessons. From the information displayed, teachers' responses showed that they asked more lower order questions compared to higher order questions. Twelve male teachers indicated that they asked mainly lower order questions, three male teachers indicated that they asked mainly higher order questions. On the other hand, three female teachers asked mainly lower order questions and two female teachers asked mainly higher order questions.

Table 5 displays data on a Chi square test carried out on lower and higher order questions teachers of mathematics asked in Petauke district.

Table 5: Chi square test statistics of lower and higher order questions

	What type of levels of questions do you usually ask pupils during lessons, tests or assignments?
Chi-Square	5.000 ^a
df	1
Asymp. Sig.	0.025

To determine the significance of the information obtained in Table 4, a chi square test was carried out to compare responses of lower order questions to responses of higher order questions asked by mathematics teachers. The chi square test was used to test the null hypothesis (H_0) that levels of questions asked by mathematics teachers differed. The alternative hypothesis (H_1) tested was that levels of questions asked by mathematics teachers did not differ. The p-value used for testing was set at $\alpha = 0.05$. Table 6 suggested that, $\chi^2 = 5.000$ and a p-value of 0.025 which was below the standard $\alpha = 0.05$. The alternative hypothesis was rejected and concluded that the levels of questions asked by mathematics teachers differed significantly.

Table 6 displays data on responses from mathematics teachers dealing with whether they tested specific objectives outlined in the senior secondary school syllabus.

Table 6: Responses on whether teachers tested the specific objectives outlined in the senior secondary school syllabus when preparing questions

	Frequency	Percentage
Yes	18	90.0
No	2	10.0
Total	20	100.0

Table 6 shows the responses of the teachers concerning whether they tested the specific objectives outlined in the senior mathematics syllabus. Ninety percent of the teachers said they tested the objectives in tests, class exercises and assignments while only ten percent of the teachers said they did not. On the contrary, even though Table 6 showed that many teachers did test the specific objectives outlined in the senior syllabus, they mainly tested objectives of lower order questions as was observed in Table 5.

Table 7 displays data on responses from mathematics teachers dealing with how regular they tested specific objectives outlined in the senior secondary school syllabus.

Table 7: Responses on how regular did mathematics teachers use the senior school syllabus when preparing questions for pupils

Response	Frequency	Percentage
Very regular	5	27.8
Regular	12	66.7
Not regular	1	5.6
Total	18	100

Table 7 shows how teachers responded in terms of the use of the mathematics senior syllabus. A total of 12 mathematics teachers (66.7%) responded that they used the syllabus of mathematics on a regular bases when they were preparing the lessons, a total of 5 (27.8%) responded that they used the syllabus very regularly and 5.6% did not regularly use the syllabus when preparing questions.

The study also sourced information from mathematics teachers on the subject whether they followed the revised Bloom’s taxonomy in their teaching of mathematics to learners. A t-test was performed on the two groups obtained, for those who said they followed any taxonomy in their teaching and those who did not. The results are recorded in Table 8.

Table 8: Understanding of application of any taxonomy between two independent Groups

Group	N	mean Score	SD	t	df	Mean diff	sig	Application of Taxonomy
Yes applied	14	9.86	4.470	4.470				
				2.954	16.047	4.690	0.09	application
Not applied	6	5.17	2.563	2.563				

Table 8 shows the contingency table for the t-test obtained. A t-test was carried out to determine if there was any difference between the observed means of the two groups in Table 8 for those who applied any taxonomy in their lessons and for those who did not. The null (H_0) hypothesis test: There was significant difference between the two observed means.

The alternative (H_1) hypothesis: There was no significant difference between the two observed means which were tested. The p-value for the data obtained was 0.009. Since the p-value obtained was less than the standard p-value 0.05 for testing, the alternative hypothesis was rejected and concluded that there was evidence that the mean ($M = 9.86$, $SD = 4.470$, $N = 14$) for the number of years of experience of teachers who said they used any taxonomy was significantly different from those who indicated that they did not. ($M = 5.17$, $SD = 2.563$, $N = 6$), $t(16.047) = 2.954$, p-value = 0.009. From this test it was concluded that there was evidence within the setting observed that a good number of mathematics teachers applied any kind of taxonomy they knew in their questioning techniques in mathematics.

The study further sourced information on whether mathematics teachers knew correctly the name of the type of taxonomy they applied in their lessons as indicated in Table 8. The results are given in Figure 4.

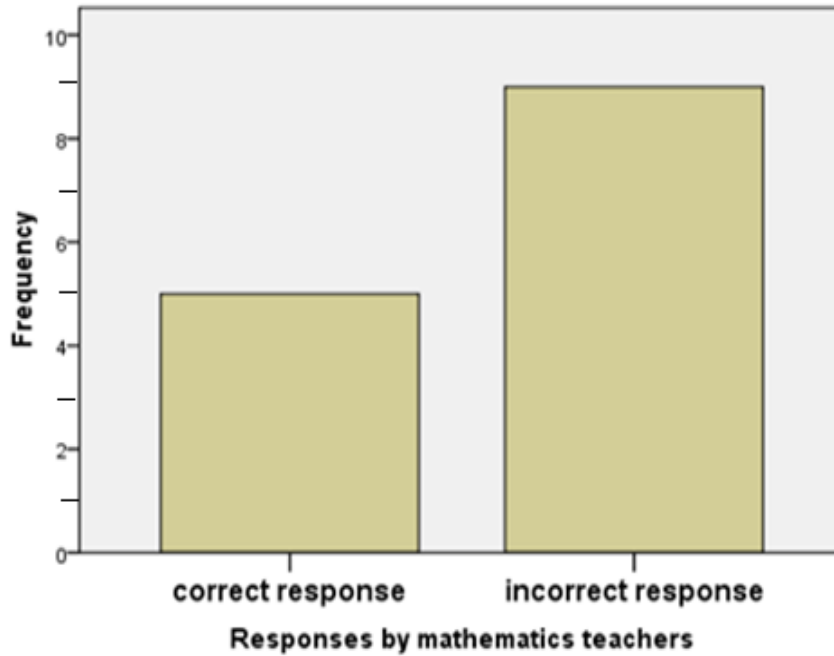


Figure 4: Correct taxonomy mentioned by mathematics teachers.

According to the data obtained in Figure 4, Only 5 (35.7%) of the respondents out of 14 mentioned the correct name of the taxonomy they followed and applied in their lessons and 9 (64.3%) gave incorrect name of the taxonomy they followed.

4.2 Research question 2: How do pupils perceive teachers' classroom questions on their performance in mathematics?

Data in Table 9 shows the comparison of boys and girls responses on how they perceived questions asked by their mathematics teachers whether they could help them pass mathematics.

Table 9: Comparison of boys and girls responses on how they perceived questions asked by their mathematics teachers

Sex		Frequency	
		Yes	No
Boys	Count	17	24
	% within	41.5%	58.5%
Girls	Count	14	23
	% within	37.8%	62.2%
Total	Count	31	47
	% within	39.7%	60.3%

According to Table 9, 41.5% of the total number of boys said that they perceived the questions asked by their mathematics teachers as questions that could make them answer mathematics exercises and pass mathematics tests while on the other hand, 58.5% of the total number of boys said that they perceived the questions teachers asked could not make them answer mathematics exercises and pass mathematics tests. Similarly, 37.8% of the total number of the girls said they perceived the questions asked by their mathematics teachers as questions that could make them answer mathematics exercises and pass mathematics tests while 62.2% of the total number of girls responded that they did not perceive the questions asked by their mathematics teachers as questions that can make them answer correctly mathematics exercises and pass mathematics tests. Information in Table 9 also suggested that the total number of both boys and girls who did not perceive the questions as that could

make them pass mathematics was more than the total number who said that they perceived the questions as the type that could make them pass mathematics.

To determine the significance of the information obtained in table 9, a chi square test was carried out to compare responses of boys and girls on how they perceived the questions asked by their teachers in mathematics lessons whether they could make them answer class exercises and pass mathematics tests (See Table 10)

Table 10: Chi-Square Test for comparison of boys and girls responses

Value (2-sided)	df	Asymp. Sig.	
Pearson Chi-Square	0.107	1	0.744
Likelihood Ratio	0.107	1	0.744
N of valid Cases	78		

The chi square test was used to test the null hypothesis (H_0) that perception of boys on whether the questions asked by mathematics teachers could make them answer correctly mathematics exercises and pass mathematics tests differed significantly from that of girls. The alternative hypothesis (H_1) tested was that perception of boys on whether the questions asked by mathematics teachers could make them answer correctly mathematics exercises and pass mathematics tests did not differ significantly from that of girls. The p-value used for testing was set at $\alpha = 0.05$. Table 10 suggest the Pearson chi square, $\chi^2 = 0.107$ and a p-value of 0.744 which was above the standard $\alpha = 0.05$ for testing. The null hypothesis was therefore rejected and the researcher concluded that there was no significant difference in the responses between boys and girls on how they perceived the questions asked by their mathematics teachers $\chi^2 (1, N=78) = 0.107$ and $p = 0.744$.

Besides soliciting for information from pupils on how they perceived their mathematics teachers' classroom questions, the study also targeted to source information on how mathematics teachers rated pupils' perception on their classroom questioning. Table 11 shows the information.

Table 11: Responses from teachers on how they rated pupils' perception on their classroom questioning in mathematics

Responses	Frequency	Percentage
Very good	1	5.0
Good	16	80.0
Not good	3	15.0
Total	20	100

Referring to Table 11, we can see that 80% of the respondents indicated that pupils perceived their classroom questions as good, 5% of the respondents indicated that pupils perceived their questions as very good and 15% indicated that pupils perceived their questions in mathematics not good.

The study further compared the responses of male and female mathematics teachers on whether the questions they asked helped pupils to answer examination questions. The responses are tabulated in Table 12.

Table 12: Comparison responses from mathematics teachers on how they rated pupils' perception on their classroom questioning

Sex	Very good	Good	Not good	Total
Female	0	4	1	5
Male	1	12	2	15
Total	1	16	3	20

Table 12 shows the comparison responses between male and female mathematics teachers on how they rated the pupils' perception concerning their techniques or types of questions. A total of 17 male and female teachers indicated that their pupils considered their questions good, a total of 3, 2 male teachers and 1 female teacher indicated that their pupils considered their questions not good and only one male teacher indicated the questions asked by him were very good.

The study also further sourced information from pupils on whether the questions teachers asked helped them to answer examination questions. The responses were tabulated in Table 13.

Table 13: Responses from pupils whether questions asked by teachers in mathematics helped them to answer examination questions

Responses	Frequency	Percentage
Very much	22	28.2
Not much	41	52.6
Not at all	15	19.2
Total	78	100

Table 13 suggests that 28.2% of the pupils considered the questions asked by their teachers as very much helpful to answer examination questions, 52.6% considered the questions asked by their mathematics teachers as not much helpful to answer examination questions and 19.2% considered the questions not at all to be helpful to them to answer the examination questions.

To determine the significance of the information obtained in Table 13 a one way ANOVA test was performed to compare the means of the three groups whether they significantly differed. The responses “Very much, Not much and Not all” were assigned numbers 1, 2 and 3 respectively to enable the use of the ANOVA. The results are tabulated in Table 14.

Table 14: Pupils understanding whether questions asked by teachers in mathematics helped them to answer examinations among groups of Grade 11 eleven pupils.

Group	N	Mean score	SD	df	F	sig
Very much	22	18.36	1.590	2		
Not much	41	19.44	2.599	75	3.231	0.045
Not at all	15	18.00	2.226			
Total	78	18.86	2.226			

Significant at $P < 0.05$

From table 14, it can be seen that the mean for the group who answered “very much” was 18.36, standard deviation of 1.590. For those who answered “not much” the mean was 19.44 and with a standard deviation 2.599 and for those who answered “not at all” the mean was 18.00 and with a standard deviation of 2.226

The ANOVA test was used to test the null hypothesis (H_0) that the means of the three groups significantly differed from each other. The alternative hypothesis (H_1) tested was that the means of the three groups did not significantly differ from each other. The p-value used for testing was set at $\alpha = 0.05$. Table 13 indicates a p-value of 0.045 which was slightly below the standard $\alpha = 0.05$. The alternative hypothesis was rejected and the researcher concluded that the results of the ANOVA, $F(2, 77) = 3.231, p = 0.045$ indicated that there was a significant difference among the means of the three observed groups.

4.3 Research question 3: Do teachers ask questions in the mathematics classroom that they intend to ask?

The study also sourced information on whether teachers of mathematics asked what intended to ask. The responses were recorded in Table 15.

Table 15: Responses from mathematics teachers on whether they asked what they intended to ask in mathematics lessons

Responses	Frequency	Percentage
Yes	13	65
No	7	35
Total	20	100

The tabulated data in Table 15 shows that a total of 13 out of 20 teachers said they asked what they intended to ask which represented 65% while 7 responded that they did not ask what they intended to ask which represented 35%.

Similarly, the four heads of mathematics department interviewed in the study and referred to H1, H2, H3 and H4 indicated their responses whether teachers of mathematics asked what they intended to ask in the mathematics lessons. The responses are shown in table 16.

Table 16: Responses from Heads of department on whether teachers of mathematics asked what they intended to ask in mathematics lessons.

Teacher of mathematics knows intentions of asking questions in the mathematics lesson	H1, H2, and H3
Teacher of mathematics ask what they intended to ask in the mathematics lesson.	H1, H2, H3 and H4
Teacher remembers to ask what they had planned in their lessons	H1, H2, H3 and H4

From Table 16, three heads of department (H1, H2, and H3) indicated that teachers knew their intentions of asking questions in mathematics lessons. All the four (H1, H2, H3, H4) heads of department indicated that teachers of mathematics asks what

they intend to ask and remembers to ask what they plan in their lessons. This was based on the regular observations heads of department conducted to monitor their teachers during the teaching and learning of mathematics in the classroom.

4.4 Research question 4: What are the factors that affect teachers’ questioning in the mathematics classroom?

The study also solicited information on whether the factors which affected teacher questioning in mathematics also affected the performance of the learners. The responses are given in table 17.

Table 17: Responses from mathematics teachers on whether factors which affected Teachers’ questioning also affected the performance of the learners.

Responses from mathematics teachers.	Frequency	Percentage
Yes	17	85
No	3	15

Table 17 suggests 17 respondents (85%) agreed that factors that affected the teachers’ questioning in mathematics lessons also affected the performance of the learners while 3 (15%)respondents did not agree.

To determine the significance of the information obtained in Table 17, the chi square test was carried out to compare responses of mathematics teachers who said ‘yes’ and those who said ‘no’ whether they significantly differed in their responses. The results are shown in Table 18

Table 18: Chi square test on responses whether the factors which affected teacher questioning in mathematics also affected the performance of the learners.

Value	df	Asymp. Sig.
Pearson Chi-Square	9.81	0.002
N of valid Cases	20	

The chi-square test was used to test the null hypothesis (H_0) that teachers' responses did not differ. The alternative hypothesis (H_1) tested was that teachers' responses differed significantly. The p-value used for testing was set at $\alpha = 0.05$. Table 18 gives $\chi^2 = 9.8$ and a p-value of 0.002 which was below the standard $\alpha = 0.05$. The alternative hypothesis was therefore rejected and concluded that teachers' responses observed from the questionnaire on whether factors which affected teachers' questioning also affected the performance of learners did not differ significantly.

Fear to ask questions during mathematics lessons was one of the factors the respondents gave during the focus group discussions, during interviews with Mathematics heads of department and from both the pupils' questionnaire and teachers' questionnaire.

The study also sought to compare the responses of boys and girls whether they feared to ask questions during mathematics lessons. The responses are given in Table 19.

Table 19: Responses from pupils whether they feared to ask questions

Responses	Frequency	Percentage
Yes	50	64.1
No	28	35.9
Total	78	100

Data tabulated in Table 19 suggests that 50 (64.1%) of the pupils who answered the questionnaire feared to ask questions in mathematics lessons and 28 (35.9%) of the pupils did not fear to ask questions in mathematics lessons.

In order to determine the significance of the information obtained in Table 19, the chi square test was carried out to compare responses of boys and girls whether they feared to ask questions during mathematics lessons. The results are tabulated in Table 20.

Table 20: Chi-Square test of responses between boys and girls whether they feared to ask questions during mathematics lessons.

Value (2-sided)	df	Asymp. Sig.
Pearson Chi-Square	2.407 1	0.121
Likelihood Ratio	2.4331	0.188
N of valid Cases	78	

The chi square test was used to test the null hypothesis (H_0) boys' responses differed significantly from girls' responses. The alternative hypothesis (H_1) tested was that boys' responses did not differ significantly from girls' responses. The p-value used for testing was set at $\alpha = 0.05$. Table 20 gives a $\chi^2 = 2.407$ and a p-value of 0.121 which lied above the standard $\alpha = 0.05$. Therefore, the null hypothesis was rejected and the researcher concluded that there was no significant difference in responses between boys and girls.

The study gathered information from the pupils to find out whether teachers of mathematics gave them enough time to answer questions in mathematics. The responses are shown in Table 21.

Table 21: Responses from pupils whether teachers of mathematics gave them enough time to answer mathematics questions.

Responses	Frequency	Percentage
Yes	30	38.5
No	48	61.5

From Table 21, a total of 30 pupils (38.5%) indicated that their mathematics teachers gave them enough time to answer questions in mathematics lessons. A total of 48 pupils (61.5%) indicated that their mathematics teachers did not give enough time to answer questions in mathematics.

The study also sourced information on what teachers did when pupils did not understand the questions asked. The responses are shown in Table 22.

Table 22: Responses on what teachers did when pupils did not understand the questions asked.

Responses	Frequency	Percentage
Repeats the question	5	25
Rephrases the question	13	65
Gives clue	2	10
Answers on their behalf	0	0

As it can be observed from Table 22, 65% of the mathematics teachers who participated in the study responded that they rephrased the question, 25% indicated that they repeated the question and 2% said that they gave clues.

The study also gathered information on whether mathematics departments conducted Continuing Professional Development meetings on classroom questioning. The responses from the mathematics teachers are tabulated in Table 23.

Table 23: Responses whether Departments conducted CPDs on questioning

Responses	Frequency	Percentage
Yes	3	15.
No	17	85
Total	20	100

Referring to Table 23, we can see that 85% of the respondents indicated that their departments did not conduct Continuing Professional Development meetings on classroom questioning in mathematics and 15% of the respondents indicated that their departments conducted continuing Professional Development meetings on classroom questioning.

Further analysis of teachers' responses on factors that affects teachers' questioning from the questionnaire indicated the followings as shown in Table 24.

Table 24: Factors identified by mathematics teachers that affects teachers questioning in mathematics lessons.

Factors identified by respondents (Mathematics teachers)	Frequency	Percentage
Lack of pupil interaction	16	80
Language barrier	17	85
Reactions to pupils responses	15	75
Lack of substantial subject matter know-how	14	70
Lack of preparation	19	95
Teachers views about pupils abilities	12	60
Lack of text books	18	90

Referring to Table 24, a total of 16 (80%) mathematics teachers out of 20 who answered the questionnaire indicated and explained that lack of pupil interaction was one of the factors affecting teacher questioning techniques in mathematics. A total of 17 (85%) mathematics teachers indicated that language problems with pupils tended to affect teachers' questioning in the classroom. Lack of substantial subject matter know-how by mathematics teachers was also one of the factors explained and indicated by a total of 14 (70%) mathematics teachers which they claimed affected the aspect of questioning in mathematics. The issue of lack of preparation was also mentioned by the majority (19) as one the factors which affected the type of questions teachers of mathematics asked in the classroom. A total of 12 teachers (60%) mentioned that teachers' views about pupils' abilities and lack of text books

for preparation mentioned by 18 teachers (90%) were some of the factors affecting teachers' questioning in the classroom.

In the focus group discussions, the researcher sourced information on pupils' opinions about the factors which affected teachers questioning in the mathematics classroom. The four different groups from four different schools selected for the study were referred to as G1, G2, G3 and G4. Table 23 shows the data obtained from the focus group discussions.

Table 25: Pupils responses on what affected teachers questioning in the mathematics classroom.

	Number of participants	Factors mentioned which affected teachers' questioning techniques
G 1	10	Fear to ask or answer questions by pupils, difficulties by pupils to express in language correctly.
G 2	10	Failure by teachers to give them enough time to answer questions, lack of preparations by mathematics teachers,
G 3	10	Fear to ask or answer questions by pupils, difficulties by pupils to express in language correctly.
G 4	10	Negative reactions to pupils' responses by mathematics teachers, fear to ask or answer questions by pupils, difficulties by pupils to express in English language correctly.

From Table 25, pupils in the focused discussions all contended that teachers' questioning in the mathematics classroom was affected by fear to ask or answer questions because pupils were worried to be laughed at if they gave wrong solutions. Pupils also mentioned other factors such as negative reactions to pupils' responses by mathematics teachers, difficulties by pupils to express themselves correctly in English. One pupil from G1 mentioned that:

“sometimes pupils kept silent whenever teachers asked questions in the classroom because they got discouraged whenever the teacher reacted negatively to the wrong response given.”

4.5 Summary of the findings

The study indicated that teachers of mathematics in Petauke district mostly used the three types of the Bloom’s revised taxonomy: remembering, understanding and applying. The other three types, analysing, evaluating and creating were rarely applied in their lessons. Questions involving lower level category were found to be predominant as compared to questions involving higher level category.

The study also showed that both girls and boys felt that the type of questions asked by their teachers did not help them to pass mathematics tests and mathematics examinations. Pupils did not answer the questions even though they understood the questions and knew the answers because of fear of making mistakes. The pupils also indicated that they were unable to answer questions even though they understood them because of their inability to put ideas into words due to their limited vocabulary. Teachers of mathematics indicated that teachers’ questioning technique in the classroom was affected by lack of knowledge of the taxonomies, Lack of Continuing Professional Development meetings on classroom questioning in mathematics, lack of substantial subject matter know-how and lack of preparation by mathematics teachers.

CHAPTER 5

DISCUSSION OF THE FINDINGS

5.0 Introduction

This chapter discusses the findings of the study. The findings investigated teachers' questioning techniques in the mathematics classrooms at Grade 11 level in four selected secondary schools in Petauke District.

5.1 Types and levels of questions asked by mathematics teachers.

Walker (1975) and Wringe (1989) stated that intensive communication takes place in lessons by asking and answering questions. In the questioning-answering exchange, varieties of questions are very important. However, this study found that teachers of mathematics mostly used remembering, understanding and applying types of questions (Table 2). Teachers concentrated on factual answers that had little to do with developing creative thinking and creative abilities that could provide learners with opportunities to practice mathematics and answer higher level questions. The other three types of questions, analysing, evaluating and creating were rarely used by all the eight teachers observed in the classrooms. There could be reasons for this. The nature of the lessons and the pupil's ability might have inhibited teachers to use those types of questions. On the other hand, knowledge, comprehension and application questions do not require much time to plan. Furthermore, teachers may pay attention to knowledge and comprehension questions in order to cover the required instructional material in the given time (Kissock and Iyortsuun, 1982).

Teachers generally agree that they should emphasise the development of pupils' skills in critical thinking rather than in recalling facts, they also agree that a relationship exists between questioning and cognition and that questions which

elicite abstract thinking seem to be most effective in moving pupils toward higher levels of understanding(Cotton 1998). In addition the researcher found that teachers of mathematics do usually test the mathematical objectives outlined in the senior syllabus and they often used the syllabus when preparing the questions,

However, this study has indicated that the majority of the mathematics teachers asked questions at lower level. This finding supports earlier research done by Barnes(1983),Clegg (1971), Gall(1970) and Wilen (1991). Lower order questions involve remembering, understanding and applying while higher order questions involve analysing, evaluating and creating. The predominance of lower levels questions asked by the teachers of mathematics indicated that questioning was used in a narrow sense than in a broader way.

The study further found that pupils were not challenged to think and tackle higher levels of questions. This finding pointed to the fact that pupils, regardless of their ability, had not been given much exposure to high level questions in the classroom even though the school curriculum and the senior school syllabus stipulates that one of the aims of teaching mathematics in Zambia is to make pupils become problem solvers and apply the knowledge in real situations.

It has been argued that apart from reducing the opportunity for asking high level questions, excessive use of low-level questions in the classroom succeeds only in keeping pupils permanently in cognitively second rate instructional program (Ornstein, 1995) because pupils are denied experiencing more challenging tasks (Marriott, 2001; Myhill and Dunkin, 2005). This is due to the fact that low level

questions access only superficial understanding and thoughts and do not give pupils much opportunity for meaningful interaction through expressing their ideas, personal interpretation and evaluation; giving stimulating thought provoking responses and trying to relate their learning to real life experiences (Bromley, 1992; Good and Brophy, 2003).

The fact that the eight teachers (Table 3) observed asked enough lower order questions could be because they wanted their pupils to achieve this (master basic skills, focus their attention on specific information and for teachers to gauge their knowledge). But, there is a need to find a balance in the use of questions in both levels low and high. Therefore, teachers of mathematics should incorporate some higher level questions in their instruction even with weak learners to provide them with exposure to higher level thinking and to stimulate development of their thinking skills (Morgan and Saxton, 1994; Ornstein, 1995).

The study also suggested that even though a good number of mathematics teachers indicated that they applied the objectives outlined in the senior mathematics syllabus in their lessons and regularly used the syllabus when preparing questions, they mainly considered objectives testing lower order questions. This finding may indicate that mathematics teachers are under covering in terms of testing the outlined objectives in the senior mathematics syllabus as expected by the Examinations Council of Zambia and setters for final mathematics examination at Grade 12 level. The final examination papers usually have more questions involving higher order questions as compared to lower order questions. This could be one area which is affecting the pupils' performance of mathematics at Grade 12 level

5.2 Perceptions of pupils on teacher questioning in mathematics

From the analysis of responses from the pupils (Table 9), they (pupils) perceived that teachers' classroom questions had no effect on their passing mathematics class exercises, tests and examinations. The study also found that there was no significant difference in the way boys and girls perceived their teachers' classroom questions. The study showed that both girls and boys felt the type of questions asked by their teachers did not help them to do well in mathematics. This implies that there is need for mathematics teachers in secondary schools in Zambia to improve their use of classroom questions and even their questioning techniques to help pupils to perform well in mathematics.

Teachers' classroom questions should be an effective and an important part of the lesson. According to Muijs and Reynolds (2005), there are several factors which might be considered as important for effective questioning, one of them being a good question. When teachers' classroom questions and the questioning techniques are not used effectively, there may be negative results in the teaching- learning process.

The secondary school pupils in Petauke district did not perceive that their teachers' classroom questions had any effect on their achievement or learning outcomes in mathematics, whereas the teachers' questions should have a significant effect on their performance in mathematics. Mason (2000) stated that the style and nature of questions encountered by pupils strongly influences the sense that they make of the subject matter. Teachers can facilitate the development of critical thinking, decision making and problem solving in pupils in mathematics classrooms for effective learning outcomes. One of the ways of improving the performance of pupils in mathematics at senior level in Zambia could be to improve on teachers' classroom

questions and questioning techniques which are necessary for the teaching and learning of mathematics and should eventually have an impact on the achievements or performance of pupils.

5.3 Do teachers ask what they intend to ask?

Results from the teachers' questionnaire (Table 15) showed that most of the teachers asked what they intended to ask for both lower and higher levels of questions in mathematics. The study also found that teachers mostly remembered what they were teaching and which also indicated that they asked what they intended to ask from the learners. From the classroom observations, the teachers' questions correlated with the pupils' answers given. The questions also matched with what was being taught in the classroom. On the other hand a few teachers did not ask what they had intended to ask. From also the interviews carried out with the four heads of department (Table 16), they indicated that from the regular observations they carry out in their departments on lessons, teachers know the intentions of asking questions in their mathematics lessons.

5.4 Factors affecting questioning in mathematics classrooms

Questioning in mathematics is affected by certain factors which inhibit teachers from asking good and effective questions in their lessons. This section discusses the factors found by this study.

5.4.1. Fear to ask questions by pupils.

In the classroom situation, answering questions asked and asking varieties of questions are very important for effective learning. However, this study showed that a large proportion of the pupils indicated that they feared to ask questions or answer questions (Table 19). They restrained themselves from asking questions directed to their teachers because they did not want to embarrass the teacher, not wanting to expose their ignorance to their fellow pupils and not to get negative reactions from their teachers if they gave wrong answers or asked questions which were not clear. Therefore, they opted to remain silent as lessons were in progress. Topping and Trickey (2007) explained that teachers should aim at increasing pupils' questioning by not threatening the pupils with fear whenever they gave wrong responses because by doing so would result in them reducing their own questioning. Teachers of mathematics need to encourage pupils to ask questions during mathematics lessons.

5.4.2. Lack of knowledge of the taxonomies

The teachers who participated in the study claimed (Figure 4) that they knew about the taxonomies of Bloom (1956), Gallagher and Asher (1963), Wu (1993) and Krathwol (2001) and for the others such as Sander, Taba, Guilford and Barret. They also claimed that knowledge of the taxonomies helped them to ask questions suitable to pupils' needs in a variety of contexts, as stipulated in the syllabus. However, findings from the teacher questionnaire indicated that their knowledge of the taxonomies claim of asking questions at various levels in their lessons were paradoxical, since some of them did not even remember any of the levels within Bloom's Taxonomy. No one was able to mention the taxonomies for Gallagher and Asher, Krathwol, Wu, Sander, Taba, Guilford and Barret. Obviously, teachers' lack of knowledge of levels of questions within the taxonomy might have led them to ask

questions at knowledge level most of the times and neglecting the other higher levels. Knowledge of the taxonomy is believed to be useful for teachers to ask questions at various levels (Walklin, 1990; Muth and Alvermann, 1992; Brown, 2001). Basic knowledge of the taxonomy would help teachers to ask questions hierarchically in which teachers would build an informational data base at lower level first before proceeding to higher levels (Kauchak and Eggen, 1998).

5.4.3 Lack of enough wait-time

One of the factors that can have a powerful effect on pupils' participation in lessons is the amount of time pauses between asking a question and allowing pupils to answer the questions or work out the question. From the data collected (Table 21), the study showed that a total of 48 pupils out of 78 pupils considered time given by their mathematics as not enough to answer mathematics questions while 30 pupils considered it to be enough. This implies that pupils need to be given some wait time in order for them to comprehend a question, consider the available information, formulate an answer and begin to respond. Teachers need to ask a question and then wait for a minute or also before moving on to another pupil or before asking another question. Wait time increases the complexity of the answer, the number of unsolicited responses and the number of questions asked by pupils. Waiting decreases the number of pupils who fail to respond when called upon

5.4.4 Lack of Continuing Professional Development meetings.

From the analysis of the data collected from the teacher questionnaire, only three teachers indicated that their departments conducted Continuing Professional

Development meetings on classroom questioning. The Majority (17) out of 20 mathematics teachers who answered the questionnaire indicated that their departments did not conduct Continuing Professional Development (CPD) meetings on classroom questioning (Table 23). This pointed to the fact that CPD meetings were not conducted at a large scale in secondary schools and mathematics teachers did not share knowledge on classroom questioning. If anything, very little was done on classroom questioning. Mathematics heads of department and teachers should realise that Continuing Professional Development is a fundamental part of teaching. It is the process, by which teachers keep up-to-date with knowledge, improve their skills, progress into new roles and it keeps them employable throughout their lives. As professionals, mathematics teachers have a requirement to keep their skills and knowledge up-to-date. Continuing Professional Development is an opportunity to develop oneself, the nature and measure of the benefit depends entirely on the individual. It is crucial because it enables mathematics teachers to progress and develop their professional self, as well as remaining current with their skills and competencies. Continuing Professional Development aids teachers to turn responsibility into a positive opportunity to identify and achieve their own career objectives.

5.4.5. Lack of teacher and pupil interaction.

Lack of pupil and teacher interaction in mathematics lessons was one of the factors indicated by the respondents that could affect questioning in mathematics (Table 24). Some teachers responded that they tried to enhance interactivity in their classrooms; however, they got discouraged as soon as they saw that their pupils were not responding. According to Topping (2007), the lack of good talk in the class is the

result of false assumption that teachers have about pupils because they seem to believe that pupils know how to discuss. Teachers need to engage pupils to participate in their lessons and have a friendly approach. This would help learners to participate and ask questions and also respond to the teachers' questions.

5.4.6 Language barrier

From the analysis of the teachers' responses (Table 24), pupils were reluctant to answer and ask questions because of language barrier. Sometimes teachers' questions were ambiguous for pupils to understand them and in the process affected learners from giving clear responses. Both teachers and pupils indicated that learners who were not well acquainted with the English language were afraid to ask questions or answer questions because they were worried that their fellow pupils or the teacher would laugh at their poor language. This could affect pupils' participating and asking questions during lessons. Therefore, one way is to encourage pupils is to use English language by giving them enough opportunities to use the language in asking and answering questions.

Perrot (1986) indicated different ways of asking questions in a classroom. One of the ways he discussed was that teachers should avoid repeating questions if learners did not understand. Their repeating of questions does not help to keep the attention of all the pupils in the classroom. If the teacher had the habit of repeating questions, many pupils do not listen at first as they know their teacher's habit. On the contrary, the research showed that there were some mathematics teachers who liked repeating their questions if pupils did not understand their questions. However the study showed that a good number of mathematics teachers rephrased the question if their

pupils did not understand the question. It is appropriate to rephrase the question if pupils have not understood. Simple and appropriate level of language should be used to explain the everyday life phenomena which are related to mathematical concepts, in order to motivate pupils to understand better.

According to Chaudron (1988), teachers should modify a question by rephrasing it with an alternative. Therefore, modified and effectively rephrased questions may avoid ambiguity and encourage pupils to participate in the classroom discussion. Moreover, a rephrased question enhances language learning and increases pupils' productive skills.

5.4.7 Negative reactions to pupils' responses.

The study also showed that reacting to pupils' responses may reflect negative or positive responses (Table 25). According to Nunan (1991), reacting positively to pupils' responses plays an important role in transforming pupils' attitude towards the lesson and engages learners in the discussion and in asking questions. Besides, encouraging pupils in asking more and more questions, teachers are expected to treat pupils' responses appropriately in order to encourage them to ask and answer questions. Therefore, if the reactions to pupils' responses are negative, they would discourage pupils to ask and answer questions. Pupils may give correct, partly correct or incorrect answers or they may not respond at all. Some pupils' responses encourages further discussion while others are intended to bring the discussion to an end (Amdlsselassie, 1999). Therefore the teacher's task is to give a reaction that is suitable to the response and situation in which it is presented. As indicated above, a reaction to pupils' responses should be pertinent to the response and situation in order to enhance the discussion maintaining the participation of the pupils.

5.4.8 Lack of substantial subject matter know-how

From data analysed (Table 24), lack of substantial subject matter knowledge was indicated as one of the factors affecting questioning by mathematics teachers. Pedagogical content knowledge is the knowledge of how to transform formal subject matter knowledge into meaningful learning outcomes for pupils and it also involves an understanding of a particular topic and how teachers explain the topic or concepts to make sense to the pupils (Mushashu, 1997).

Because of pedagogical content knowledge problems of classroom teachers, the knowledge of what to teach and how to teach the subject matter effectively affect the type of questions to ask pupils (Mushashu, 1997). This could be one of the factors contributing to pupils underachieving or not performing well in mathematics at senior level.

According to Ball (2003), a teacher with good mathematical pedagogical content knowledge can break down mathematical knowledge into less polished and abstract forms, thus making it accessible to pupils who are at different cognitive levels. A teacher with good pedagogical content knowledge can unpack the mathematics into its discrete elements, link the topic to other topics, ask many questions and can explain a concept or procedure at a level that includes the steps necessary for the pupils to make sense of the reasoning. Ball (2003) further indicated that teachers with good mathematical pedagogical content knowledge understand where pupils may have problems learning the subject and would be able to represent mathematical concepts in a way that their pupils could comprehend its structure.

Therefore, mathematics teachers are always expected to exhibit a basic set of pedagogical knowledge and skills in the classroom, which involves a good knowledge of their teaching subjects, teaching methods, skills, questioning techniques and knowledge of child development.

5.4.9 Lack of preparation

From the analysis of data collected through the teacher's questionnaire (Table 24), the other factor indicated by teachers which affect teachers' questioning techniques was lack of preparation. Data collected indicated that sometimes mathematics teachers did not spend enough time to prepare questions to ask during their mathematics lessons. Teachers need to plan the questions for the class well in advance. During planning, teachers need to think about the structure of the question and its purpose, uncover misunderstandings the question can bring, encourage further questions, to think also about how they will word the question in order to enable pupils to think about the question and answer it correctly. They need also to plan or consider whether the questions prepared are for the whole class, pairs of pupils or group work.

5.4.10 Teachers' views about pupils' abilities

From the responses of teachers' questionnaire (Table 24), data collected and analysed indicated that teachers' views about pupils' abilities was another factor which affected the teachers' questioning techniques during mathematics lessons. Beliefs about their pupils' abilities to learn is one of the essential constraints to classroom questioning in mathematics. Data collected further indicated that many teachers tended to justify their lack of use of the higher order type of questions

approach by explaining that their pupils were immature and incapable of completing complex tasks without explicit guidance. This was in support of Roehrig and Luft (2004) findings who explained that some teachers believed that pupils' abilities hinder their application or implementation of questions in lessons.

5.4.11Lack of mathematics textbooks

According to Lemmer (2003),the other problem which contributes to poor quality of education provision in schools is the shortage of text books and other learning materials. Teachers (Table 24) who answered the questionnaire indicated that essential mathematics textbooks were in short supply in many schools. As a result, this affected teachers in their preparation. Lack of essential mathematics textbooks in mathematics hinders teachers to prepare good questions for their pupils since they have no reference books to use or to refer to. The study also revealed that teachers used old and outdated textbooks to prepare their lessons which in the process affected their questioning patterns.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.0 Conclusion

In conclusion, the information that was gathered during the study was an eye-opener to educate mathematics teachers on questioning techniques in mathematics. The awareness about questioning techniques in mathematics among teachers may provide a spring board for the easy take off to embark on activities in mathematics on questioning techniques that may help to address the poor performance in mathematics at Grade 11 level.

The use of questions as an instructional strategy since ancient times to the present time confirms its importance as an indispensable tool for teachers in the classroom. However, researchers and educators have pointed out the fact that teachers' techniques of questioning have not improved much over the years, despite improvements in curricula, teaching materials and teaching methodologies (Ornstein, 1995; Newton, 2002). This statement supports the findings of this study that majority of the mathematics teachers asked more questions within the low level than the high level category.

The predominance of lower levels questions asked by the teachers of mathematics showed that questioning had been used in a narrow way in their lessons. According to Cotton (1998) and Wilen (1991), low cognitive level questions concentrate on factual information that can be memorised. This type of questions can limit pupils by not helping them to acquire a deep, elaborate understanding of the subject matter and to think critically in the classroom. Newmann (1990) maintained that lower

cognitive level questions demands only routine or mechanical application of previously memorised and acquired knowledge and information, thus this might not challenge pupils to interpret, analyse, or generate their own responses. Therefore, teachers should ensure that they have a clear purpose for their questions rather than just testing what knowledge is learned.

Tan (2007) also asserted that high proportions of lower cognitive level questions do not encourage or guide pupils to formulate their own judgment by analysing, evaluating, or creating when teachers use questions at lower level of cognition. In contrast, high-level-cognitive questions require pupils to use higher order thinking or reasoning skills (King, 1995). By asking these questions, pupils do not only remember factual knowledge instead, they also use their knowledge to solve problems, to analyse and to evaluate given problems (Cotton, 2004).

Brualdi (1998) stated that good questions recognise the wide possibilities of thought and are built around varying forms of thinking toward learning and evaluative thinking rather than determining what has been learned in a narrow sense. Effective questioning involves planning and practice and effective questions should stimulate interest in new subjects, ideas, and challenges, it encourages pupils to be reflective about their own beliefs, assumptions and comprehension.

Teachers' techniques of asking questions and sourcing of questions determine the levels and types of questions they ask to their pupils (Good and Brophy, 2003; Newton, 2002) which reflects teachers' knowledge and beliefs pertaining to questioning and their pupils' needs and ability. Teachers' lack of knowledge of

effective questioning strategies (Morgan, 1994) may have lead them into asking questions that were not conducive to stimulating their pupils' thinking. Furthermore, lacking knowledge of effective questioning might have not enabled teachers to utilise fully the various sources available to them. The study showed that there was no difference in the way boys and girls perceived their teachers' classroom questions and that the type of questions asked by their teachers did not help them to pass mathematics examinations. This implies that the learning of mathematics in secondary schools was not promoted through proper and adequate teachers' classroom questions. Teachers' classroom questions should be an effective and important part of the lesson. When teachers' classroom questions and the questioning techniques are not used effectively, there may be negative results in the teaching learning process.

This study also indicated the factors that hindered teachers' questioning techniques in the mathematics classroom such as pupils' limited language ability, fear to ask questions, insufficient wait-time provided by the teachers, teachers' views about pupils' abilities and lack of pupil interaction. The other actors indicated by the study that affected teachers' questioning techniques were lack of substantial subject matter know-how, lack of preparation by mathematics teachers, lack of textbooks and lack of knowledge of taxonomies such as those for Bloom, Sanders and Guilford.

Keeping the above-mentioned factors in mind, teachers can help to promote their questioning techniques by anticipating words in their questions that pupils may have difficulties to understand and plan to use a variety of strategies. In addition, teachers should prepare a series of questions that begin with less complicated content that

eventually leads to more complex content (Eble, 1988; Meyers and Jones, 1993). They should provide pupils with background knowledge relating to the topic of the lesson before discussion and present questions with enough information to encourage pupils to think critically and formulate a meaningful answer.

The teachers who participated in the study claimed that they knew about taxonomies which they applied in their questioning and that the knowledge of the taxonomies helped them to ask questions suitable to pupils' needs in a variety of contexts, as stipulated in the syllabus. However, the findings from this study indicated that their knowledge of the taxonomies claim of asking questions at various levels in their lessons were inconsistent, since a total of nine mathematics teachers out of fourteen teachers did not even remember any of the levels within Bloom's taxonomy. Knowledge of the taxonomy is useful for teachers to ask questions at various levels and would help them to ask questions of different types.

6.1 Recommendations

These suggestions are made after the study on questioning techniques in mathematics at Grade 11 level in Petauke district. The significance of the findings from the study are seen to create awareness among education authorities, practicing teachers and student teachers of the state of the current classroom questioning practice in Petauke district. Based on the findings of the research and the conclusions reached, the following recommendations are made:

6.1.1 Awareness about classroom questioning in mathematics

To begin with, there should be awareness among mathematics teachers that questioning is a fundamental skill for effective teaching and that teachers' lack of knowledge may prevent them from being effective in asking questions. Therefore policy makers and education authorities should provide training courses specifically geared to train mathematics teachers in asking questions for their subject and across disciplines. Improving their knowledge of effective techniques to ask questions would highlight to them that there were various ways of teaching the same issue and help them to discard their beliefs about ways of asking questions and their pupils' ability levels. For mathematics teachers, being aware of their inadequacies in asking questions would help them to take steps to rectify them and in turn improve their practice.

6.1.2 Balanced incorporation of both low and high level questions

Mathematics teachers need to realise that the Examinations Council of Zambia prepares national examinations involving questions on lower levels and higher levels. Therefore, mathematics teachers should realise that a good lesson or test should have balanced incorporation of both low and high level questions and to select questions that emphasise major points and stimulate lively discussion. Giving questions which involve both lower and higher levels would enable learners practice on both categories and also help them to answer properly final mathematics examinations questions

6.1.3 Plan and Prepare questions.

Planning questions is very important in mathematics lessons. Therefore, teachers should prepare their questions before they go to the classroom. If they prepare questions well in advance, they would minimise making mistakes in formulating questions and would be clear about the purposes of asking questions. Above all, planning questions may help teachers to ask the various types of questions in mathematics.

6.1.4. Questions must be given emphasis in the mathematics methodology courses

The researcher believes that questions must be given emphasis in the mathematics methodology courses. The types of questions, questioning strategies, their uses in the mathematics classrooms, ways of preparing questions, the purposes of questions in the class should be intensively given and practiced by the would be teachers while in training. Therefore, the training that incorporates questions and questioning strategies could help the trainees to be familiar with different kinds of questions and their immense uses in the mathematics classes. It could also help the trainees to discover better ways to make use of questions in teaching mathematics to pupils in schools.

6.1.5 Continuing Professional Development meetings

It is evident from the findings of this research that mathematics teachers know some of the challenges and factors that affect the questioning in mathematics lessons. However, the findings also show that they are not aware of the other challenges which they may face when it comes to questioning techniques in mathematics. As a result, mathematics teachers in this study seem not to have developed questioning strategies that may help them in preparing the pupils to pass mathematics examinations at Grade 12 level. Therefore, schools need to hold workshops,

Continuing Professional Development meetings and encourage teachers to go for in-service training. The programmes mentioned can be enriched by well documented cases that highlight the challenges and shortcomings that mathematics teachers face concerning questioning techniques in mathematics. This would assist the mathematics teachers to recognise, talk about and act on those challenges and shortcomings. Such engagements would empower the mathematics teachers to upgrade their knowledge on asking effective questions which in turn would let them realise the importance of having their knowledge rather than their beliefs to influence their practice. They would also improve the way they utilise sources available to them, relent their tendency to dominate classroom interaction and make their lessons more learner-centred and make informed contextually appropriate strategies to maximise their questioning techniques in mathematics lessons. The challenges and the dilemmas that exist in the teaching and learning of mathematics in secondary schools will still continue to exist. Therefore, this would require that mathematics teacher educators be sensitised about these problems and together find an appropriate way of preparing the student teachers for mathematics teaching,

6.2 Suggestions for Further Research

- One limitation of this study was that a small sample size of mathematics teachers and a small sample of pupils were used. The results of the findings may not be generalisable to a wider context. Therefore future research on classroom questioning techniques should be conducted using similar instruments but on a wider context.
- A study to investigate the apparent gap between theoretical knowledge and classroom questioning practices in mathematics should be conducted. This

study had established that there was not much correlation between what teachers said and what they practiced in the classroom.

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APPENDIX 1
RESEARCH INTERVIEW
HEAD OF DEPARTMENT MATHEMATICS

TOPIC: Teachers' questioning techniques in mathematics at
Grade 11 level: The case of four selected secondary schools in
Petauke District.

1. Do you think it important for teachers to ask questions to pupils in mathematics lessons?
2. If yes, why do you think it is important?
3. Do pupils ask questions in your lessons? Yes or No
4. In what way do you think questioning helps pupils to learn?
5. Are teachers aware of different levels and types of questioning?
6. Do teachers in your department follow certain taxonomies in asking questions either through tests or assignments or during lessons.
7. Do mathematics teachers manage to achieve the stated objectives in the mathematics senior syllabus through questioning? If the answer is yes or no, why do you think they do this?
8. Do you think teachers ask the questions that they intend to ask in mathematics lessons?
9. How do teachers prepare the questions in their lessons?
10. What are the differences between the questions constructed by the teacher and the questions in the text books?
11. Does your department hold Continuing Professional Development meetings on questioning techniques in mathematics?

12. Do you think teachers in your department ask questions in tests and assignments which can help pupils answer examination questions in mathematics? Explain
13. Do you think the examination system in mathematics at Grade 12 level in Zambia is prepared according to a certain taxonomy?
14. Are the taxonomies of learning practical and applicable in the classroom context? Why?
15. Do you think certain questioning techniques by maths teachers affect the performance of the learner in mathematics? How?
16. What are the factors that affect teachers questioning in mathematics?
17. Is there anything you would like to suggest to add about questioning in mathematics? do you have any suggestions about how questioning in mathematics can be improved?

Appendix 2

Questionnaire for teachers

Dear teacher,

I am conducting a research on teachers' questioning techniques in mathematics at Grade 11 level in four selected secondary schools in Petauke district. Therefore this questionnaire is designed to provide information on teacher questioning techniques in mathematics. It is believed that your response would help the researcher to get the necessary information. Your school is one of the schools selected for the study. You are humbly requested to answer the questions to the best of your knowledge and kindly be assured that your answers will be treated with absolute confidentiality.

Thank you for your help

Part one: Instruction: Respond to the following questions by putting a tick in the boxes provided.

1. Sex: Male

Female

2. Educational Background

Diploma

Advance Diploma

Degree

Master's Degree

3. Number of years teaching mathematics answer: Years

Part Two: Answer the following questions as it is required.

4. If pupils do not understand your questions, what do you often do?

A. repeat the question

B. Rephrase the question put letter of choice

C. Gives them a clue here.

D. Answer on their behalf

5. Do you think that using different questioning techniques in mathematics help

pupils to respond to questions well? Yes /No answer

6. If your answer to question 5 is 'Yes' to what extent?

A. to a very great extent

B. to a large extent

C. to some extent

D. to a limited extent

put your letter of
here

7. Do your pupils fear to ask and answer questions in mathematics?

Yes /No answer

8. If your answer to question '7' is 'Yes' please state your reason (s).

9. Do you ask questions during lessons

Yes/No answer

10. In what ways do you think questioning helps pupils to learn?

11. As a teacher of mathematics, do you follow certain taxonomies in asking questions either through tests or assignments or during lessons.

Yes or No answer

12. If the answer is yes or no? Please explain.

13. How regular do you use the senior school syllabus when preparing your questions for pupils? Tick your choice.

very regular

regular

not regular

none

14. Do you think as a teacher of mathematics, you ask what you intend to ask in Mathematics lessons?

Yes or No answer

Please explain

15. Do you give pupils enough time to ask questions in mathematics lessons?

Yes /No answer

16. If your answer to question 15 is 'No' please, state your reason (s).

17. Do you follow any type of taxonomy of learning? Yes/No answer

18. If the answer is yes to question 17. Write down the type of taxonomy you know

19. If the answer is yes to question 17, how often do you use the same taxonomy in your lessons? Make a tick for your choice in the boxes provided.

very often

not often

none

20. (a) what are the factors that affect teacher questioning technique in mathematics.

(b) How can these factors be reduced?

21. What type of questions do you usually ask pupils during lessons, tests or assignments.

A. questions of lower order put your choice here

B. questions of higher order

22. Do you think the examination system in mathematics at grade twelve level in Zambia is prepared according to a certain taxonomy?

Yes or No answer

23. Do you feel asking questions of different levels help learners to have higher achievement mathematics?

Yes or No answer

Explain your answer.

24. Do you usually test the specific objectives outlined in the senior secondary school syllabus when you are preparing questions?

Yes or No answer

25. If the answer is yes, how often? Make a tick for your choice in the boxes provided.

very often

not often

none

26. Write down any three levels of questioning techniques which you often apply in asking pupils during mathematics lessons?

(a) _____

(b) _____

(c) _____

27. How would you rate how pupils perceive your classroom questioning on their performance in Mathematics?

A. very good

B. good

C. not very good

D. poor

put your choice here

28. How would you rate yourself on how you implement planned questions during mathematics lessons?

A. Very good

B. good

C. Not good

D. Not sure

put your choice here

29. Do you think that the factors which affect teachers' questioning in mathematics also affect the performance of learners in mathematics?

Yes or No

answer

Explain your answer

30. Is there anything you would like to suggest to add about questioning in

mathematics Yes or No?

 answer

If yes explain.

31. What is the difference between the questions constructed by you as a
mathematics teacher and the questions in the text book?

32. Do you have any suggestions about how questioning in mathematics can be
improved

33. Does your department conduct continuous professional development meetings on
questioning techniques? Yes or No

 answer

APPENDIX 3

FOCUS GROUP DISCUSSIONS

1. Are you always able to answer questions asked by your teachers in mathematics?
(if yes, why? if no, why not?)
2. Are the questions asked easy or difficult?
3. How do you decide whether or not a question is easy or difficulty?
4. What kind of questions are easy or difficult?
5. What type of questions do you like to answer?(Questions that challenge you to think? Questions that require you consult, discuss or read from the library?)
6. How do you find questions asked in mathematics as compared to other subjects?
(Interesting, challenging, easy, difficult, boring)
7. Are there similarities or differences between the questions asked in examinations, monthly tests, weekly tests and the questions asked in daily exercises mathematics? In what ways are they similar or different?
8. Do you think the type of questions your teacher asks you in mathematics lessons have an effect on your performance in mathematics?
9. Do the questions asked by teachers in mathematics help you to answer examination questions. If no, were do you think is the problem?
10. If you have a chance to choose the way questions are asked by your teacher, how would like it to be?
11. Is there anything you would like to suggest to add about questioning in mathematics?

Appendix 4.

Questionnaire for pupils

Dear Pupil,

This questionnaire is designed to provide information on teacher questioning techniques in mathematics. It is believed that your response would help the researcher to get the necessary information. Your school is one of the schools selected for the study. You are humbly requested to answer the questions to the best of your knowledge and kindly be assured that your answers will be treated with absolute confidentiality.

Thank you for taking your valuable time to fill this questionnaire.

Part one: Instruction: Respond to the following questions by putting a tick in the boxes provided.

1. Sex: Boy Girl

2. Age: Years

Part Two: Answer the following questions as it is required.

3. Do you think classroom questioning during mathematics lessons promotes the learning of Mathematics?

A. Yes

B. No

answer

4. Does your mathematics teacher encourage you to answer questions in mathematics lessons?

A. Yes

B. No

answer

5. Does the mathematics teacher give you enough time to answer questions in mathematics lessons?

A. Yes

B. No

answer

6. Do you fear to ask questions in mathematics lessons?

A. Yes

B. No

answer

7. If your answer to question 6 is 'Yes', why do you fear? Explain your reason (s)

8. How do you find questions asked in mathematics as compared to other subjects?

A. interesting,

B. challenging

C. easy

D. difficult

E. boring

put your choice
of letter here.

9. Do you think the type of questions your teacher asks you in mathematics lessons can make you performance well in mathematics?

A. yes

B. No

answer

10. If your answer is yes or no. Please explain

11. Do the questions asked by teachers in mathematics help you to answer examination questions?

A. very much

B. not much

C. not at all

put your choice of letter here.

12. How would you rate the types of tests, assignments and class exercises in mathematics given to you in terms of preparation for you to answer final examination mathematics questions?

A. very helpful

B. helpful

C. Not helpful

put your letter of choice here

13. How would you rate the type of questions from text books you have been using in terms of helping you to answer past final examinations questions?

A. Very good

B. good

C. poor

D. very poor

put your letter
of choice here

14. Is there anything you would like to suggest to add about questioning in mathematics? If yes explain.

15. Do you think your teacher's classroom questions help to raise your attention and hope to do well in mathematics?

A. Strongly disagree

B. Disagree

C. Agree

D. Strongly agree

put your letter of
choice here.

16. Do you think your teacher's classroom questions stimulates you to pursue knowledge on your own in mathematics.

A. Strongly disagree

B. Disagree

C. Agree

D. Strongly agree of choice here.

put your letter

17. How often do you ask questions in a mathematics lesson?

- A. never
- B. hardly ever
- C. sometimes
- D. often
- E. very often

put your letter
of choice here

18. Do you think that your teacher of mathematics ask what he or she intended to ask in Mathematics lessons?

Yes or No answer

19. Explain your answer

.....

.....

.....

.....

.....

.....

20. Do you think your mathematics teacher give you enough time to answer mathematics questions?

- A. yes
- B. No

answer

Appendix 5

Observation checklist

Types of questions

QUESTIONS	T1 No of questio ns	T2 No of questio ns	T3 No of questio ns	T4 No of questio ns	T5 No of questio ns	T6 No of questio ns	T7 No of questio ns	T8 No of questio ns
Remembering								
Understanding								
Applying								
Analysing								
Evaluating								
Creating								

APPENDIX 6

LETTER TO SCHOOL HEAD TEACHERS.

**Petauke Boarding Secondary School,
P.O. Box 560050,
PETAUKE.
The Head teacher**

PETAUKE.

Dear, Sir / Madam,

I am a postgraduate student of the University of Zambia in the School of Education pursuing a Master of Education in Mathematics Education. My supervisor is Dr. M. Tabakamulamu, a lecturer at the University of Zambia in the School of Education under the Department of Mathematics and Science Education. I intend to conduct a research on teachers' questioning techniques in mathematics at Grade 11 level. I have selected your school as one of the four schools to collect data for my study.

The purpose of my study is to investigate teachers' questioning techniques in mathematics classroom at Grade 11 level and help to create awareness among teachers of mathematics on questioning techniques in order for them to correct any weaknesses and thus improve their classroom practice.

I would like to request participation of your school in this study by allowing me to conduct interview with the head of department, focus group interviews with ten grade twelve pupils, six mathematics teachers and 20 pupils to answer the questionnaire on questioning techniques in mathematics. I will not use teachers' or pupils' names or anything else that might identify them in the written work, oral presentations or publications. The information will remain confidential. They are free

to change their minds anytime and withdraw even after they have consented to participate. If you would like to get more information, please contact me by phone on 0977-926749. Please contact me at your earliest convenience to discuss the work or to provide your consent to participate.

Thank you in anticipation for your consideration.

Yours sincerely,

Chidongo Mkandawire
Student.

APPENDIX 7

LETTER TO DEBS

**Petauke Boarding Secondary School,
P.O. Box 560050,
PETAUKE.**

**The District Education Board Secretary
Ministry of Education, Science, Vocational Training and Early Education.
P.O. Box 560080
PETAUKE.**

Dear, Sir / Madam,

**RE: PERMISSION TO CONDUCT RESEARCH AT FOUR SELECTED
SCHOOLS IN PETAUKE DISTRICT.**

I kindly write to your office to ask for permission to conduct research at four selected secondary schools in Petauke District.

I am a postgraduate student of the University of Zambia in the School of Education pursuing a Master of Education in Mathematics Education. My supervisor is Dr. M. Tabakamulamu, a lecturer at the University of Zambia in the School of Education under the Department of Mathematics and Science Education.

I intend to conduct a research on teachers' questioning techniques in mathematics at Grade 11 level.

The purpose of my study is to investigate teachers' questioning techniques in mathematics classroom at Grade 11 level and help to create awareness among teachers of mathematics on questioning techniques in order for them to correct any weaknesses and thus improve their classroom practice. I will not use teachers' or pupils' names or anything else that might identify them in the written work, oral presentations or publications. The information will remain confidential.

Thank you in anticipation for your consideration.

Yours sincerely,

Chidongo Mkandawire

Student.