TEACHERS' USE OF MATHEMATICS TEXTBOOKS IN THEIR TEACHING OF MATHEMATICS

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Declaration

I declare that the work in this research report was carried out in accordance with the regulations of the University of the Witwatersrand Johannesburg (WITS). The work is original except where indicated by special reference in the text.

No part of the research report has been submitted for any other degree.

The research report has not been presented to any other University for examination either in South Africa or overseas.

The views expressed in the research report are those of the researcher and in no way represent those of the University of the Witwatersrand Johannesburg.

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(Signature of candidate – Charles Ramoshebi)

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God Almighty, for the gift of life.

Dedication

To my wife Rosy

And our children, Tumelo and Tshepiso.

Abstract

This is a baseline descriptive case study on the use of mathematics textbooks by Grade 9 teachers in the Johannesburg East district. Three research methods were used to collect data, namely, a survey, direct observation and interviews. Responses from the survey and transcripts of lesson observations and those of interviews were analysed to establish how individual teachers use textbooks to mediate mathematics concepts to their learners and to find out whether teachers adhere to Curriculum and Assessment Policy Statement (CAPS) requirements with regard to the use of the four Mathematics CAPS cognitive levels. Findings from the study highlighted different approaches in teachers' use of textbooks. Some of the aspects in Nicol and Crespo's (2009) argument relating to different ways in which teachers use textbooks are perceptible in the findings. Contrary to Nicol and Crespo's (2009) findings the study revealed that experience and level of qualification do not play a significant role in the use of textbook by individual teachers. The study also revealed that when selecting examples to demonstrate concepts, for learners' classroom practice and for homework, teachers do not consciously select questions according to the four Mathematics CAPS cognitive levels but use questions as presented in various textbooks without necessarily rating them accordingly. The study reveals through a sample used that the majority of teachers would rather use prescribed textbooks than any other resource when preparing lessons, when teaching lessons, for learners' classroom practice exercises, for homework and assessment.

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CHAPTER ONE: AN OVERVIEW OF THE STUDY

Introduction

In most South African public schools, mathematics textbooks are considered an essential component in the teaching of mathematics. It is required that all mathematics teachers in public schools use prescribed mathematics textbooks in their classroom teaching of mathematics. To make sure that all schools provide textbooks to the teachers, the Department of Basic Education (DBE) allocates special budgets to all public schools on an annual basis for the procurement of the department's approved textbooks.

"Mathematics textbook is one of the most important resources for teaching and learning mathematics" (Rezat, 2009, p.1260). Rezat (2009) argues that though modern technology plays an effective role in classroom mathematics instruction, a textbook is still considered a primary and most important resource for most mathematics teachers. This argument is supported by Kulm and Capraro (2009) who argue that "teachers using standards-based textbooks [are] more likely to use teaching strategies that engaged students and facilitated student thinking" (Kulm & Capraro, 2009, p. 20).

Their study reveals two types of textbooks and two types of teachers. The first type of a textbook they point out is the one that is highly commercialized but with less or no benefits for teaching and learning. Teachers using this kind of textbook experience less students' engagement and are therefore forced to work much harder to create useful models to mediate learners' understanding. The second type is the one that is rich with content, teaching and learning strategies and therefore provides benefits to both the teacher and the student. The first group of teachers they point out is those who do not prefer to use a textbook and find themselves missing on new approaches and strategies to teaching content. This group of teachers they argue may also deprive their students an opportunity to engage with other ways of dealing with content as suggested by and contained in those good quality textbooks. The

second group of teachers is those who are open to using what they term the good quality textbook to their benefit and to the benefit of their students (Kulm & Capraro, 2009).

From the survey conducted and other methods used in this study, it is worth noting that the majority of schools in this study and therefore teachers still prefer a textbook or have more access to a textbook than any other resource as a basic tool in their teaching of mathematics. Nicole and Crespo (2006) make reference to a number of researchers who argue that "Textbooks are an important part of classroom life in elementary and secondary schools [and that] teachers, as well as students, spend a great deal of their preparation, class, and homework time working with textbook materials" (Apple, 1992; Ben-Peretz, 1990; Goodlad, 1984; Schmidt et al., 1997 cited in Nicole & Crespo, 2006, p. 331). In their argument Nicole and Crespo (2006) view textbooks as "intricate part of what is involved in doing school mathematics; [that textbooks] provide frameworks for what is taught, how it might be taught, and the sequence for how it could be taught" (Nicole and Crespo, 2006, p. 331). They emphasise that "this is true in many parts of the world but is especially so in North American classrooms" (Nicole and Crespo, 2006, p. 331). It is not clear though whether this practice is generally influenced by financial affordability or by the quality of content presented in textbooks. From the two studies above it can be established that, despite the availability of other resources which appear highly rated, a good textbook takes precedence over other available resources considering the benefits it provides to both the teacher and the learner.

The study at hand follows from a number of studies including the studies above, which have been conducted on the use of mathematics textbooks by mathematics teachers in their day to day classroom instruction. The study made an attempt through a survey of a sample of high school mathematics teachers, observations of a mini-sample from the sample and subsequent interviews of this mini-sample of teachers, to show different ways in which different teachers in some South African schools use mathematics textbooks to teach mathematics. Data gathered from these three methods highlighted aspects in the teachers' use of textbooks that either concur with or contradict some of the findings by other researchers as outlined in the two studies above and in many others.

Rationale

The study is intended to investigate the use of mathematics textbooks by South African mathematics teachers in their classroom instruction of mathematics. As pointed out earlier the availability and accessibility of textbooks to mathematics teachers in most South African public schools is regarded as critical by both civil society and the DBE. The general assumption is that the availability and accessibility of a textbook to a mathematics teacher has a bearing on the teacher's effectiveness. Unfortunately, it has been revealed that poor learner performance in mathematics is a yearly experience despite teachers having mathematics textbooks at their disposal. The situation raises a number of questions with regard to the effectiveness of mathematics textbooks or usage thereof by mathematics teachers in their day to day teaching of mathematics.

Table 1 below is an extract from the national education ministry report on the Annual National Assessment (ANA) 2014. ANA is a national systemic evaluation for benchmarking learners' level of proficiency in mathematics at different ages of their formal schooling as indicated by grades in the table. The second, third and fourth columns show the average percentages attained for the test per grade in the three years.

Table 1: National average percentage marks for Mathematics in 2012, 2013 and 2014

GRADE	MATHEMATICS 2012	MATHEMATICS 2013	MATHEMATICS 2014
1	68	60	68
2	57	59	62
3	41	53	56
4	37	37	37
5	30	33	37
6	27	39	43
9	13	14	11

It is quite clear from the information presented in Table 1 that there is a crisis in the teaching and learning of mathematics in the whole country, especially in the higher

grades. The study is prompted largely by the scenario as presented above. Even though one acknowledges the possibility of many factors that may contribute to the results as reflected above, the focus of this study will be on the mathematics teachers and the way the teachers use the mathematics textbooks in their mathematics classroom instruction. Different uses will be explored and will be looked at against the curriculum as interpreted by the textbooks. The assumption here is that mathematics textbooks interpret the mathematics curriculum as intended. Mesa and Griffiths (2012) define the intended curriculum as “the curriculum which refers to the aims and intentions, goals, and objectives for mathematics that are envisioned for learning …” (Mesa & Griffiths, 2012, p. 86).

The Curriculum and Assessment Policy Statement (CAPS) document outlines the general aims of the South African curriculum and the specific aims of teaching and learning mathematics (Department of Basic Education, 2011, pp. 4-5). Since the textbooks that are currently used or expected to be used by the teachers are CAPS aligned it would be expected that in their presentation of mathematics concepts these textbooks would be guided by the aims of the curriculum as outlined in the CAPS document. As mentioned earlier the study aims to investigate different uses of textbooks by teachers and to establish whether teachers use the textbooks and therefore the curriculum as intended or whether there is some level of deviation during implementation.

Significance of the study

The study has significance especially in the current South African situation where a new curriculum, Curriculum and Assessment Policy Statement (CAPS) has just been introduced. The new curriculum system comes with new textbooks that are supposed to be aligned with CAPS and supposedly interpret the curriculum appropriately. All prescribed mathematics textbooks which are now used by mathematics teachers went through the process of screening to determine their CAPS alignment status and are therefore assumed to be compliant in terms of the Department of Basic Education (DBE) requirements. As part of screening, one would assume that compliance in terms of curriculum interpretation was also a determining factor.

Having this idea in mind the study will attempt to illuminate different ways in which mathematics teachers use CAPS aligned mathematics textbooks. The intention is to identify the relationships between the handling of the curriculum by mathematics teachers in their mathematics teaching and the curriculum as interpreted by the textbooks. The assumption here is that the textbooks provide reliable interpretation of the intended curriculum as mentioned earlier. The study highlights different ways in which maths teachers use mathematics textbooks thereby providing lenses through which maths teachers can reflect on and possibly restructure their own classroom practices in relation to the use of textbooks.

It is worth noting at this stage that this is a descriptive case study as alluded to earlier. Yin defines a case study as “one of the social sciences’ research strategies that is empirical in nature and therefore employed when the intention is to investigate a particular contemporary phenomenon within its real-life context” (Yin, 1994, p. 13). The study at hand is a case study since all data collected, the analysis thereof and findings are confined to a particular context, a classroom instruction context. What needs to be remembered though about any study or piece of research is that even though focus and therefore findings may be confined to a particular context the ultimate goal is not to particularize but to generalize (Yin, 1994).

Even though the study focused on a sample of schools in a particular district, the findings highlight different teachers’ use of a textbook in a mathematics classroom. The investigator took all precautionary measures to minimise external influences on any of the participants’ behaviour, especially from other participants, particularly with regard to their use of a textbook. Each participant’s behaviour was therefore independent of other participants. The findings therefore, regardless of being contextual in nature, have a potential of being used as a basis for further research on a larger scale to investigate the same phenomenon of textbook usage provincially and nationally.

A theoretical framework for textbook usage

Rezat (2006) makes reference to Gilbert (1989) and Love and Pimm (1996) who allude to the scarcity of research into the use of textbooks. They argue that the scarcity could be attributed among others to the difficulty of obtaining data on the use of textbooks and the lack of a theoretical framework for textbook use (Gilbert, 1989 and Love & Pimm, 1996). An appropriate theoretical framework, Rezat asserts, might in fact be regarded as a prerequisite to collect data on the use of textbooks (Rezat, 2006:409). His sentiments are echoed by Johansson (2006) who supports Rezat's (2006) argument that most researchers still use what she terms the didactical triangle which is only limited to the teacher, student and topic of study. She emphasises the need for a common framework that could systematically examine the crucial aspects of the use of textbooks (Johansson, 2006, p. 31).

Rezat talks about a need for an appropriate theoretical framework and endeavours to develop a suitable model for the use of textbooks by teachers and learners. On the other hand, Johansson expresses the need for a common framework for studies on the teachers' use of curriculum materials or textbooks. It is evident from what they allude to that Rezat (2006) and Johansson (2006) agree to some extent with those who express a sense of scepticism on the availability of a framework suitable for analysis of textbook use by teachers and learners.

This study focuses on the teachers' use of mathematics textbooks in their mathematics classrooms. Looking at a number of studies that have been conducted on the use of textbooks or what others refer to as the curriculum materials, one finds no mention of any particular theoretical framework. Instead, researchers formulate models suited to their particular studies which appear to be influenced mostly by their particular contexts. In the absence of some kind of substantial evidence negating the belief of a scarcity of suitable frameworks for teachers' use of textbooks as it stands now, Rezat (2006) and Johansson (2006) together with other researchers' arguments on this topic will continue to thrive thereby limiting studies on the subject.

Rezat asserts that the use of textbooks is an activity that is situated in the context of institutional teaching and learning and that the textbook is influenced by the educational system and by traditional concepts of teaching and learning (Rezat, 2006). Since educational systems are contextual it would not be uncommon to find researchers using different models to explain teachers' behaviour in a particular activity such the use of textbooks. The contextual factors seem to have a great influence on the researcher's choice of a model.

One such model is "The three approach classification of teachers' use of textbooks" designed by Nicol and Crespo (2006) and supported by key assumptions and perceptions of Remillard and Bryans (2005). This model covers a wide spectrum including teachers' interpretations of different textbooks, beliefs about textbooks and so on; and the effect these aspects have on the teachers' use of mathematics textbooks. It gives a classification that presents a well-structured framework which guides and provides lenses through which a teacher's use of mathematics textbook could be viewed.

This study will use this model to focus on teachers' experiences with mathematics textbook and their view on quality and relevance of content presented in mathematics textbooks at their disposal. Each individual teacher will be classified in one or more of the three categories based on the extent to which they display all or most of the "characteristics of use" (Nicol and Crespo, 2006, p. 343). The respondents' answers in the survey and teachers' references to and their engagement with mathematics textbook during classroom observations and their responses during interviews as captured in both the classroom observations transcripts and interview transcripts respectively, will be used to determine Nicol and Crespo's (2006) "characteristics of use" .Aspects of this model are used in this study to analyse data on the teachers' use of textbooks in their mathematics classrooms.

Data collection

Three research tools were used to collect data: a questionnaire, observation of lessons and transcripts of these observations, and interviews. This was done to get triangulated data for the purpose of lessening inaccuracies in the data and the

researcher's interpretations that could distort the picture thereby reducing the validity of the data.

Data was collected using a questionnaire given to grade 9 mathematics educators from thirty high schools in the Johannesburg East district, from classroom observations (with transcripts) of four of these educators and from interviews with these four educators. This is discussed in Chapter 3. The analysis is done using aspects of the model on the three approach classification of teachers' use of textbooks designed by Nicol and Crespo (2006). This model highlights ways in which grade 9 mathematics educators may use textbooks in their teaching of mathematics as pointed out earlier.

Summary

It is clear that most if not all public schools in South Africa use or are expected to use mathematics textbooks in their teaching of mathematics. There is literature available to support the use and effectiveness of textbooks in the teaching and learning of mathematics. The study at hand makes reference to poor performance in mathematics despite the availability of mathematics textbooks in all or most public schools and seeks to understand the discrepancies that exist between accessibility of a mathematics textbook to a mathematics teacher, the usage thereof and the outcome which in this case is poor learner performance. An acknowledgement of the scarcity of theoretical frameworks on the use of mathematics textbooks by teachers is clearly expressed. Studies on the use of textbooks by teachers have therefore opted to adopt and use appropriate models. With regard to validity and as a means to minimise inaccuracies in the data which would eventually distort the researcher's interpretations, three research methods were used in this study.

CHAPTER TWO: LITERATURE REVIEW AND ANALYTICAL FRAMEWORK

Introduction

A number of studies have been conducted in different contexts on teachers and the way they use available resources in their teaching of mathematics. One of these resources commonly used by mathematics teachers is mathematics textbooks. Since officially sanctioned mathematics textbooks are supposed to provide an appropriate interpretation of the curriculum as intended by the curriculum designers, different interpretations of mathematics textbooks by teachers suggest different interpretations of the curriculum which may lead to differences in curriculum implementation.

Different textbook usages

The study conducted in France, Germany and England by Haggarty and Pepin (2002) revealed that teachers use textbooks differently. From their sample, their findings revealed that in France teachers used textbooks almost the same way. Firstly they found that teachers used textbooks mostly for exercises and activities, and secondly for mediating National Curriculum Statements and outlining the year programmes. In France Haggarty and Pepin (2002) found out that the National Curriculum statements and year programmes are contained in textbooks. On the other hand, teachers in Germany used textbooks for lesson preparation. But when it comes to the teaching of lessons different teachers used the textbook differently. Differences in use Haggarty and Pepin (2002) point out, are brought about by different pupil abilities. For lower achieving pupils, textbooks are used the most whereas in high achieving classes textbooks are less used; rather “whole class development of ideas” is favoured (Haggarty & Pepin, 2002, p. 584).

In England Haggarty and Pepin found that textbooks are used more regularly in the classroom for practice exercises but that use outside teaching time differs

significantly. Two categories of teachers were established based on how they used textbooks. The first group of teachers, they point out, showed reliance on a textbook as a provider of materials and ideas for their lessons. The second group preferred to use different textbooks and other resources for developing ideas and planning their lessons. In addition to this Haggarty and Pepin found that experienced teachers have banks of ideas from previous experiences to draw from instead of using a textbook. On the other hand, less experienced and non-specialist teachers rely on a textbook for their lesson preparation and lessons (Haggarty & Pepin, 2002). Looking at the scenario presented above it is apparent that a number of factors play a role in how different teachers use textbooks in their teaching of mathematics. It is interesting to see that learners play a significant role in influencing the use of textbooks by their teachers. It is also worth noting that experience also plays a crucial role in how a teacher uses a textbook.

Rezat emphasises the critical role played by mathematics textbooks in the context of teaching and learning by making reference to Howson (1995) who acknowledges the power of technology in the activity of teaching and learning but points to the insignificance of this technology when compared to the role textbooks and other written materials play in “the vast majority of the world’s classrooms” (Howson, 1995 cited in Rezat, 2006, p. 1260).

It is interesting to see that researchers are aware of alternative resources available for teachers to use in their teaching of mathematics. It is also interesting to learn that despite the availability of such resources, the role played by textbooks is still considered crucial. Studies on how these textbooks are used and how different usage impact on learner performance and achievement has therefore become necessary in the South African context.

Textbooks usage frameworks

Activity Theory

Rezat (2006) makes an attempt to develop a framework on the use of textbooks by both teachers and students. Gilbert (1989) and Love & Pimm (1996) make reference to the challenge raised by a number of researchers about the scarcity of studies on the teachers' use of textbooks. In Rezat's (2006) attempt to respond to this argument which according to him could be partly resulting from a lack of a theoretical framework for textbook use, Rezat (2006) explores Engeström (1999a)'s argument about activity theory. Engeström (1999a) points out that Activity theory consists of what is termed object-oriented and artefact-mediated collective activity system as its unit of analysis. He argues that the use of the object-orientated and artefact-mediated collective system by the Activity theory has the capacity to provide a model for the activity "textbook usage". Engeström (1999a) also argues that the triad 'subject – mediating artefact – object' as the nucleus of the human activity system does not entirely represent the activity 'textbook use' (Engeström, 1999b cited in Rezat, 2006, p. 410).

According to Rezat (2006), the activity theoretical perspective could be adapted into a suitable framework for the analysis of the teachers' use of textbooks. Rezat (2006) develops a model in a form of a tetrahedron which he sees as a representation of a more comprehensive model of textbook use in the classroom. He develops this model by working on and from what Engeström (1999b) terms Vygotsky's (1978) simplified triangle model of mediated action. This model with its three triangles and a trapezium has fundamental interacting components of the activity system. (Engeström, 1999b cited in Rezat, 2006, p. 413).

The first triangle which Engeström (1999b) refers to as Vygotsky's (1978) simplified model of mediated action illustrates the interrelatedness of the three components: the subject, mediating artefact and the object. See Figure 1 below.

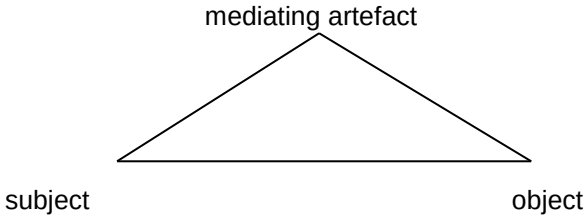

Fig. 1: Vygotsky's simplified model of mediated action

(Rezat, 2006, p. 411).

This triangle illustrates the interconnectedness of the three components of the mediated action. The impression given here is that the success of an activity depends on the strength of this connection. In the context of teaching and learning, therefore, it would mean that effective teaching and learning of concepts depends on the extent and quality of mediation done. The three diagrams below give different interpretations of Vygotsky's (1978) simplified model of mediated action.

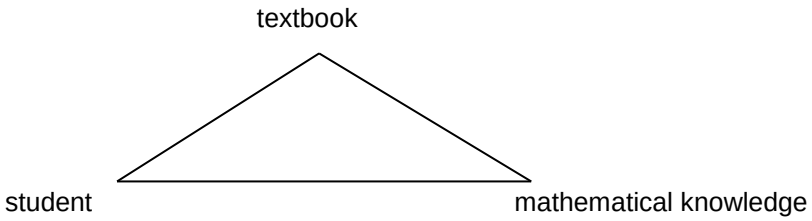

Fig. 2: Students as textbook users
(Rezat, 2006, p. 411).

Figure 2 above illustrates the interpretation of Vygotsky's (1978) simplified model with students as users of the textbook. In this case, the textbook is used by a student, the subject, to mediate mathematical knowledge which is the object of the system. The role of the teacher appears to be of less significance in this case.

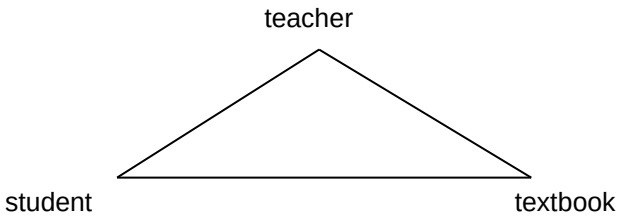

Fig. 3: Teachers and students as textbook users
(Rezat, 2006: 412).

Figure 3 above illustrates the use of the textbook by both the teacher and the student where the teacher's role is to mediate the textbook to the students. This would be a case where the teacher uses the same textbook as students to teach content. In this case, therefore, the teacher would go through the textbook with the students and guide them through the mastery of concepts.

The trapezium below (Figure 4) illustrates a different approach in the use of textbook by the teacher. In this diagram, just as in the previous triangle the use of the textbook by both student and teacher is illustrated. The difference here is that the teacher's role is that of mediating the use of the textbook rather than just the textbook itself as is the case in figure 3 above.

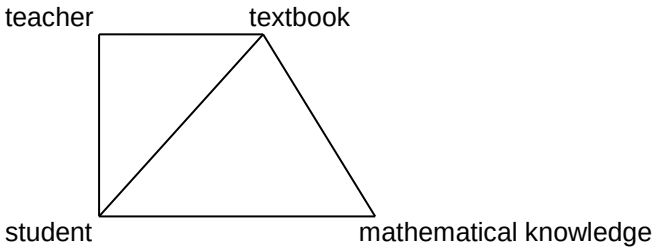

Fig. 4: Use by the teacher and student
(Rezat, 2006, p. 412).

Rezat (2006) takes all the interpretations illustrated above and put them together into a tetrahedral structure to show the dynamic nature of the process of textbook usage. Figure 5 illustrates the use of the textbook by both the teacher and the student. Each of the four faces of the tetrahedron gives a different perspective of how a textbook could be used.

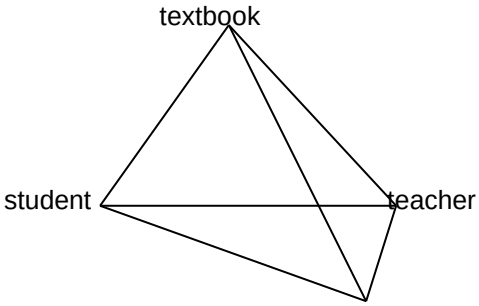

Fig. 5: Rezat's tetrahedron model
(Rezat, 2006, p. 413).

The first face, the student – teacher – textbook presents the teacher as the mediator of textbook usage to the student. The second face, the student-textbook-mathematical knowledge, presents the textbook as the mediator of mathematical knowledge to the student. The impression given here is that the teacher's role in this regard is minimal or insignificant which is a rare occurrence in most of the teaching/learning contexts. The third face, the teacher-textbook-mathematical knowledge/didactical aspects of the mathematical knowledge, presents the textbook as the mediating artefact of mathematical knowledge and didactical aspects of the mathematical knowledge to the teacher.

In Rezat's (2006) view "while the teacher acts as a mediator of textbook use in the whole activity system he is the subject of the activity in the system. The objects of his activity are the didactical aspects of the knowledge represented in the textbook" (Rezat, 2006, pp. 413 - 414). The textbook usage by the teacher may not necessarily be limited to didactical aspects of mathematical knowledge as Rezat (2006) points out, but a textbook may be used by some teachers to enhance their own mathematical content knowledge. This would mean that the teacher uses the textbook as a source of content of teaching and also as a tool for guidance in the way this content must be presented in his teaching of mathematics. The fourth face, the student – teacher – mathematical knowledge presents the teacher as the mediator of the mathematical knowledge to the student. Here the teacher as Rezat (2006) alludes to mediates mathematical knowledge without necessarily using the

textbook overtly in the classroom. This may not suggest that the teacher does not use the textbook at all but that the teacher might be using the textbook during the lesson preparation stage.

The different illustrations presented above show an acknowledgement of different ways in which a textbook could be used. Looking at Rezat's (2006) model the teacher can use the textbook in a minimum of three ways. First, he can mediate the textbook to the student as seen from the student- textbook- teacher face. Secondly, the teacher can use the textbook to mediate mathematical knowledge for the student's benefit or to mediate didactical aspects of the mathematical knowledge for his own benefit. Thirdly the teacher can use the textbook to gain mathematical knowledge and didactical aspects of the mathematical knowledge for his and for the student's benefit. Alternatively, the teacher may ignore the textbook altogether and use his mathematical knowledge and the didactical aspects of the mathematical knowledge to mediate mathematical knowledge to the learners.

Classification of teachers' use of textbooks

Nicol and Crespo (2006) conducted a study in which they wanted to establish how individual mathematics teachers in training interpret mathematics textbooks and how their individual interpretations influence the way they use these textbooks. In their view, the study gives a unique perspective on how elementary pre-service teachers interpret, use and possibly learn from curriculum materials in the context of teacher education programme. The results of their study revealed that all teachers viewed a textbook as an important and necessary teaching resource. But the results also revealed that each of the teachers had their own individual interpretations based on their individual beliefs, knowledge and actions related to curriculum material which in turn influence the way they use the textbook. Nicol and Crespo classified these differences in the use of textbooks by individual teachers into one of three approaches, namely adhering, elaborating and creating approach (Nicol & Crespo, 2006). Refer to Table 2 below.

Table 2: Three approach classification of teachers' use of textbooks (Nicol & Crespo, 2006, p. 346).

Adhering	The teacher accepts textbook as authority and therefore follow the textbook to the latter.
Elaborating	The teacher considers the textbook as a guide or main resource but uses other resources to complement what the textbook offers.
Creating	The teacher regards the textbook "as an inspiration for creating text and lesson activities … as a source of ideas …"

Compared to those teachers falling within each of the first two approaches, teachers in the creating approach seem to be those who enjoy the independence of displaying their expertise in dealing with mathematical concepts. To them a mathematics textbook is like a partner with whom they discuss, share ideas and guide each other along a path.

The classification above clearly shows that even though a particular textbook is structured and presents content in a particular way, individual teachers view the same textbook differently. Their use of the product may differ depending on how they view and interpret the textbook which in their view as pointed out earlier relates to individual beliefs and knowledge of the curriculum material. This may, in turn, lead to different results at the end (Nicol & Crespo, 2006).

As mentioned earlier Nicol and Crespo's (2006) classification of teachers' use of textbooks cover a wide spectrum in terms of teachers' interpretations and their use of mathematics textbooks and presents a well-structured framework that guides and provides lenses through which each teacher's use of any mathematics textbook could be viewed. A glance at findings from other related studies reveals the same tendency of teachers interpreting and using textbooks differently.

Theoretical perspectives on textbook usage

The study by Remillard and Bryans (2004) provides some insight into the teachers' interaction with new curriculum materials. The study was intended to investigate the teachers' response to the new and differently designed mathematics reform-oriented curriculum materials in the USA. The results revealed that teachers have different orientations towards using what they term curriculum materials. Orientation in this instance is defined as "a set of perspectives and dispositions about mathematics, teaching, learning and curriculum that together influence how a teacher engages and interacts with a particular set of curriculum materials and consequently the curriculum enacted in the classroom and the subsequent opportunity for student and teacher learning" (Remillard and Bryans, 2004, p. 364).

The study further revealed that individual knowledge of mathematical concepts and views about mathematics has an influence on the way different teachers read, interpret and use curriculum materials (Remillard and Bryans, 2004). The teachers' knowledge and views they assert shape their use of the resources (Graybeal & Stodosky, 1987 cited in Remillard and Bryans, 2004: 353). Remillard and Bryans' (2004) findings confirm and support Nicol and Crespo's (2006) findings that teachers use textbooks differently in their teaching of mathematics.

In her review of research on mathematics curriculum, Remillard (2005) examines ways of conceptualizing what she terms central constructs of research on mathematics curriculum and the impact of various conceptualizations on knowledge in the field of mathematics curriculum research. In her argument, curriculum use, teaching and curriculum materials form part of these central constructs. She alludes to the fact that "…researchers conceptualize curriculum use differently, and these conceptualizations are grounded in different assumptions about curriculum, teaching and reader-text interactions" (Remillard, 2005, p. 216). She presents four perspectives "to illuminate the varied and sometimes conflicting assumptions underlying research on curriculum use and to consider implications of this variation" (Remillard, 2005, p. 216). For each perspective, Remillard (2005) categorises the conceptions of curriculum use into five focal areas each with a particular assumption.

Table 3 below outlines Remillard's (2005) key assumptions and four theoretical perspectives.

Table 3: Key assumptions and theoretical perspectives influencing conceptions of curriculum use (Remillard, 2005, p. 216).

Conceptions of Curriculum Use	**Four perspectives underlying research on curriculum use and assumptions for each conception**			
	Following and Subverting	*Drawing on*	*Interpreting*	*Participating with*
Conceptions of curriculum materials	Fixed representation of enacted curriculum	One of the available resources	Representation of tasks and concepts	Artefacts or tools; products of sociocultural evolution
Conceptions of the teacher's role	Enactor of planned curriculum	Active designer of the enacted curriculum	Meaning maker draws on beliefs and experience to make meaning	Collaborator with curriculum materials to design enacted curriculum.
View of teacher-curriculum relationship	Fidelity is possible and a desirable goal	Teacher as agency over curriculum	Fidelity is not possible	Participatory relationship influenced by both teacher and curriculum.
Theoretical or epistemological influences	Positivism	Positivism or interpretivism	Interpretivism; reader-response literacy theory	Sociocultural analysis
Focus of research: Illustrative research questions	Agency of the text as influencing factor: To what extent and under what circumstances do teachers use the curriculum with fidelity? How can fidelity be increased?	Agency of teachers: What influences the choices that teachers make? How are their choices played out in classrooms?	Nature of interpretations and resulting classroom practices: How do teachers interpret their curriculum resources? How do these interpretations play out in mathematics teaching?	The participatory relationship: How do teachers engage with and use curriculum resources? What teacher and curricular factors influence this relationship?

The first perspective ('following and subverting') derives from a category of researchers who view curricula as fixed, embodying discernible and complete images of practice and a teacher as either falling into a group that follow the fixed curriculum with its pre-designed curriculum materials or a group that subvert the pre-designed curriculum materials in favour of alternative materials. Curriculum materials

are viewed as a fixed representation of enacted curriculum. The research, in this case, focuses on the extent and the circumstances under which teachers use curriculum materials with fidelity. The second perspective stems from a category of researchers who regard classroom rather than text as a starting point for analysis and view curriculum guides as possible influencing forces in the construction of practice. Unlike the first category of researchers, this category views the curriculum materials as one of many resources and the teacher as one of the designers of curriculum materials with a choice on which materials to use and how to use it. Research in this category seeks to find what influences the choices teachers make and how their choices play out in classrooms.

The third perspective emanates from a category of researchers who focus on the teacher and examines the meaning made from the text. To them, a text or curriculum material gives a structural representation of a mathematical concept and mathematical task and a teacher is viewed as an individual who uses experience and beliefs actively to make meaning. Curriculum materials are viewed as representations of tasks and concepts. Research here needs to investigate firstly how teachers interpret their curriculum resources and secondly how these interpretations play out in the mathematics teaching.

The fourth and last perspective arise from a category of researchers who look mainly at the relationships that teachers establishes with curriculum resources, the factors influencing that relationship and the effect that the relationship has on the teacher and the enacted curriculum. The curriculum materials are viewed as artefacts or tools representative of sociocultural contexts and the teacher as an active partner in the creation and designing of the instructional scenery. Focus of research is on how teachers engage with and use curriculum resources and on what teacher and curricular factors influence this relationship (Remillard, 2005, p. 216).

The study at hand seeks to explore teachers' use of textbooks in their day to day classroom instruction. In each of the four perspectives, there is to some extent an element of the role of the teacher in relation to curriculum materials. As Remillard (2005) admittedly points out "…the categories are overlapping and distinctions between them are due, in some cases, to different emphases of the research"

(Remillard, 2005, p. 216). Each of the perspectives, therefore, has a potential to provide my study with a source of reference that may lead to illuminating results. Since this study's main focus is on a teacher and the way a teacher uses a textbook to teach, the fourth perspective, the participating with, provides a more relevant point of reference with its emphasis on the teacher and the teacher's interaction with curriculum materials. This perspective poses questions related to "…'How do teachers engage with and use curriculum resources?' and 'What teacher and curricular factors influence this relationship?'" (Remillard, 2005, p. 217) This perspective, Remillard (2005) asserts, is a sociocultural perspective which may well mean that the group of researchers classified under this category acknowledge the sociocultural factors influencing individual teachers' views and therefore choices of curriculum materials and the way they use such materials. It will not be surprising therefore to find individual teachers using textbooks or one particular textbook in different ways as a result of the different sociocultural backgrounds and contexts each individual finds themselves in both personally and professionally.

Using her literature review Remillard (2005) presents a framework that she asserts could be used to characterise and study teachers' interactions with curriculum materials. Looking at the four perspectives outlined above it is evident that Remillard's (2005) framework is mainly based on the fourth perspective which is about the relationship that the teacher makes with the curriculum materials or what may be looked at as the teachers' use of curriculum materials. She, however, acknowledges, as mentioned earlier, the existence of overlaps amongst different perspectives. Hence the noticeable prevalence of some elements of the "use as interpretation of text" and "use as drawing on the text" in her proposed framework which she affirms cannot be ignored or avoided.

Table 4 below is an attempt to summarise and give some interpretation of some aspects of Remillard's (2005) framework.

Table 4: An interpretation of Remillard's framework of components of teacher-curriculum relationship (Remillard, 2005, p. 235).

Components of teacher-curriculum relationship	**Character Items**
The teacher	Pedagogical content knowledge, subject matter knowledge, beliefs/goals/experience, pedagogical design capacity, perception of curriculum, perception of students, tolerance for discomfort, identity
The curriculum	Representation of concepts, material objects and representation, representation of tasks, structures, voice, look
Participatory relationship between teacher and curriculum	Contextual, influences planned curriculum, influenced by planned curriculum, reflects equitable contribution by teacher and curriculum
The planned curriculum	Informs teacher-curriculum participatory relationship, informed by teacher-curriculum participatory relationship, informs enacted curriculum, informed by enacted curriculum
The enacted curriculum	Co-constructed by teacher and student, contextual, informs planned curriculum, informed by planned curriculum, informed by teacher, informs the teacher

According to Remillard (2005), what is critical in analysing the teacher's use of any curriculum material or textbooks is the relationship that exists between the teacher and the curriculum material. The teacher must be viewed as a professional with pedagogical and content knowledge, subject matter knowledge and ability to design and drive the instructional system created in the classroom. The curriculum, on the other hand, provides a structured representation of curriculum materials, content and concepts to be taught and tasks formations among others. The relationship between the planned curriculum which is the teacher's own creation and the enacted curriculum which is created by both the teacher and student and contextual in nature plays an influential role in the teacher's use of curriculum materials. The question could, therefore, be to find out the extent to which each of the components plays their individual role in enforcing or enhancing the teacher-curriculum relationship.

The assumptions and theoretical perspectives seem to have developed from studies conducted on the teachers' use of curriculum materials. Each theoretical perspective presents an acknowledgement of the difference in the teachers' use of the

curriculum materials. The first perspective alludes to the fact that teachers may choose to follow or subvert the curriculum materials. If teachers do follow the curriculum the researcher's concern is the extent of the teacher's fidelity in following the curriculum material. This may find its parallel in Nicol and Crespo's adhering class of teachers as alluded to earlier.

The second perspective, the drawing on, presents similar qualities as the elaborating classification in Nicol and Crespo's (2006) classification. The third perspective referred to as the interpreting relates very closely to the creating classification in Nicol and Crespo's (2006) classification. The fourth perspective, the participating with, views textbooks as instruments of mediation of mathematics concepts. Remillard (2005) makes reference to the enacted curriculum in the classroom and the possible gap that may exist between the enacted and the intended curriculum. This is given more focus by Jaworski (2009) who investigates the use of curriculum materials by teachers and the relationship between teachers and curriculum materials. Through this study, she manages to explore and expose discrepancy between what she terms intended and enacted curriculum.

Remillard's (2005) fourth perspective views textbooks as mediators of mathematics concepts. In Jaworski's (2009) words:

> "The professionals who write the materials interpret the intended curriculum to provide a bridge between its academic conceptualization and sociocultural settings in which teaching and learning activity is located" (Jaworski, 2009: 338).

The question is whether teachers use the textbooks as intended by the writers and therefore curriculum designers. Jaworski (2009) places the teacher as the implementer of curriculum in an overwhelming and delegate position that calls for support and sensitivity from the material developers and writers. She argues that more still needs to be done in establishing ways in which curriculum materials (textbooks) interpret the intended curriculum and the assumptions research makes about teachers who use these materials. The results from Jaworski's (2009) study also confirms and supports the study by Nicol and Crespo (2006) that the teacher's

views and interpretation of textbooks or any teaching resource will influence the way they use the resource.

Looking at the literature outlined above it is clear that the results from all the studies agree in principle that teachers use textbooks differently in their day to day teaching of mathematics. The various ways in which teachers use textbooks as expressed above are attributed to a number of factors amongst which the teacher's views and beliefs about mathematics and the role of the textbook as well as the teacher's content knowledge appear most prevalent.

The three approaches established by Nicol and Crespo (2006), supported by key assumptions and perceptions of Remillard and Bryans (2005), presents a well-structured framework that guides and provides lenses through which teachers' interpretations and use of mathematics textbook could be viewed. The researcher's intention is to adapt, use and possibly extend Nicol and Crespo's (2006) classification of three approaches to the teachers' use of textbooks to develop a conceptual framework for this study. The study will mainly focus on linking teachers' qualifications and teachers' experiences in teaching mathematics with their use of textbooks in teaching mathematics.

The Mathematics CAPS Cognitive levels

"Bloom's Taxonomy is a multi-tiered model of classifying thinking according to six cognitive levels of complexity. It is used […] as a means of dividing concepts into categories and hierarchies of ideas, [and] is probably the most well-known taxonomy in education" (Orey, 2010, p. 9). Orey (2010) differentiates between the old Bloom's taxonomy and the revised Bloom's taxonomy. He argues that the revised Bloom's taxonomy "…offers teachers an even more powerful tool to help design their lesson plans" (Orey, 2010, p. 45). It "…is categorized into three domains of learning: cognitive, affective and psychomotor" (Orey, 2010, p 11). The purpose of having this taxonomy Krathwohl (1956) asserts, is to "help curriculum builders plan learning experiences and prepare evaluation devices; clarify the meaning of a learning objective (what level of 'understanding' is trying to be achieved)" (Krathwohl, 1956 cited in Orey, 2010, p. 11).

The discussion of Bloom's taxonomy above brings about a number of aspects that need to be considered by both the curriculum developers and users of the curriculum. Firstly that thinking can and should be categorised into different levels. Secondly, that curriculum developers and curriculum users must know and understand each level of thinking. Thirdly that those curriculum developers must clearly spell out all levels of thinking to be addressed by the curriculum and that those curriculum users must be able to determine, identify and develop activities to address those levels of thinking. Since teachers are amongst the users of curriculum it is important that each one of them knows and understands Bloom's taxonomy. The understanding here is that knowledge and understanding of this taxonomy will assist teachers in preparing lessons, designing lesson activities, teaching lessons and assessing learners as expected by the curriculum.

The study will confine itself to only one of these three domains namely, the cognitive domain. The table below differentiates between the old and revised levels of thinking as outlined in the Bloom's taxonomy's cognitive domain.

Table 5: The old and revised cognitive levels in Bloom's taxonomy
(Orey, 2010, p. 43)

Old Version	**New Version**
Knowledge	Remembering
Comprehension	Understanding
Application	Applying
Analysis	Analysing
Synthesis	Evaluating
Evaluation	Creating

What is noticeable about the two versions is firstly the change from using nouns in the old version to using verbs in the revised version. The second noticeable change is the use of more simple and direct words to describe particular mental actions as can be seen in level 1 and level 2. The third and last change is the changing of the concept of synthesis to the action of evaluating and the concept of evaluation to the action of creating. The reason for these changes could presumably be the emphasis on modeling the actual mental or thinking activities that happen during learning rather than conceptualizing the actions as it appears in the old version.

Orey (2010) presents the descriptions of the six cognitive levels of the revised Bloom's taxonomy as outlined in Anderson & Krathwohl (2001).

- **Remembering**: Retrieving, recognizing, and recalling relevant knowledge from long-term memory.
- **Understanding**: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
- **Applying**: Carrying out or using a procedure through executing, or implementing.
- **Analyzing**: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.
- **Evaluating**: Making judgments based on criteria and standards through checking and critiquing.
- **Creating**: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

(Anderson & Krathwohl, 2001, pp. 67-68 in Orey, 2010, p. 43)

The descriptions of the six cognitive levels above are done in a more general and broader way to cover a wide spectrum of different fields and subjects in teaching and learning. Since teachers are specialists in different subjects, for each cognitive level they would probably focus on those parts of the description relevant to their individual subjects. The focus might even require teachers to interpret some of the describing words and look out for more suitable words to describe the kind of mental activity for each cognitive level.

Looking at aspects constituting each of the six cognitive levels in Bloom's taxonomy it is clear that for mathematics and probably other subjects, it would be difficult to assign with an acceptable level of accuracy, a specific cognitive level to most of the questions or to mental activities expected of learners in mathematics. In South Africa, an attempt has been made probably to address discrepancies that might

possibly arise as a result of ambiguities in the terminology used in Bloom's taxonomy.

According to Long et. al. (2014), the development of the four cognitive levels in the South African mathematics Curriculum and Assessment Policy Statement (CAPS), was influenced by both the Bloom's taxonomy and Trends in International Mathematics and Science Study (TIMSS) frameworks (Long et. al., 2014).TIMSS is an International Association for the Evaluation of Educational Achievement (IEA) project measuring trends in students' performance in mathematics and science (Kadijevich D., 2002).

Long et. al. (2014) argue that from their inception the TIMSS have been working in consultation with both the original and revised Bloom's taxonomies to develop among others, frameworks suitable for assessment in mathematics; hence the existence of similarities between Bloom's categorisations and those in the TIMSS. Long et. al. also point to similarities existing between the cognitive levels in Mathematics CAPS and the cognitive levels categorisation in the TIMSS 1995 and 1999 (Long et. al., 2014).

It could, therefore, be concluded that the currently used Mathematics CAPS cognitive levels framework or taxonomy has its origins in both the Bloom's taxonomy and the TIMSS frameworks. The table below outlines the cognitive levels presented in the Mathematics CAPS document. These cognitive levels will be used in the analysis of the lesson observation transcripts to determine the cognitive levels of teacher examples, learner exercises and homework activities used by teachers in their teaching of mathematics.

Table 6: Cognitive levels (Department of Basic Education: 2011, p. 157)

DESCRIPTION AND EXAMPLES OF COGNITIVE LEVELS		
Cognitive levels	**Description of skills to be demonstrated**	**Examples**
Knowledge (≈25%)	Estimation and appropriate rounding of numbers Straight recall Identification and direct use of correct formula Use of mathematical facts Appropriate use of mathematical vocabulary	1. Estimate the answer and then calculate with a calculator: 62 816 325 + 279. **[Grade 7]** 2. Use the formula A = πr_2 to calculate the area of a circle if the diameter is equal to 10 cm. **[Grade 8]** 3. Write down the y-intercept of the function $y = 2x + 1$ **[Grade 9]**
Routine procedures (≈45%)	Perform well-known procedures Simple applications and calculations which might involve many steps Derivation from given information may be involved Identification and use (after changing the subject) of correct formula Generally similar to those encountered in class	1. Determine the mean of 5 Grade 7 learners' marks if they have respectively achieved 25; 40; 21; 85; 14 out of 50. **[Grade 7]** 2. Solve x in $x - 6 = 9$ **[Grade 8]** 3. R600 invested at r% per annum for a period of 3 years yields R150 interest. Calculate the value of r if $SI = P.n.r$ 100 .**[Grade 9]**
Complex procedures (≈20%)	Problems involving complex calculations and/or higher order reasoning Investigate elementary axioms to generalize them into proofs for straight line geometry, congruence and similarity No obvious route to the solution Problems not necessarily based on real world contexts Making significant connections between different representations Require conceptual understanding	1. Mr Mnisi pays R75 for a book which he marks up to provide 20% profit. He then sells it for cash at 4% discount. Calculate the selling price. **[Grade 7]** 2. A car travelling at a constant speed travels 60 km in 18 minutes. How far, travelling at the same constant speed, will the car travel in 1 hour 12 minutes? **[Grade 8]** 3. Use investigation skills to prove that the angles on a straight line are supplementary. **[Grade 9]**
Problem solving (≈10%)	Unseen, non-routine problems (which are not necessarily difficult) Higher order understanding and processes are often involved Might require the ability to break the problem down into its constituent parts	1. The sum of three consecutive numbers is 87. Find the numbers. **[Grade 7]** 2. Mary travels a distance of km in 6 hours if she travels at an average speed of 20 km/h on her bicycle. What should be her average speed if she wants to cover the same distance in 5 hours? **[Grade 8]** 3. The combined age of a father and son is 84 years old. In 6 years' time the father will be twice as old as the son was 3 years ago. How old are they now? **[Grade 9]**

The table above shows that CAPS has reduced the six cognitive levels to only four cognitive levels for mathematics and has reverted to the old Bloom's taxonomy terminology, knowledge in place of the revised terminology, remembering for the 1st cognitive level. The second Mathematics CAPS Cognitive levels cognitive level is referred to as the routine procedure and covers both the mental activities under the second and third revised Bloom's taxonomy cognitive levels, the understanding and applying levels respectively. The third CAPS cognitive level, the complex procedure, covers the fourth revised Bloom's taxonomy cognitive level, the analysing level. The fourth and last CAPS cognitive level, the problem-solving level, covers both the fifth and sixth levels of the revised Bloom's taxonomy, the evaluating and creating cognitive levels.

Summary

The studies referred to above are key texts around the teachers' use of textbooks in teaching and learning of mathematics. There is an indication in all of them that teachers do use mathematics textbooks in their teaching of mathematics. There is also an indication that teachers' use of these textbooks differs from one teacher to another and from one context to another. There is also an indication of similar trends in the way teachers use textbooks. The factors affecting how individual teachers use textbooks range from personal preferences to professional judgement. The Mathematics CAPS Cognitive levels will also be used in the analysis of the lesson observation transcripts to determine the extent to which mathematics teachers consciously or unconsciously use Bloom's taxonomy when preparing mathematics lessons, when choosing examples and exercises for their classroom instruction, for homework and when assessing learners.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

Introduction

This chapter presents the research design of this study. It starts off with the aim of this descriptive case study and an outline of the research problem and the research questions. This is followed by a brief discussion of case study methodology followed by issues around the validity and reliability of a case study. All processes in the design starting with the selection of the participants, research techniques, preparation for the collection of data and the collection of data itself are outlined and discussed. Quantitative and qualitative approaches have been adopted for purposes of validity. Three data collection methods: survey, observation and interview were used for purposes of data accuracy and consistency verification. To ensure validity and reliability of this case study all documentation relating to the preparation of data collection and evidence of data collection have been formally designed and made available as Annexures in the Appendix section at the end of the report.

Aim and Research Questions

This study aims to illuminate different ways in which grade 9 mathematics teachers use CAPS aligned grade 9 mathematics textbooks in their teaching of mathematics. Two research questions pertaining to the teachers' use of textbooks are answered as the study progresses. These questions are:

1. How do Grade 9 mathematics teachers use mathematics textbooks to mediate their teaching of mathematics in their classroom?

2. What type of questions, according to the Mathematics CAPS Cognitive levels do teachers select or use for examples when demonstrating concepts, for learners' classroom exercises, for learners' homework and for assessment?

This case study should be regarded as a baseline study on how mathematics teachers use mathematics textbooks in their teaching of mathematics. Three

research methods were used to collect data in this study: a survey, transcripts of observations of lessons and interviews with teachers. The three methods were used for purposes of triangulation. Since all the teachers were given all information about the study, it would not have been uncommon for some teachers to be tempted to act in ways that may give inaccurate information hence triangulation for the enhancement of data accuracy and consistency verification. Each method and how it was carried out in this study is discussed below.

A case study

According to Yin (1994) and as mentioned earlier, a case study is one of the methods of empirical inquiry and therefore one of the preferred strategies in investigations of current events. He emphasises though that such events should happen without any form of external influence or manipulation. He further points out that a case study relies on multiple data collection methods including direct observation and interviews and that a mix of both quantitative and qualitative evidence can be used. Yin (1994) acknowledges what he terms traditional criticism that case studies cannot be generalized to population or universes but points out that they have a potential of being generalized to theoretical proportions (Yin, 1994, pp. 1-17).

As mentioned earlier this study is a case study focusing on the mathematics teachers' use of textbooks in the classroom situation. Throughout time mathematics teachers have been using textbooks in their classroom teaching of mathematics, such that a textbook has become a critical component in mathematics teaching and learning activity. The three triangles used in the interpretation of Vygotsky's (1978) simplified model of mediated action in Chapter 2 depict a textbook (mediating artefact) as one of the critical components of the mediated action (Rezat, 2006, pp. 411-412). The use of a textbook by a teacher when teaching mathematics could, therefore, be interpreted and accepted as part of the classroom teaching and learning activity. Therefore an investigation of the use of a textbook by a teacher in the classroom teaching of mathematics could be viewed as an investigation of a phenomenon in its real life context. Using a case study in this investigation was therefore relevant. Following from Yin's (1994) argument as outlined above, the

findings of the study cannot be generalised but can be used, as mentioned earlier, as a basis for further research that could be extended to include the provincial and national teaching fraternity.

Validity and reliability

According to Yin validity and reliability are:

> "… some of the criteria commonly used to establish the quality of any empirical social research. Validity he points out can be categorised into three different concerns, which according to him play a vital role in ensuring the quality of any scientific study particularly any case study. The first concern, constructive validity, deals with the establishment of correct operational measures for the concepts being studied; the second concern, internal validity, is concerned with the establishment of a causal relationship; and the last one, external validity, deals with the establishment of the domain to which a study's findings can be generalized" (Yin, 1994, pp. 32-33).

Looking at the case study at hand, two of these three validity concerns, namely, the constructive and external validity, are more relevant and will therefore be focused on. The constructive validity which according to Yin (1994) can be tested among others by the use of what he terms "multiple sources of evidence" was ensured by employing triangulation. Three data collection methods were used; namely the survey, the lesson observation and the interviews. The aspects focused on in the questions used in both the survey and interviews were also focused on during lesson observations. This was done as Yin (1994) points out, to ensure convergence of all the methods used to one focal point. This would mean that the authenticity of responses received in the survey for any particular respondent who subsequently participated in the lesson observations could be verified firstly during the lesson observation and subsequently during the interviews.

Yin makes reference to another validity test, external validity, which he says, addresses the generalizability of findings in any case study. He argues that even though findings in a case study cannot be generalized for populations they can be generalized for hypotheses (Yin, 1994). Looking at the case study at hand, it is

acknowledged that the findings of this study are contextual and therefore cannot be generalized. It is also worth noting though that the study has a potential of been used as a basis for further research on the phenomenon of teachers' use of textbooks.

Another important test that needs to be considered is the reliability of the study which according to Yin (1994) is intended to: "minimize the errors and biases in a study" (Yin, 1994, p. 36). Reliability according to Yin is: "Demonstrating that the operations of a study such as the data collection procedures can be repeated, with the same results" (Yin, 1994, p. 33).Yin emphasises that: "The objective is to be sure that, if a later investigator followed the exactly the same procedures as described by an earlier investigator and conducted the same case study all over again, the later investigator should arrive at the same findings and conclusions" (Yin, 1994, p. 36).To ensure the reliability of the case study at hand all processes and procedures followed in this study have been formally documented as evidence for scrutiny by other investigators. From the beginning of work on this study, data collection procedures have been reviewed by the supervising professor.

Participants

The teachers in this study are grade 9 mathematics teachers from different public high schools in the Johannesburg East district. Although thirty teachers from thirty different high schools were expected to take part in the first stage of data collection, a total of thirty four teachers participated. Three teachers were from the same school, three others from another school and three more from the third school. A total of nine teachers were therefore from three different schools. Four more teachers participated, two from one school and the other two from another school. This gives a total of thirteen teachers from five schools. Fifteen more teachers were from fifteen different schools. The remaining six chose to remain anonymous. Therefore a total of twenty eight teachers who participated in the questionnaire were from twenty two different schools whilst the other six did not reveal the names of their schools.

The reason more than one teacher participated in the survey in any particular schools was that no particular teacher was selected to take part but all interested

grade 9 mathematics teachers in a school were requested to take part in the survey. A mini-sample of four teachers was selected from the thirty two who participated in the survey to take part in lesson observations and interviews. These four were selected from four different high schools. The process of selecting these four teachers will be discussed later in the chapter.

Survey

A questionnaire was developed and distributed to Grade 9 mathematics teachers in thirty Johannesburg East district public high schools. **Annexure A** gives a clear picture on how the questionnaire was structured. A sample Questionnaire below illustrates how one teacher who also participated in the lesson observation process and subsequently interviewed about her lessons completed the questionnaire.

QUESTIONNAIRE FORMAT

***Note that pseudonyms are used.**

Name: **Teacher 1**

Specify your academic and professional qualifications. e.g. BSc

Highest Qualification	Certificate	Diploma	Degree ✓	Post Grad. Degree	Other

Specify your academic and professional qualifications. e.g. STD Maths 3

Highest Qualification in Mathematics	Certificate	Diploma	Degree ✓	Post Grad. Degree	Other

How many years' experience do you have as a mathematics teacher? **05**

In which Grades have you taught Mathematics in the last two years	Grade 8 **05**	Grade **05**	Grade 10 **05**	Grade 11 **04**	Grade 12 **04**	Other: Specify
Does the school give you a textbook(s) to use in your mathematics lessons?					Yes	No ✓

Please give title(s) of any textbook that you use, and indicate who provided the textbook. (e.g. school, self, GDE, etc.)

Title of the textbook	Provided by school	Not by school. Provided by:
Platinum	**Yes**	

Indicate your choice by a tick

	Always	Sometimes	Occasionally	Not relevant	Not at all
I use a textbook(s) to prepare my lessons			✓		
I use a textbook(s) to teach in class			✓		
I use a textbook(s) to assess			✓		
I use a textbook(s) for homework			✓		

Do you use other resources e.g. DVDs to teach mathematics? Yes No✓

If yes state the resource

_____

Thank you very much for investing your time on this questionnaire and for providing valuable information.

The respondents were made aware that completing and submitting the questionnaire is voluntary. The distribution was done during the subject meetings and during school visits. This questionnaire served two purposes: it assisted in establishing the extent to which mathematics teachers use mathematics textbooks in their teaching of mathematics and also in identifying the popularity of certain textbooks among teachers. The questionnaire required the teacher to indicate their highest qualifications which could be in any field of study; and their highest qualifications in mathematics. In both instances, the questionnaire gave teachers five options to choose from, a certificate, diploma, degree, post-graduate qualification and any other.

Remillard and Bryans' (2004) study revealed that individual knowledge of mathematical concepts and views about mathematics has an influence on the way different teachers read, interpret and use curriculum materials (Remillard and Bryans, 2004). Their view is supported by Graybeal and Stodolsky (2004) who argue that teachers' knowledge and views shape their use of the resources (Graybeal & Stodolsky, 1987 cited in Remillard and Bryans, 2004, p. 353).

In the South African context, different levels of qualifications in a subject may imply different levels of formal content knowledge of individual teachers in the subject. It would be interesting therefore to see if a teacher's level of qualification will have any influence in the way they use a textbook. It should be acknowledged that in addition to qualifications, experience also plays a crucial role in a number of aspects related to curriculum implementation. With that in mind, teachers were also asked to respond to a question on their teaching experience in mathematics and about the accessibility of the textbooks. This would give an indication of the how easy or how difficult it is for the respondents to access textbooks thereby confirming or denying the claim that textbooks accessibility is a priority for the Department of Basic Education (DBE).

It would also give an indication of the respondent's view of textbooks in cases where the respondents take it upon themselves to acquire a textbook through means other than through the Department of Education. The last question on the questionnaire focused more closely on ways in which the respondents use textbooks. The question wanted to find out the extent to which the teacher uses a textbook in their lesson preparation, teaching, homework and assessment.

Selection of mini sample

From the responses received a final sample of four teachers was selected based on convenience. A total of twelve teachers, eight from township schools and four from the suburban schools in the district, were approached and invited to take part in the second stage of the study. Six of these teachers from six different schools expressed their interest to proceed to the second stage of the study. Two of these teachers 6 were from poor performing schools, one in the township and the other in the eastern suburb. The other four were from four moderately performing schools in the northern suburb. Unfortunately, both teachers from the two underperforming schools could not proceed with the study. The teacher from the township resigned and left the school just before the study began and at the same time, a new principal was appointed at the school. It was, therefore, difficult to start the process all over again with totally new people.

Since the study initially intended to use only four teachers for lesson observations four of the remaining teachers were asked to participate. These were from the four quintile 5 moderately performing northern suburb high schools. Moderately performing high schools are those high schools that attain an overall matric pass rate of between 70% and 80%. Quintile 5 are fee-paying schools, which means all learners except those whose parents were granted exemptions based on their socioeconomic background, are expected to pay school fees and provide for their own textbooks, stationery and other resources.

The reason for deciding on these four teachers was the proximity of their schools which made it easy to move from one school to the other at any given time. The sample, therefore, became more of a convenient sample. It must be noted that performance in the South African public high schools is determined not by Grade 9 performance but by the school's performance in grade 12. Even though these schools were performing moderately in Grade 12, their performance in Grade 9 as evident in their 2013/2014 ANA results (an average of respectively) rate them as poor performing like most schools both in the suburban areas and in the townships.

Ethics Clearance

Ethics clearance for this study was obtained from both Wits University and the Gauteng Department of Education (GDE). This was a fairly lengthy process. Before lesson observations could start a meeting with each teacher was arranged to explain the purpose of the project and implications for their participation and teachers were also made aware of their rights to withdraw from the study at any time if they so wish. Each was made aware that their two selected mathematics lessons would be observed and audio recorded and that an observation protocol would be used together with the audio recorder in each of their lessons. All teachers were given assurance that the only people who would have access to the data are those who are directly involved in the study (myself and my supervisor) and that anonymity will be guaranteed. In all transcriptions and the write-ups, pseudonyms are used and the names of schools are not disclosed. In addition, all data collected will be stored and locked up in a safe place at my house where others will not have access. Data will be destroyed within 3-5 years after completion of the project.

Meetings with principals of participating schools were arranged where the same information given to each teacher was shared. The four teachers took it upon themselves to share the information with potential learners and to explain what the project is all about and the learners' role in the project. In addition, all participants (i.e. teachers; principals; learners and parents since the learners are minors under 18) were provided with a Participant Information Sheet as well as Letters of Consent.

Each Information Sheet and Consent Letter was tailored for the recipient (i.e. learners, parents, teachers, Principal and the Department of Education).

The teachers and principals' information sheets and letters of consent were hand delivered during meetings with each individual teacher and principal. The participating teachers were again helpful in distributing and receiving information sheets and letters of consent to and from learners and parents. Where learners and parents had questions and concerns they were able to communicate with the researcher whose contact details were provided in the information sheets and letters of consent. For example, on receiving the information sheet and letter of consent one parent thought the researcher was going to offer special mathematics lessons for a fee. Her confusion was addressed telephonically to her satisfaction by the researcher. GDE policies were observed during the period of this study and permission was granted by GDE in order to conduct this study at their schools.

Transcripts of observations of lessons

Three of the four teachers were observed in two lessons each and the fourth teacher, with his permission, was observed in three lessons. The reason for this teacher to be observed in three lessons was the technical challenges experienced with the recording of the first lesson as a result of noisy activities outside the classroom. Transcriptions of two observed lessons per teachers were done. These transcriptions are analysed to ascertain the extent to which each teacher uses a textbook in each of their lessons.

The following six aspects are focused on in the analysis of the transcripts:

1. Definitions of concepts
2. Examples used by teacher in each lesson
3. Exercises given to learners in each lesson
4. Homework questions
5. Assessment questions

6. Cognitive levels of questions according to the Mathematics CAPS Cognitive levels

Examples used by each teacher and questions given to learners in exercises, homework and assessment were rated using a Mathematics CAPS Cognitive levels. As discussed in the previous chapter, the taxonomy has been modified as evident in the Mathematics CAPS Senior Phase Grade 7–9 policy document to better address different cognitive levels in mathematics. Out of the six cognitive levels, which are remembering, understanding, applying, analysing, evaluating and creating in the revised Bloom's taxonomy, modification done for mathematics produced only four cognitive levels. These are knowledge, routine procedure, complex procedure and problem solving.

The four cognitive levels were coded as LV-1 for level 1 (i.e. knowledge questions),

e.g. "what is the mode of a data set?"

LV-2 for level 2 (i.e. routine procedure questions),

e.g. "calculate the mean of a data set: 1 ; 3 ; 5 ; 6 ; 8"

LV-3 for level 3 (i.e. complex procedure questions),

e.g. "given a set of data 1; 7 ; 12 ; 14 which number should be added to the set to give a mean of 35,6?"

LV-4 for level 4 (problem-solving questions),

e.g the heights of four out five netball players in a team are 1,5 m, 1,7 m, 1,7 m and 1,75 m. If the mean height of all five players is 1, 65 m, what is the height of the fifth player?

Observation protocol and matrix checklist

For each lesson observed an observation protocol together with a checklist were also used. It should be noted that the observation protocol and the matrix checklist were not used as primary data collection tools but were used to record some aspects in each lesson to enhance the collection of data. The first part of the protocol indicated the name of the school, the teacher's gender and the teacher's highest qualifications in mathematics. The teacher's qualification was important to the researcher since it addresses two critical aspects. Firstly it gave verification of

teacher's current qualification compared to qualification submitted on the questionnaire. Secondly, it gave the researcher data surrounding the relationship (if any) between qualifications and how the teachers used a textbook in presenting a lesson.

The second part of the protocol requested the name of the observer, the date of the observation, the total number of learners, the total number of learners who participated in the lesson, the topic and concept taught and the number of the lesson observed; whether first, second or other. The total number of learners was important to establish whether a difference in number could have any effects on how a particular teacher uses a textbook. An indication of a topic and concept of teaching was important to ascertain if a teacher maintains the same way of using a textbook or vary his/her approach to a different topic or concept.

Labelling the lesson as first or second and so on was also important in assisting the processes of dealing with discrepancies that might show between different lessons as a result of the level of tension in the teachers due to the observer's presence. This would help in minimising the distortions in perceptions emanating from lack of spontaneity from teachers as a result of uncertainties in expectations, especially during the first lesson. The third part requested the time scheduled and the actual time the lesson took place and an explanation for the discrepancy if any. Adhering to time frames was important since the researcher made and signed the assurances with the principals and all teachers that the school's Annual teaching plan (the ATP) would not be disturbed. Refer to Annexure B below for the observation protocol used during each observed lesson. Teacher 1's lesson is used here to show how the protocol was completed for each teacher.

Participant: **Teacher 1**

CLASS OBSERVATION PROTOCOL

Use of different cognitive levels as outlined in the CAPS document in the selection of examples, exercises, homework activities and assessment tasks

School: **"Mountainside"**

Gender	Male	Female ✓

Highest Qualification in Mathematics	Certificate	Diploma	**Degree** ✓	Post Grad. Degree	Other

Observer: **Charles Ramoshebi** Class: **"9B"** Date: **27 October 2014**

Number of learners: **29**

Topic: **Rotation** Concept: **rotation**

Lesson:

1	✓	2		3		4	

Scheduled time for this class: From **8:50** to **9:30**.

Time instruction actually began: **8:50**

Explain if different from scheduled time.

_____

Time instruction actually ended: **9:30**

Explain if different from scheduled time.

_____

A checklist matrix was included in the observation protocol. It was used during each lesson to note each teacher's frequency in using a textbook or alternative resource and also to note cognitive levels of the examples used and exercises given to learners. Below is how the checklist matrix was completed during Teacher 1's lesson.

Participant: **Teacher 1**

Aspects for observation	Time in minutes											
	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
DF-TEX												
DF-ALT												

EXL-TEX												
EXL-ALT		✓										
LV-1												
LV-2												
LV-3		✓										
LV-4												

EXS-TEX					✓							
EXS-ALT			✓	✓		✓	✓					
LV-1												
LV-2												
LV-3			✓	✓	✓	✓	✓					
LV-4												

AT-TEX												
AT-ALT												
LV-1												
LV-2												
LV-3												
LV-4												

HW-TEX								✓				
HW-ALT												
LV-1												
LV-2												
LV-3								✓				
LV-4												

List of resources:

_____

_____

_____

A full description of each code used is given in the table below.

Table 7: Descriptions of the codes

DF-TEX	Definition of concepts from textbook
DF-ALT	Definition of concepts from alternative resource
EXL-TEX	Example from textbook
EXL-ALT	Example from alternative resource
EXS-TEX	Class Activity from textbook
EXS-ALT	Class Activity from alternative resource
HW-TEX	Homework Activity from textbook
HW-ALT	Homework Activity from alternative resource
AT-TEX	Assessment task from textbook
AT-ALT	Assessment task from alternative resource
LV-1	Recall/ Remembering
LV-2	Routine Procedures
LV-3	Complex Procedures
LV-4	Problem Solving

Interviews with teachers

After all lessons observations were completed a meeting was scheduled with each teacher where each was interviewed about their respective lessons. Closed and open-ended questions were used in the interviews. Questions asked in the interviews were mainly about certain aspects of each individual lesson which the researcher viewed as illuminating with regard to how each teacher uses a textbook in each lesson. Some of these questions were in some way related to the questions in the survey. These questions assisted the researcher to a certain extent in validating data collected from the survey and the classroom observations thereby intensifying the triangulation and minimising discrepancies in findings. The first group of questions in the interviews were based on each teacher's teaching experience.

According to Haggarty and Pepin (2002), experience seems to play a critical role in how a teacher uses a textbook. They assert that less experienced and non-specialists tend to rely on a textbook whereas experienced teachers have an option of using other resources developed through their years of teaching experience. The following questions which form part of the first group of questions in the interview relate to Haggarty and Pepin's findings regarding experience:

- What is your teaching experience in years?
- How long have you taught grade 9 mathematics?

The second group of questions was based on how each individual teacher uses a textbook. Haggarty and Pepin (2002) found that teachers in France use textbooks commonly for exercises and activities, those in Germany commonly used textbooks for lesson preparations and in England for classroom practice exercises. The following questions relating to how each teacher uses textbooks were asked:

- When did you start using a textbook in your teaching of mathematics?
- To what extent do you use a maths textbook in your maths lesson preparation?
- To what extent do you use a maths textbook in your teaching of maths lessons?
- To what extent do you use maths textbook for homework?
- To what extent do you use maths textbook when assessing learners?
- Do have any specific textbook(s) and/or other resources you use in your teaching of maths?
- What resource(s) did you use to prepare your observed lessons?

The third group of questions was based on the actual classroom instruction per lesson. Haggarty and Pepin (2002) found that in Germany pupils' abilities play an important role on how a teacher uses a textbook, whereas in England the teacher's experiences influence the teacher's use of a textbook. The following are examples of questions asked following the actual teacher/learner interaction in each individual lesson.

- In your lessons I realise that you used the textbook for definition of concepts, for examples and for exercises. Why is that?
- Where do you get your examples, your exercises and your homework?
- How do you choose your examples, your exercises, your homework and your assessment tasks?
- For your learners to understand the concept of [….] do you think the textbook gives enough examples and exercises?
- You gave learners Exercise 2.3.1 on page 280 of Platinum Maths. Why did you explain the questions and guide them through each question?
- In your lessons I realised that you start by giving your own definition of concepts without referring to any document and later refer learners to definitions from the textbook. e.g. rotation in lesson 1 and measures of central tendency in lesson 2. Is there in reason why you do it like that?
- When you design your assessment tasks how do the questions in the tasks relate to your examples and exercises that you give during your lessons?

Refer to Annexure D in the Appendices for the complete interview schedule used.

Summary

In his chapter, the aim of the study and the research questions were outlined. Emphasis was made that this is a case study focusing on a small sample of teachers in a particular district. On the basis of this, therefore, it was stressed that the findings of this study are specific to the context in question and may therefore not qualify for generalization but could be used as a basis for further research.

The validity and reliability of this study were accounted for. Evidence to ensure compliance to the two of the three validity tests, the constructive validity test, and the external validity test, together with evidence for compliance to reliability test were established.

Three methods used in the collection of data, namely, the survey, the classroom lesson observations and the interviews were discussed. Triangulation was cited as the main reason for using these three methods of data collection. It was expressed that the main purpose of triangulating was to minimize the biases and other discrepancies that might impact negatively on the validity and reliability of data collected and the findings thereof, thereby tainting the quality of the study. Therefore an attempt was made to ensure that questions for the survey were carefully designed to address the same aspects as questions in the interviews. The same aspects were also focused on during the classroom lesson observations. Data collected using the three methods, therefore, converged to the same focal point.

A selection of participants was briefly outlined, starting with a sample from the survey to a mini sampling of four participants who participated in both the classroom lesson observations and the subsequent interviews. Exemplar questionnaire and lesson observation schedules of one of the participants were presented to give an idea of the questions asked and to illustrate how some of the respondents and participants answered the questions. An exemplary matrix checklist was also presented as an illustration of how the investigator recorded some of the focal aspects during the classroom lesson observations.

CHAPTER FOUR: ANALYSIS OF DATA AND DISCUSSION

Introduction

Drawing on Nicol & Crespo's (2006) three approach classification of teachers' use of textbooks and the modified Bloom's taxonomy as outlined in Chapter 2, data collected from the questionnaire, classroom observations of four grade 9 teachers and the subsequent interviews with the four teachers are analysed. This classification by Nicol & Crespo's (2006) is relevant to this study because it provides a particularised framework on how different teachers use textbooks in their teaching of mathematics. The Curriculum and Assessment Policy Statement (CAPS) for Grade 7 to Grade 9 mathematics outlines a modified Bloom's taxonomy specifically adapted to address cognitive levels in the teaching and learning of mathematics (DBE, 2011).

Since CAPS for mathematics Grade 7 to Grade 9 emphasises the incorporation of all four cognitive levels in the classroom teaching of mathematics, the modified taxonomy will be used as one of the data analysis instruments to determine the extent to which each individual teacher exposes learners to questions of different cognitive levels. Using the taxonomy will serve two purposes; firstly it will to some extent, give information about the individual teacher's quality of teaching with reference to the types and cognitive levels of questions he or she uses in his or her teaching. Secondly, it will highlight the extent to which the individual teacher's instructional practice conforms to the demands of the curriculum as outlined in CAPS.

Summary of methods of analysis

Firstly all 34 teachers who participated in the survey were categorised according to their highest qualifications in mathematics, starting with those who have a certificate as their highest qualification in mathematics, a diploma, degree and those who have a post graduate qualification in mathematics. This was followed by a summary of responses by individual teachers and an analysis of these responses with reference

to the extent to which they use a mathematics textbook(s) in their preparation of lessons, their teaching of lessons, assessment and homework.
Secondly, the transcriptions of all observed lessons were used to establish the extent to which each of the four teachers uses a mathematics textbook(s) in their teaching of these lessons. Thirdly each individual transcription of all the four interviews with the four teachers was used to establish how each teacher used mathematics textbook in their teaching of mathematics, which includes preparation of lessons, the actual teaching of the lessons, assessment tasks and homework.
The following aspects were focused on:

1. Respondents' frequency of textbook usage for lesson preparation, for teaching of lessons including definitions of concepts, teacher's examples and learners' practice exercises, for homework and for assessment

2. Teachers' adherence or non-adherence to a textbook (e.g. definition, examples, exercises, etc.)

3. Use of different cognitive levels as outlined in the mathematics CAPS Cognitive levels document in the selection of examples, exercises, homework activities and assessment tasks

Analysis of data from the questionnaire

Responses of 34 teachers who participated in the questionnaire were captured and organised in tables according to their qualifications in mathematics. The qualifications were categorised into five namely, teachers with a certificate as their highest qualification in mathematics, those with a diploma, those with a degree, those with post-graduate qualifications and those with no specific qualifications in mathematics. Graphs are used to represent the data organised in Table 8 (a), Table 8 (b), Table 8 (c), Table 8 (d) and Table 8 (e) respectively.

Table 8 (a): Questionnaire on how teachers use mathematics textbooks (Teachers with a certificate)

Teachers with a certificate in mathematics: 03 Teachers					
		Years teaching mathematics			
Teacher (Tn)		T1	T2	T3	**Total**
Questions on use of textbook	**Extent of textbook usage**	**5**	**23**	**25**	
I use a textbook to prepare mathematics lessons	Always	✓	✓		**2**
	Sometimes				
	Occasionally			✓	**1**
	Not relevant				
	Not at all				
I use a textbook to teach mathematics lessons	Always	✓	✓		**2**
	Sometimes			✓	**1**
	Occasionally				
	Not relevant				
	Not at all				
I use a textbook to assess learners	Always	✓	✓	✓	**3**
	Sometimes				
	Occasionally				
	Not relevant				
	Not at all				
I use a textbook for mathematics homework	Always	✓	✓		**2**
	Sometimes				
	Occasionally				
	Not relevant				
	Not at all				

The shaded region indicates that the teacher neither gave an answer nor made any comment on the question.

Graphical representations of teachers with certificate in mathematics:

Note: n means number of teachers

Textbook usage for lesson preparation:$n = 3$

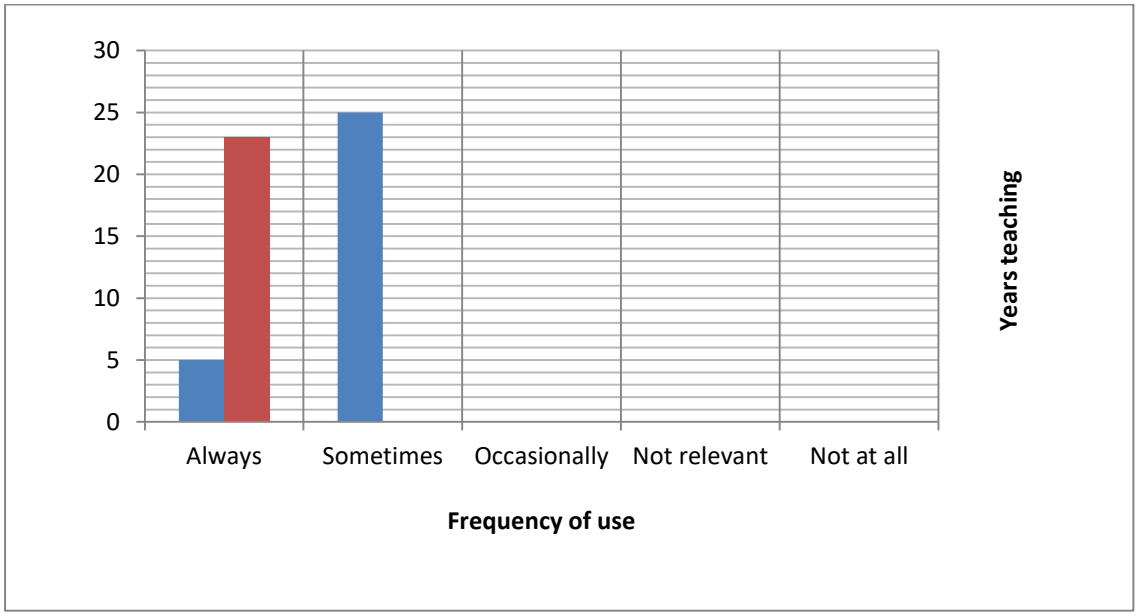

Figure 1 (a): Questionnaire on how teachers use mathematics textbooks (Teachers with a certificate)

The graph shows that out of a total of three teachers with a certificate as their highest qualification in mathematics two of them, the one with 5 years' experience in teaching and the one with 23 years' experience always use a textbook(s) when preparing their mathematics lessons. The third teacher with 25 years' experience uses a textbook(s) occasionally when preparing his/her mathematics lessons.

Textbook usage for teaching mathematics: $n = 3$

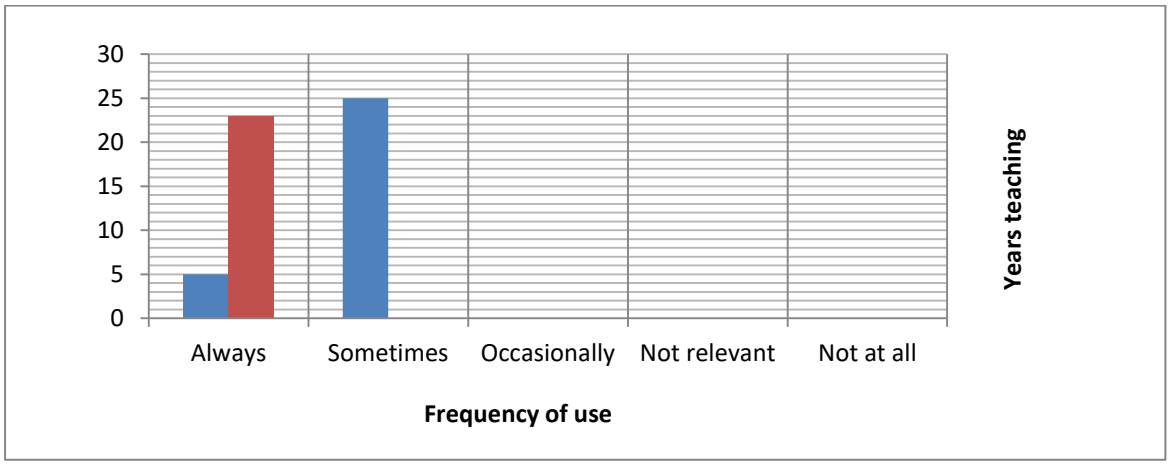

Figure 1 (b): Questionnaire on how teachers use mathematics textbooks (Teachers with a certificate)

The graph shows that out of a total of three teachers with a certificate as their highest qualification in mathematics two of them, the one with 5 years' experience in teaching and the one with 23 years' experience always use a textbook(s) when teaching their mathematics lessons. The third teacher with 25 years' experience uses a textbook(s) sometimes when teaching his/her mathematics lessons.

Textbook usage for assessment: $n = 3$

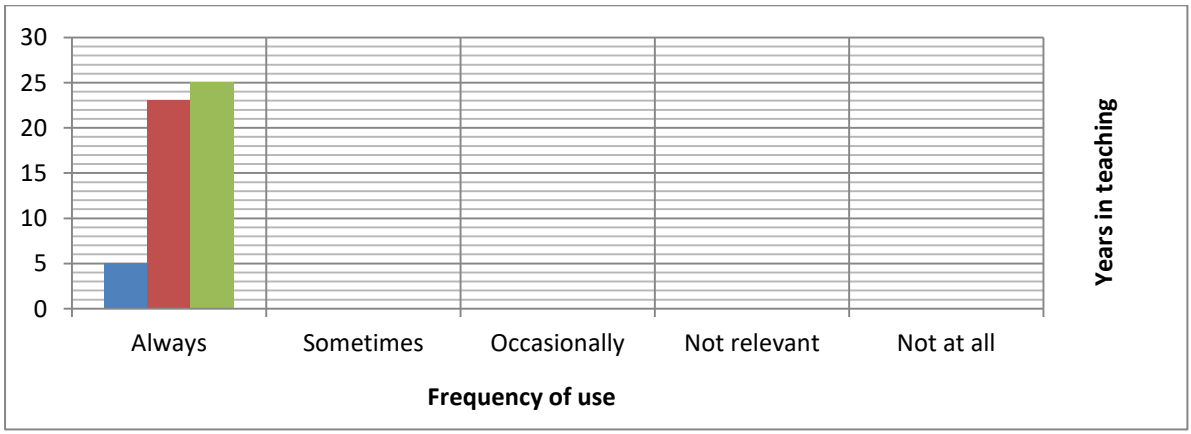

Figure 1 (c): Questionnaire on how teachers use mathematics textbooks (Teachers with a certificate)

The graph shows that all the three teachers with a certificate as their highest qualification in mathematics always use a textbook(s) when assessing learners. Their teaching experiences are 5, 23 and 25 years.

Textbook usage for homework: $n = 3$

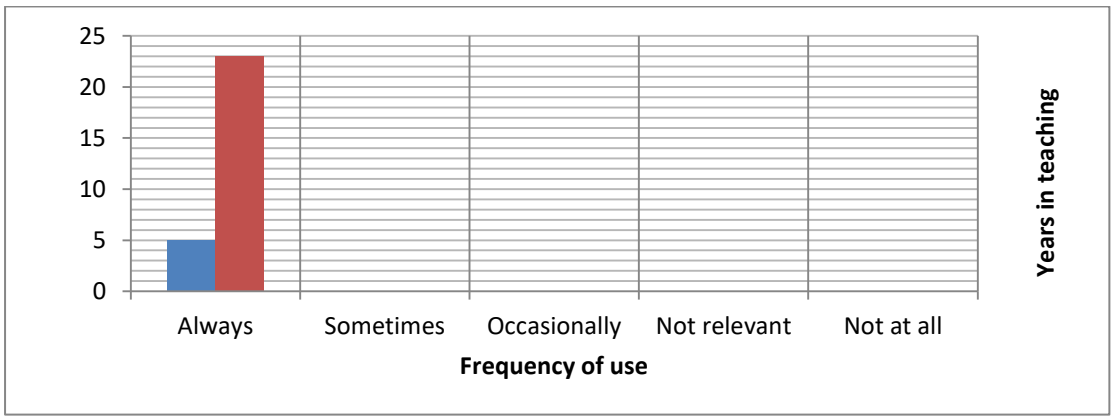

Figure 1 (d): Questionnaire on how teachers use mathematics textbooks (Teachers with a certificate)

The graph shows only two out of a total of three teachers with a certificate as their highest qualification in mathematics. These two of teachers, the one with 5 years' experience in teaching and the one with 23 years' experience always use a textbook(s) for learners' homework. The third one with 25 years did not comment on her/ his use of textbook usage for homework.

Table 8 (b): Questionnaire on how teachers use mathematics textbooks (Teachers with a diploma)

Teachers with a diploma in mathematics: 10 Teachers												
		Years teaching mathematics										
Teacher (Tn)		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	**Total**
Questions on use of textbook	**Extent of textbook usage**	**2**	**10**	**10**	**11**	**20**	**22**	**26**	**26**	**31**		
I use a textbook to prepare mathematics lessons	Always			✓	✓		✓	✓	✓		✓	**6**
	Sometimes					✓				✓		**2**
	Occasionally											
	Not relevant											
	Not at all											
I use a textbook to teach mathematics lessons	Always	✓	✓		✓	✓	✓	✓	✓		✓	**8**
	Sometimes			✓						✓		**2**
	Occasionally											
	Not relevant											
	Not at all											
I use a textbook to assess learners	Always		✓		✓	✓		✓	✓		✓	**6**
	Sometimes	✓		✓						✓		**3**
	Occasionally						✓					**1**
	Not relevant											
	Not at all											
I use a textbook for mathematics homework	Always				✓	✓	✓	✓		✓	✓	**6**
	Sometimes		✓	✓								**2**
	Occasionally											
	Not relevant											
	Not at all											

The shading in column 3, 4, 10 and 12 indicates that teacher number 1, number 2, number 9 and number 10 neither gave an answer nor made any comment on the question. For instance, teacher number 10 who indicated that he/she always uses a textbook for lesson preparations, teaching, assessment and homework did not indicate his/her years of teaching experience.

Graphical representations of teachers with diploma in mathematics:

Note: n means number of teachers

Textbook usage for lesson preparation: $n = 10$

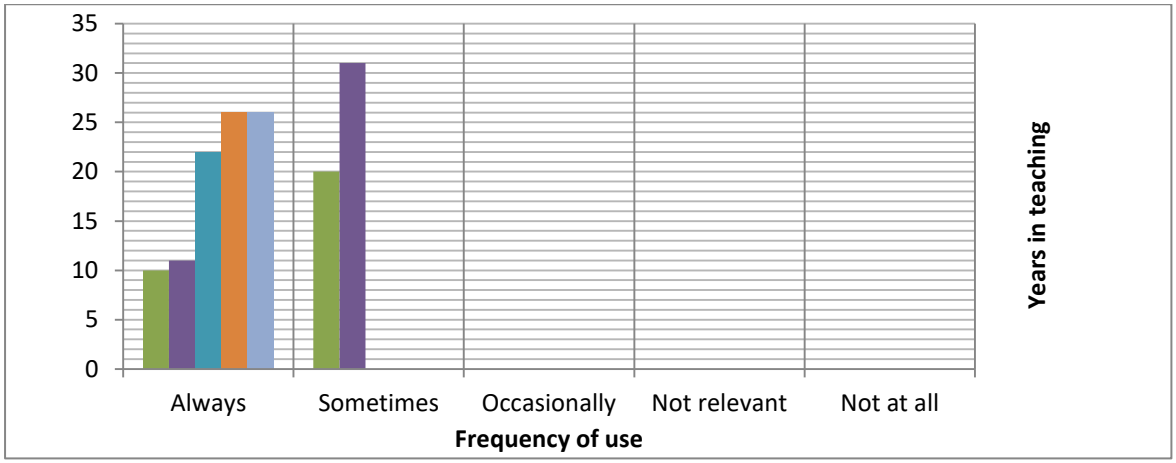

Figure 2 (a): Questionnaire on how teachers use mathematics textbooks (Teachers with a diploma)

The graph shows only 7 out of a total of 10 teachers with a diploma as their highest qualification in mathematics. Five of them always use a textbook(s) when preparing their mathematics lessons. In addition to these five, there is one who also indicated that he/she always uses a textbook when preparing lessons. The graph could not capture him/her because he/she did not reveal his/her years of teaching experience. Therefore a total of six indicated that they always use a textbook when preparing their mathematics lessons. The years of teaching experience for the five are 10, 11, 22 and two with 26 years teaching experience. Two teachers with 20 and 31 years' experience respectively, indicated that they use a textbook(s) sometimes when preparing their mathematics lessons. The other two teachers, one with 2 years' teaching experience and the other with 10 years' teaching experience did not respond to the question on lesson preparation.

Textbook usage for teaching mathematics lessons: $n = 10$

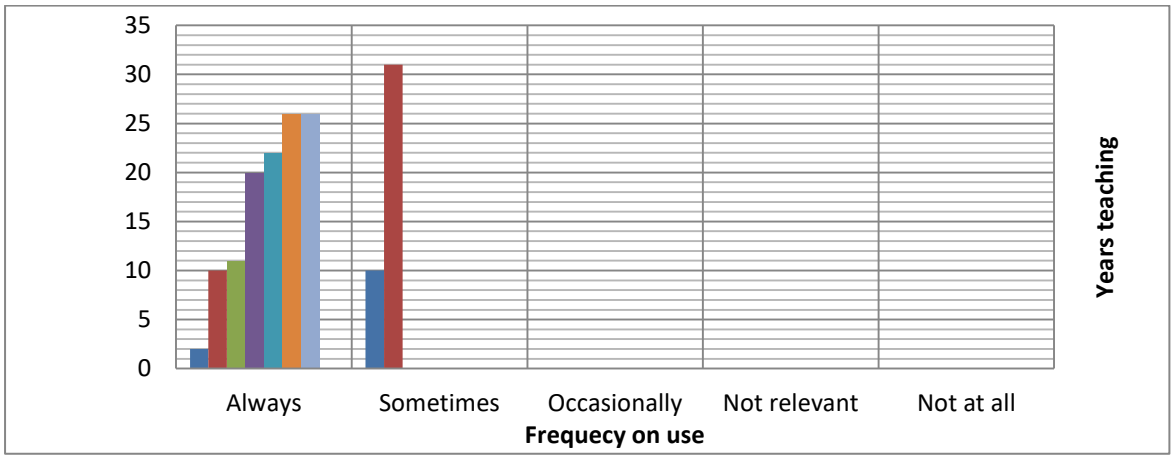

Figure 2 (b): Questionnaire on how teachers use mathematics textbooks (Teachers with a diploma)

The graph shows only 9 out of a total of 10 teachers with a diploma as their highest qualification in mathematics. Seven of them always use a textbook(s) when teaching their mathematics lessons. In addition to these seven the same teacher who did not indicate his/her years of teaching experience in the question on lesson preparation also indicated that he/she always uses a textbook when teaching lessons. The graph could not capture him/her since he/she did not reveal his/her years of teaching experience. Therefore a total of eight indicated that they always use a textbook when teaching their mathematics lessons. The years of teaching experience for the five are 2, 10, 11, 20, 22 and two with 26 years teaching experience. Two teachers with 10 and 31 years' experience respectively, indicated that they use a textbook(s) sometimes when teaching their mathematics lessons.

Textbook usage for assessment: $n = 10$

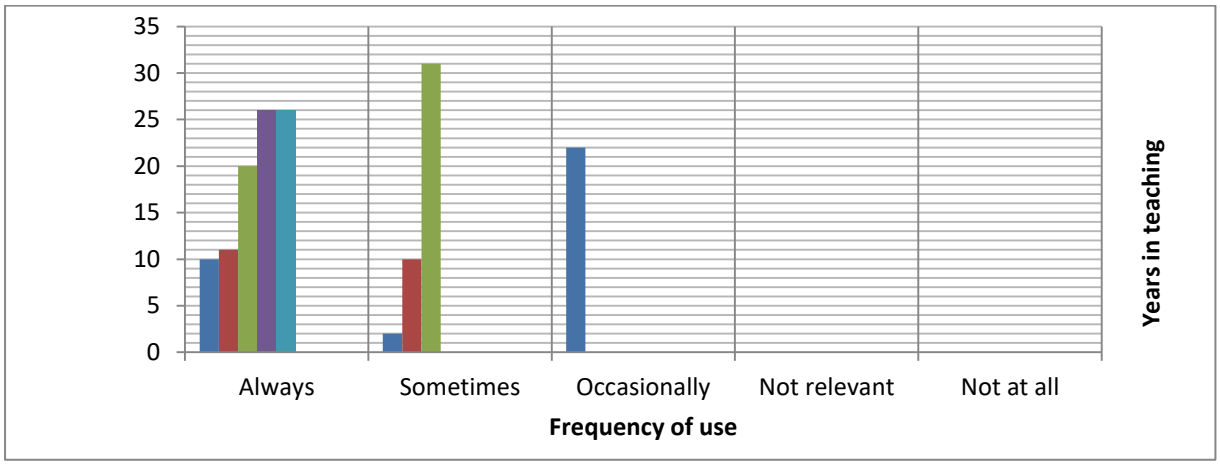

Figure 2 (c): Questionnaire on how teachers use mathematics textbooks (Teachers with a diploma)

The graph shows only 9 out of a total of 10 teachers with a diploma as their highest qualification in mathematics. Five of them always use a textbook(s) when assessing learners. In addition to these five the same teacher who did not indicate his/her years of teaching experience in the question on lesson preparation and teaching of mathematics lessons, also indicated that he/she always uses a textbook when assessing learners. The graph could not capture him/her since he/she did not reveal his/her years of teaching experience. Therefore a total of six indicated that they always use a textbook when teaching their mathematics lessons. The years of teaching experience for the five are 10, 11, 20 and two with 26 years teaching experience. Three teachers with 2, 10 and 31 years' experience respectively, indicated that they use a textbook(s) sometimes when teaching their mathematics lessons. The one with 22 years teaching experience uses the textbook occasionally when assessing learners.

Textbook usage for homework: $n = 10$

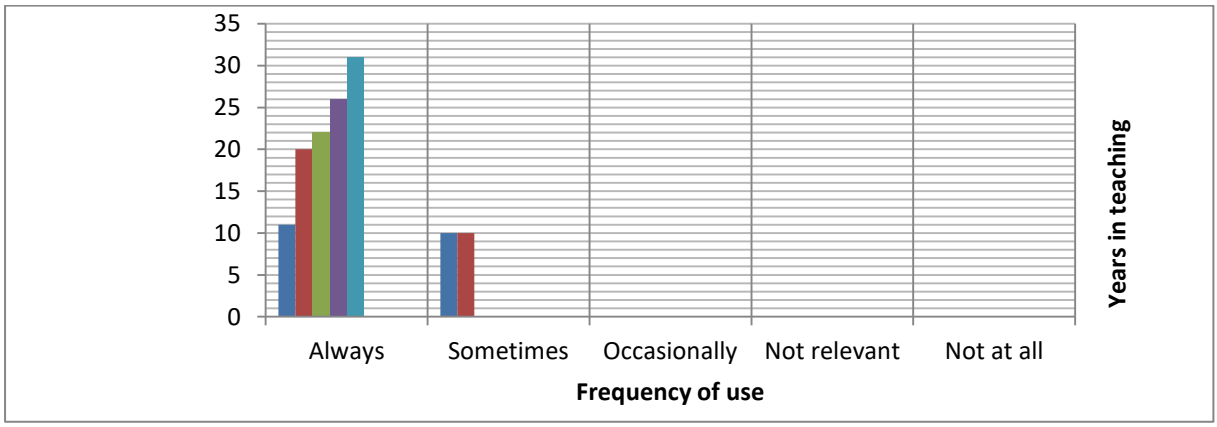

Figure 2 (d): Questionnaire on how teachers use mathematics textbooks (Teachers with a diploma)

The graph shows only 7 out of a total of 10 teachers with a diploma as their highest qualification in mathematics. Five of them always use a textbook(s) for homework. In addition to these five the same teacher who did not indicate his/her years of teaching experience in other components also indicated that he/she always uses a textbook for homework. The graph could not capture him/her since he/she did not reveal his/her years of teaching experience. Therefore a total of six indicated that they always use a textbook. The years of teaching experience for the five are 11, 20, 22, 26 and 31. Two teachers both with 10 years' experience indicated that they use a textbook(s) sometimes for homework. The last two, one with 2 years' and the other 26 years' teaching experience, did not comment on the use of textbooks for homework.

Table 8 (c): Questionnaire on how teachers use mathematics textbooks (Teachers with a degree)

Teachers with a degree in mathematics: 14 Teachers															
		Years teaching mathematics													
Teacher (Tn)		**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	
Questions on use of textbook	**Extent of textbook usage**	**< 1**	**2**	**2**	**2**	**5**	**7**	**8**	**14**	**15**	**18**	**18**	**20**	**23**		**Total**
I use a textbook to prepare mathematics lessons	Always	✓	✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	**11**
	Sometimes			✓							✓					**2**
	Occasionally					✓										**1**
	Not relevant															
	Not at all															
I use a textbook to teach mathematics lessons	Always	✓	✓		✓		✓					✓				**5**
	Sometimes							✓	✓		✓		✓	✓	✓	**6**
	Occasionally			✓		✓										**2**
	Not relevant															
	Not at all									✓						**1**
I use a textbook to assess learners	Always				✓		✓		✓				✓		✓	**5**
	Sometimes	✓	✓	✓				✓		✓	✓					**6**
	Occasionally					✓						✓		✓		**3**
	Not relevant															
	Not at all															
I use a textbook for mathematics homework	Always				✓		✓				✓	✓		✓	✓	**6**
	Sometimes	✓	✓					✓		✓			✓			**5**
	Occasionally					✓			✓							**2**
	Not relevant															
	Not at all			✓												**1**

The shading in columns 7, 9 and 15 indicates that teacher number 5, 7 and 13 also participated in the class observations and subsequent interviews. The other shading in column 16 indicates that the teacher not reveal his/her number of years teaching.

Graphical representations of teachers with a degree in mathematics

Textbook usage for lesson preparation: $n = 14$

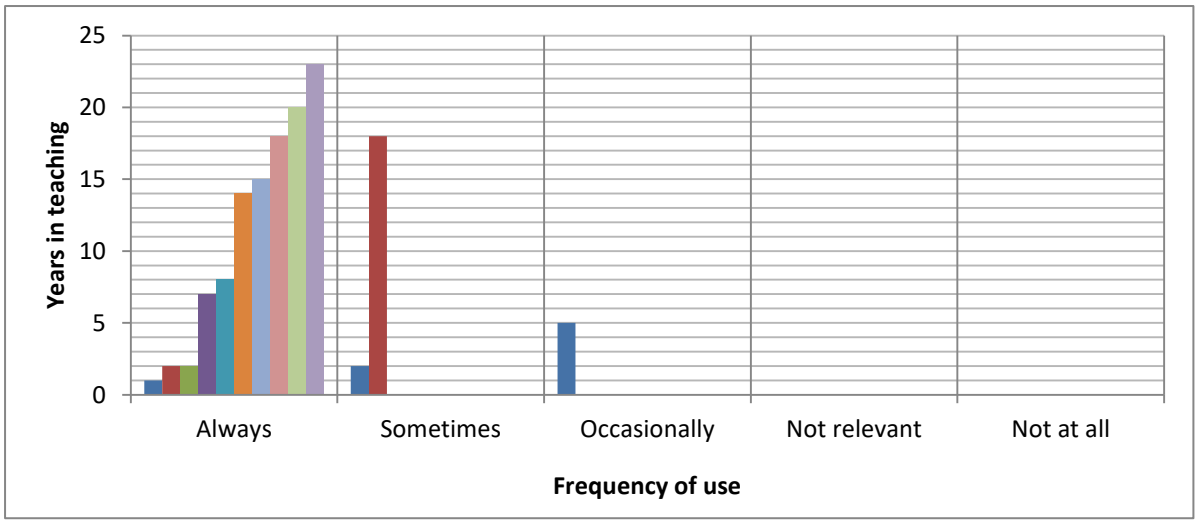

Figure 3 (a): Questionnaire on how teachers use mathematics textbooks (Teachers with a degree)

The graph shows only 13 out of a total of 14 teachers with a degree as their highest qualification in mathematics. Ten of them always use a textbook(s) preparing their mathematics lessons. The years of teaching experience for the eleven are 1, 2, 2, 7, 8, 14, 15, 18, 20 and 23. In addition to these ten teachers, one teacher who did not indicate his/her years of teaching experience indicated that he/she always uses a textbook when preparing mathematics lessons. The graph could not capture him/her since he/she did not reveal his/her years of teaching experience. Two teachers with 2 and 18 years' experience respectively, indicated that they use a textbook(s) sometimes when preparing their mathematics lessons. One with 5 years teaching experience indicated that he or she uses a textbook occasionally when preparing his or her mathematics lessons.

Textbook usage for teaching mathematics lessons: $n = 14$

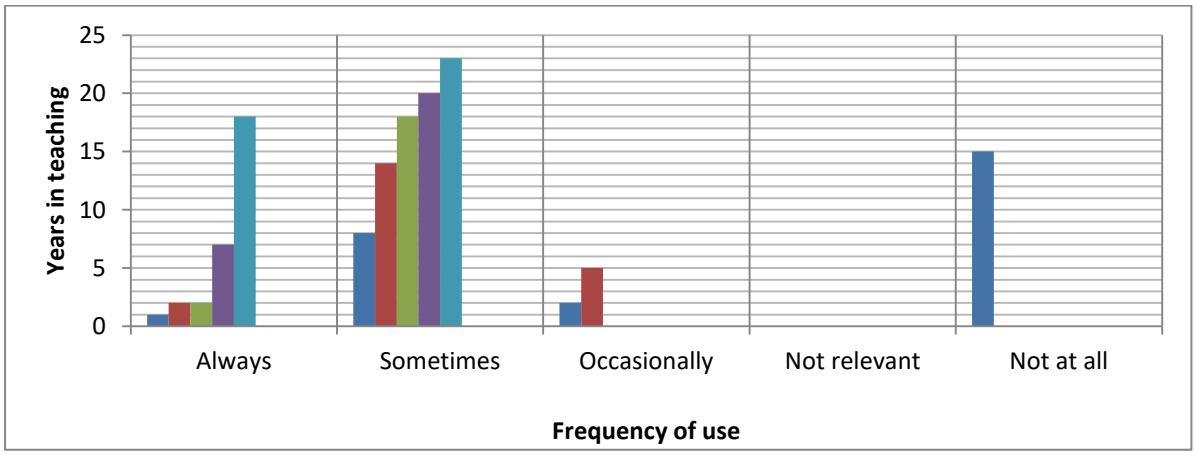

Figure 3 (b): Questionnaire on how teachers use mathematics textbooks (Teachers with a degree)

The graph shows only 13 out of a total of 14 teachers with a degree as their highest qualification in mathematics. Five of them always use a textbook(s) when teaching their mathematics lessons. The years of teaching experience for the five are 1, 2, 2, 7 and 18. A total of six teachers use a textbook sometimes when teaching their mathematics lessons. One of these six could not be captured on the graph since he or she did not indicate his/her years of teaching experience. The years of teaching experiences for the five are 8, 14, 18, 20 and 23. Two teachers with 2 and 5 years' experience respectively, indicated that they use a textbook(s) occasionally when teaching their mathematics lessons. One indicated that he or she does not use a textbook at all when teaching mathematics.

Textbook usage for assessing: $n = 14$

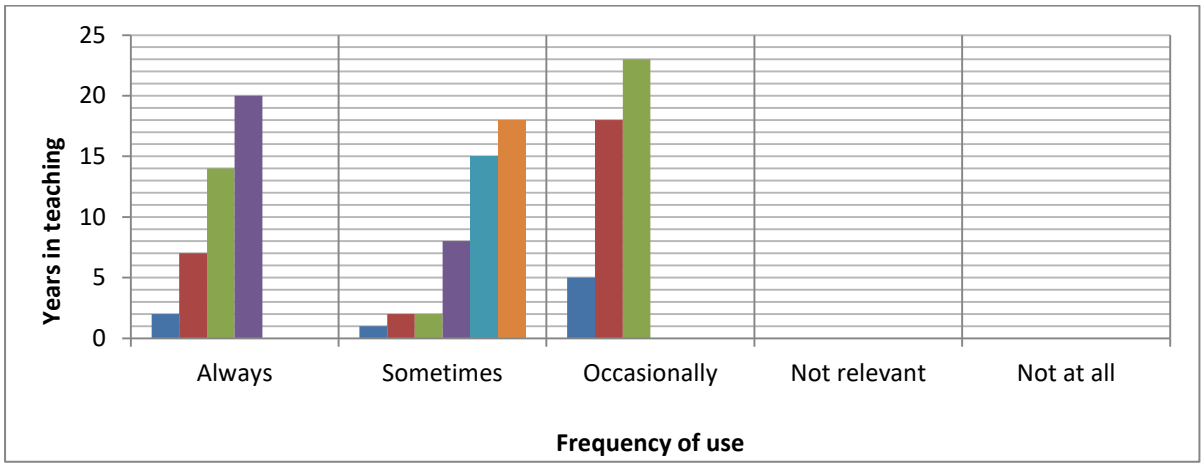

Figure 3 (c): Questionnaire on how teachers use mathematics textbooks (Teachers with a degree)

The graph shows only 13 out of a total of 14 teachers with a degree as their highest qualification in mathematics. Four of them always use a textbook(s) when assessing learners. The years of teaching experience for the four are 2, 7, 14 and 20. In addition to these four one teacher who did not indicate his/her years of teaching experience indicated that he/she also uses a textbook always when assessing learners. Six teachers indicated that they use a textbook(s) sometimes when preparing their mathematics lessons. Their years of teaching experience are 1, 2, 2, 8, 15 and 18. Three indicated that they use a textbook occasionally when assessing learners. Their years of teaching experience are 5, 18 and 23.

Textbook usage for homework: $n = 14$

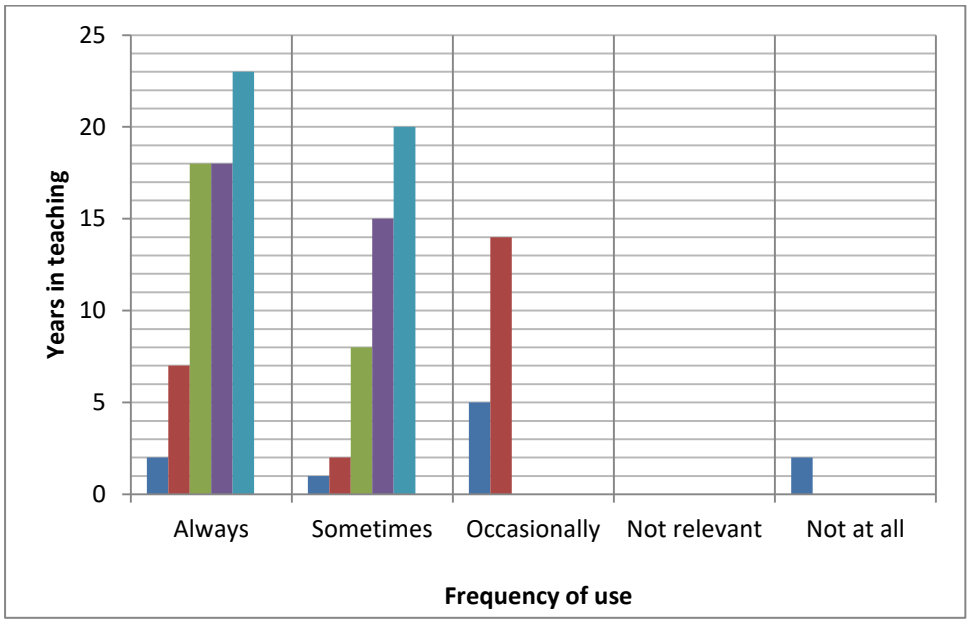

Figure 3 (d): Questionnaire on how teachers use mathematics textbooks (Teachers with a degree)

The graph shows only13 out of a total of 14 teachers with a degree as their highest qualification in mathematics. Five of them always use a textbook(s) when assigning homework. The years of teaching experience for the five are 2, 7, 18, 18 and 23. In addition to these five one teacher who did not indicate his/her years of teaching experience indicated that he/she also uses a textbook always for homework. A total of five teachers use a textbook sometimes for homework. Their years of teaching experiences are 1, 2, 8, 1 and 20. Two teachers with 5 and 14 years' experience respectively, indicated that they use a textbook(s) occasionally for homework. One teacher indicated that he or she does not use a textbook at all for homework.

Table 8 (d): Questionnaire on how teachers use mathematics textbooks
(Teachers with a post graduate degree in mathematics)

Teachers with a post graduate degree in mathematics: 05 Teachers							
		Years teaching mathematics					
Teacher (Tn)		T1	T2	T3	T4	T5	**Total**
Questions on use of textbook	**Extent of textbook usage**	**4**	**14**	**18**	**19**	**20**	
I use a textbook to prepare mathematics lessons	Always	✓	✓	✓		✓	**4**
	Sometimes				✓		**1**
	Occasionally						
	Not relevant						
	Not at all						
I use a textbook to teach mathematics lessons	Always	✓	✓	✓		✓	**4**
	Sometimes				✓		**1**
	Occasionally						
	Not relevant						
	Not at all						
I use a textbook to assess learners	Always	✓		✓	✓	✓	**4**
	Sometimes		✓				**1**
	Occasionally						
	Not relevant						
	Not at all						
I use a textbook for mathematics homework	Always	✓	✓	✓	✓	✓	**5**
	Sometimes						
	Occasionally						
	Not relevant						
	Not at all						

The shading in column 6 indicates that teacher number 4 also participated in the class observations and subsequent interviews.

Graphical representations of teachers with post graduate degree in mathematics.

Textbook usage for lesson preparation: $n = 5$

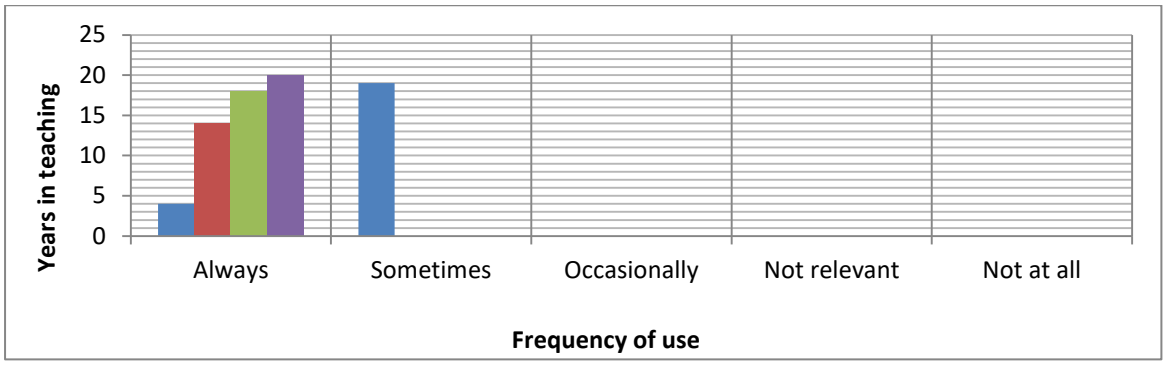

Figure 4 (a): Questionnaire on how teachers use mathematics textbooks (Teachers with a post graduate degree in mathematics)

The graph shows that out of a total of five teachers with a post graduate degree as their highest qualification in mathematics, four of them always use a textbook(s) when preparing their mathematics lessons. The years of teaching experience for the four are 4, 14, 18 and 20. One teacher with 19 teaching years' experience indicated that he/she uses a textbook(s) sometimes when preparing mathematics lessons.

Textbook usage for teaching: $n = 5$

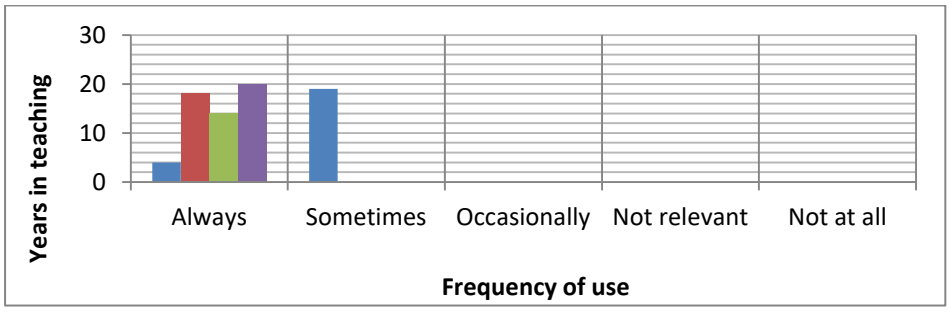

Figure 4 (b): Questionnaire on how teachers use mathematics textbooks (Teachers with a post graduate degree in mathematics)

The second graph shows that out of a total of five teachers with a post graduate degree as their highest qualification in mathematics, the same four who indicated that they always use a textbook(s) when preparing their lessons, they also use a textbook always when teaching their mathematics lessons. The years of teaching experience for the four are 4, 14, 18 and 20. The one with 19 teaching years' experience indicated that he/she uses a textbook(s) sometimes when teaching mathematics lessons. This is the same teacher who indicated that he/she uses a textbook sometimes when preparing mathematics lessons.

Textbook usage for assessment: $n = 5$

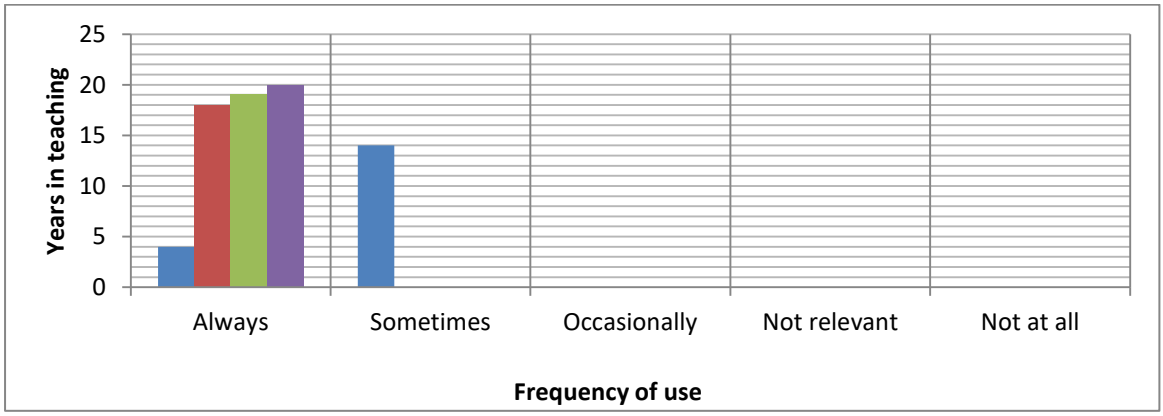

Figure 4 (c): Questionnaire on how teachers use mathematics textbooks
(Teachers with a post graduate degree in mathematics)

The graph shows that out of a total of five teachers with a post graduate degree as their highest qualification in mathematics, four of them always use a textbook(s) when assessing learners. The years of teaching experience for the four are 4, 19, 18 and 20. One teacher with 14 teaching years' experience indicated that he/she uses a textbook(s) sometimes when assessing learners.

Textbook usage for homework: $n = 5$

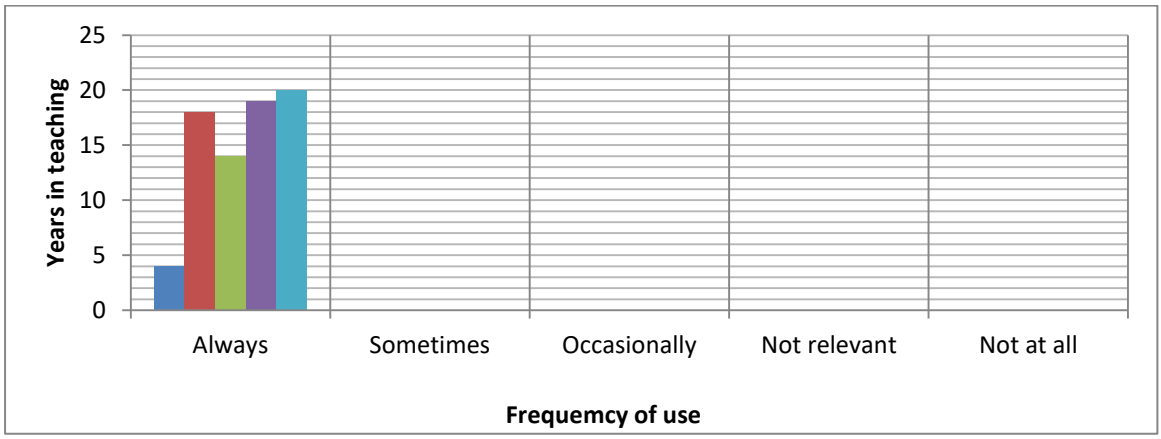

Figure 4 (d): Questionnaire on how teachers use mathematics textbooks
(Teachers with a post graduate degree in mathematics)

The graph shows that all five teachers with a post graduate degree as their highest qualification in mathematics always use a textbook for homework. The years of teaching experience for the four are 4, 14, 18, 19 and 20.

Table 8 (e): Questionnaire on how teachers use mathematics textbooks
(Teachers with no special qualification in mathematics)

Teachers with no special qualification in mathematics: 2 Teachers				
		Years teaching mathematics		**Total**
Teacher (Tn)		T1	T2	
Questions on use of textbook	**Extent of textbook usage**	**8**	**23**	
I use a textbook to prepare mathematics lessons	Always	✓		**1**
	Sometimes			
	Occasionally			
	Not relevant			
	Not at all			
I use a textbook to teach mathematics lessons	Always	✓	✓	**2**
	Sometimes			
	Occasionally			
	Not relevant			
	Not at all			
I use a textbook to assess learners	Always			
	Sometimes	✓	✓	**2**
	Occasionally			
	Not relevant			
	Not at all			
I use a textbook for mathematics homework	Always	✓	✓	**2**
	Sometimes			
	Occasionally			
	Not relevant			
	Not at all			

The shaded region in column 4 indicates that teacher number 2 neither gave an answer nor made any comment on the question.

Graphical representations of teachers with no special qualification in mathematics.

Textbook usage for lesson preparation: $n = 2$

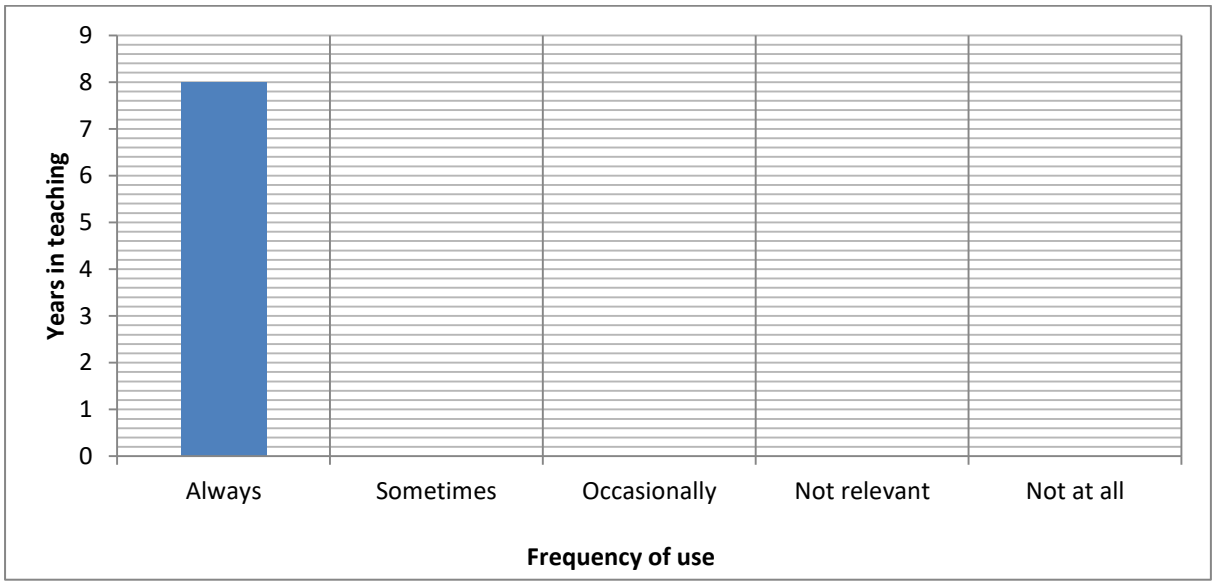

Figure 5 (a): Questionnaire on how teachers use mathematics textbooks
(Teachers with no special qualification in mathematics)

The graph shows only 1 out of a total of 2 teachers with no special qualification in mathematics. This one teacher with 8 years' experience in teaching always use a textbook when preparing his/her mathematics lessons. The second one with 23 years' teaching experience did not comment on the use of textbook for lesson preparation.

Textbook usage for teaching mathematics lessons: $n = 2$

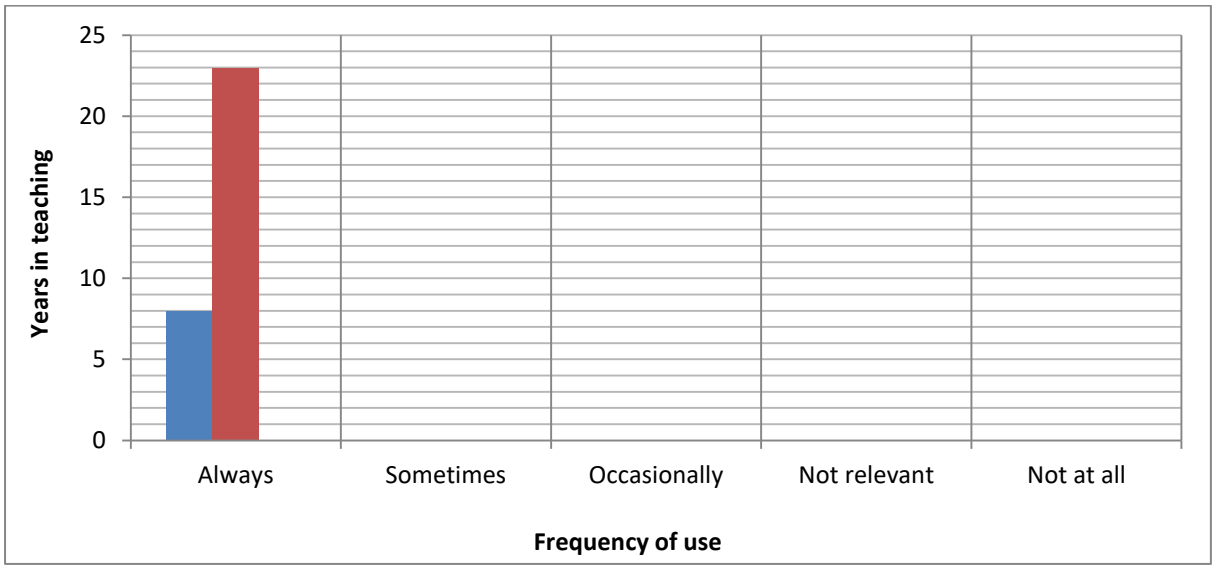

Figure 5 (b): Questionnaire on how teachers use mathematics textbooks
(Teachers with no special qualification in mathematics)

The graph shows that both teachers with 8 and 23 years teaching experience respectively and with no special qualification in mathematics always use a textbook when teaching their mathematics lessons.

Textbook usage for assessment: $n = 2$

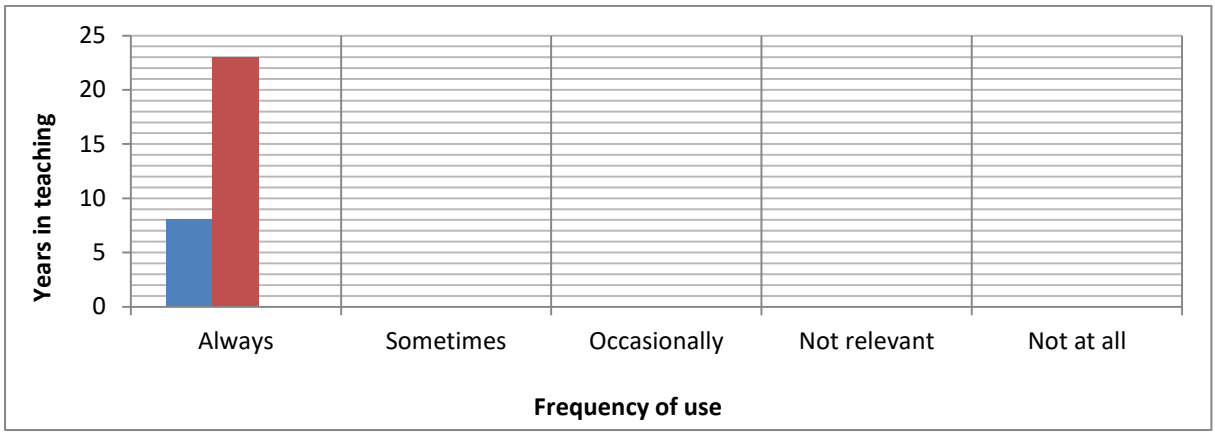

Figure 5 (c): Questionnaire on how teachers use mathematics textbooks
(Teachers with no special qualification in mathematics)

The graph shows that both teachers with 8 and 23 years teaching experience respectively and with no special qualification in mathematics always use a textbook when assessing their learners.

Textbook usage for homework: $n = 2$

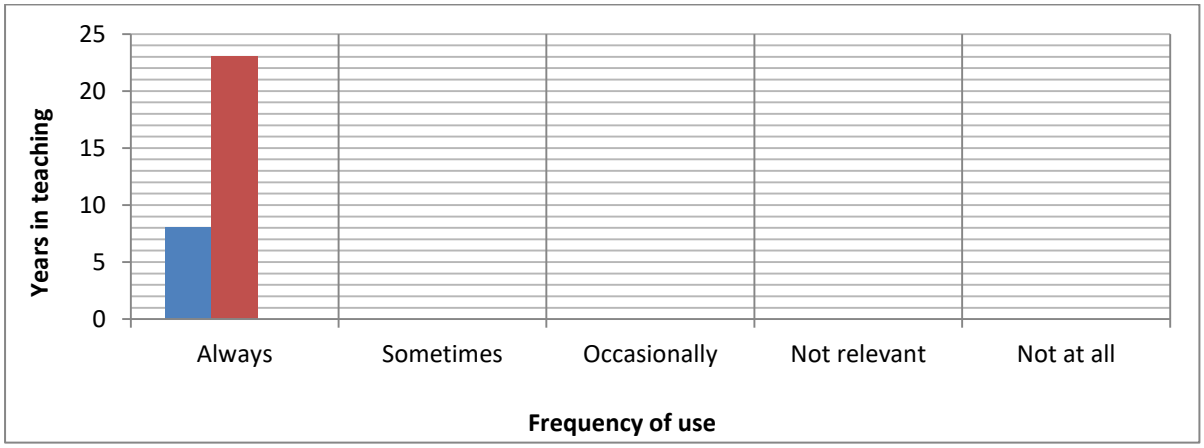

Figure 5 (d): Questionnaire on how teachers use mathematics textbooks
(Teachers with no special qualification in mathematics)

The graph shows that both teachers with 8 and 23 years teaching experience respectively and with no special qualification in mathematics always use a textbook for homework.

Composite Graphs

Each graph below represents a particular use of textbooks by all 34 teachers across all the five categories, i.e. those with a certificate as the highest qualification in maths, those who have a diploma and so on.

Lesson Preparation: $n = 34$

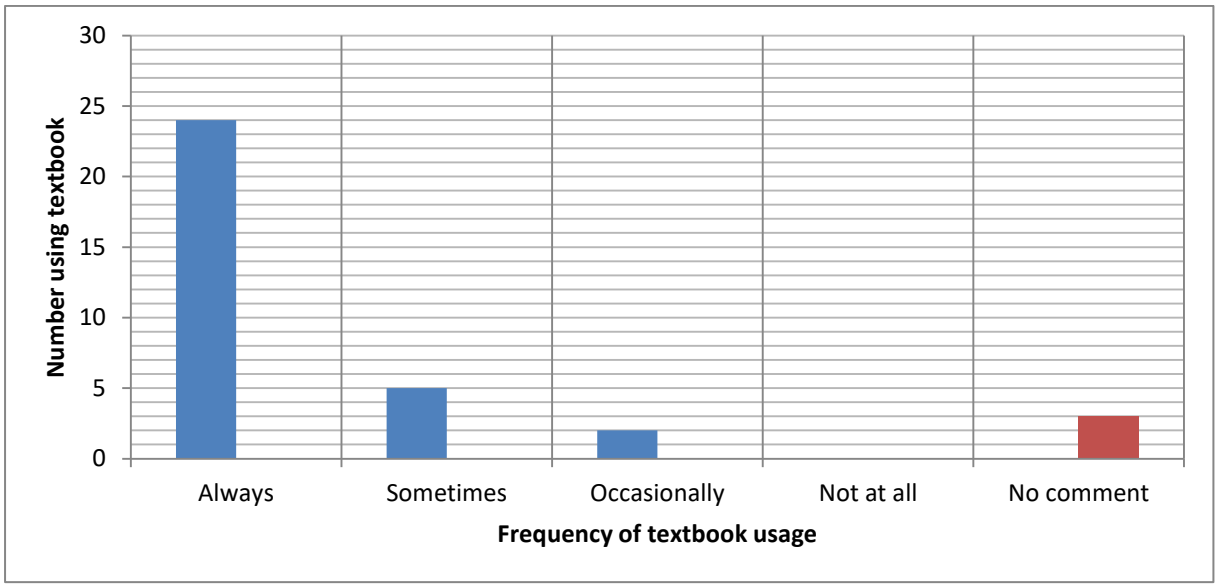

Figure 6 (a): Textbook use for lesson preparation

Always

A total of twenty-four out of 34 teachers who participated in the survey indicated that they always use a textbook when preparing their mathematics lessons. This is 70,6% of all teachers.

Sometimes

A total of five out of 34 teachers who participated in the survey indicated that they sometimes use a textbook when preparing their mathematics lessons. This is 14,7% of all teachers.

Occasionally

A total of two out of 34 teachers who participated in the survey indicated that they occasionally use a textbook when preparing their mathematics lessons. This is 5,9% of all teachers.

Not at all

No one out of all 34 teachers who participated in the survey indicated that they do not at all use a textbook when preparing their mathematics lessons. This is 0% of all 34 teachers who participated in the survey.

No comment

A total of three out of all 34 teachers who participated in the survey did not comment or did not answer the question on the use of textbook for lesson preparations. This is 8,8**%** of all teachers who participated in the survey.

Teaching lessons: $\boldsymbol{n = 34}$

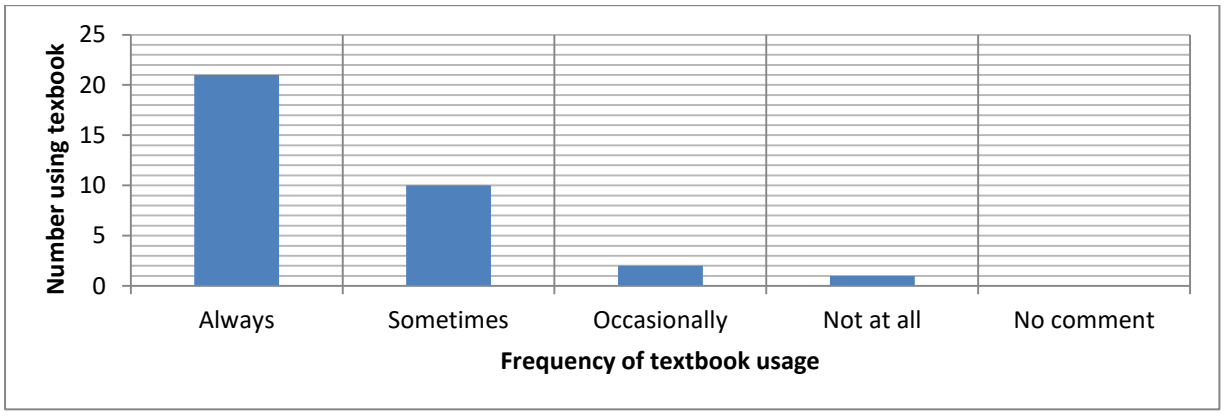

Figure 6 (b): Textbook use for teaching lessons

Always

A total of twenty-one out of 34 teachers who participated in the survey indicated that they always use a textbook when teaching mathematics lessons. This is 61,8% of all teachers.

Sometimes

A total of nine out of 34 teachers who participated in the survey indicated that they sometimes use a textbook when teaching mathematics lessons. This is 26,5% of all teachers.

Occasionally

A total of three out of 34 teachers who participated in the survey indicated that they sometimes use a textbook when teaching mathematics lessons. This is 8,8% of all teachers.

Not at all

Only one teacher, one of those with a degree in mathematics, out of the whole 34 teachers indicated that he/she does not at all use a textbook when teaching mathematics. This is 2,9% of all 34 teachers who participated in the survey.

Assessment: $\boldsymbol{n = 34}$

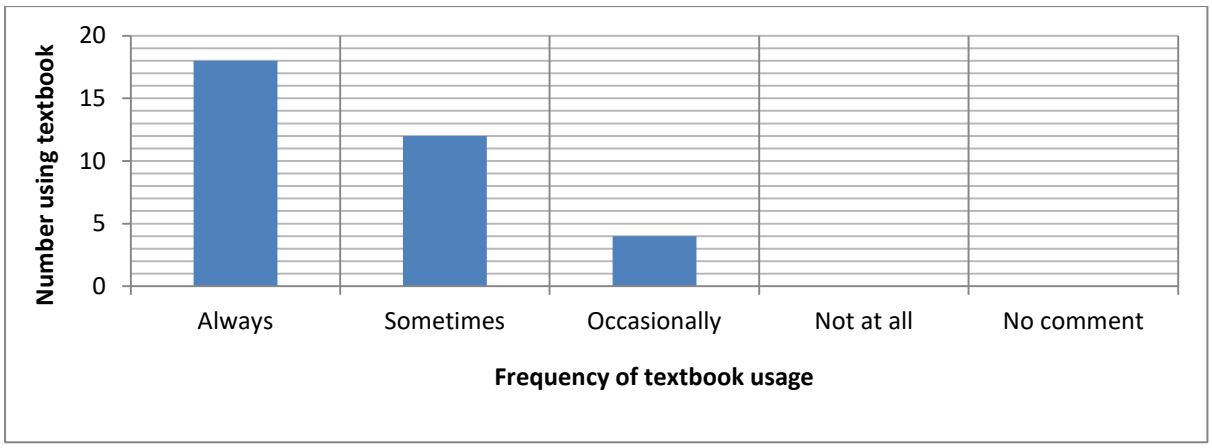

Figure 6 (c): Textbook for assessment

Always

A total of fourteen out of 34 teachers who participated in the survey indicated that they always use a textbook when assessing learners. This is 41,2% of all teachers.

Sometimes

A total of twelve out of 34 teachers who participated in the survey indicated that they sometimes use a textbook when assessing learners. This is 35,3% of all teachers.

Occasionally

A total of four out of 34 teachers who participated in the survey indicated that they occasionally use a textbook when assessing learners. This is 11,8% of all teachers.

Not at all

No one out of all 34 teachers who participated in the survey indicated that they do not at all use a textbook for assessment. This is 0% of all 34 teachers.

Homework: $\boldsymbol{n = 34}$

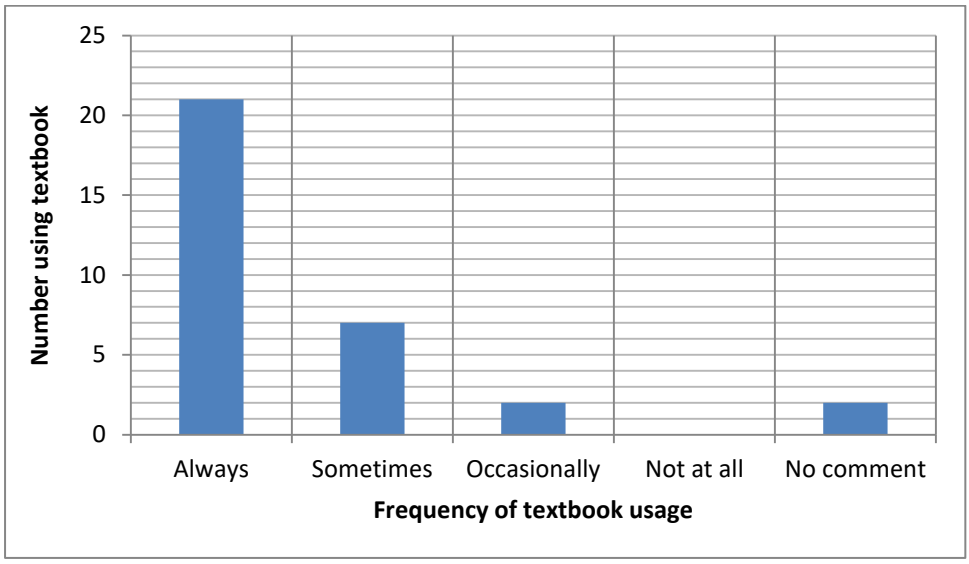

Figure 6(d): Textbook use for homework

Always

A total of twenty one out of 34 teachers who participated in the survey indicated that they always use a textbook for homework. This is 61,8% of all teachers.

Sometimes

A total of seven out of 34 teachers who participated in the survey indicated that they sometimes use a textbook for homework. This is 20,6% of all teachers.

Occasionally

A total of two out of 34 teachers who participated in the survey indicated that they occasionally use a textbook for homework. This is 5,9% of all teachers.

Not at all

Out of a total of 34 teachers, only one teacher with a degree in mathematics indicated that he/she does not at all use a textbook for homework. This is 2,9% of all teachers.

No comment

A total of two teachers did not comment on their use of textbook for homework. This is 5,9**%** of all the teachers.

Discussion

Table 9: A summary of the use of textbooks by all 34 teachers.

	Always	Sometimes	Occasionally	Not at all	No comment
Lesson Preparation	70,6%	14,7%	5,9%	0%	8,8%
Teaching	60%	25,7%	8,6%	2,9%	0%
Assessing	40%	34,3%	11,4%	0%	0%
Homework	60%	20%	5,7%	2,9%	0%

Table 9 above gives a summary of the individual teachers' extent of reliance or non-reliance on a textbook at different stages of their teaching as reflected in the four graphs above. The last two columns of the table show a minute almost insignificant number of teachers who show no interest in using a textbook for their mathematics instruction. Focus will be on the teachers who indicated that they use a textbook for the four stages of their instruction; namely lesson preparation, teaching, assessing and homework.

A large percentage of teachers (57,6%) as reflected in the table indicated that they always use a textbook for all four stages. A handful (23,7%) indicated that they use a textbook sometimes for all the four stages. This may be an indication that a textbook is an alternative resource to a primary resource or a number of other resources used. In this case, a textbook could be viewed as a supplementary resource. A very small number (7,9%) indicated they a textbook occasionally. The assumption here may be that a textbook is only used as a reference. A total of 9,3% of the respondents indicated that they do not at all use any textbook in their teaching of mathematics.

Two other statements about what the twenty graphs show can be made. Firstly, the graphs show that an individual's qualification in mathematics does not necessary

dictate how an individual uses a textbook. Secondly, they show that the individual's experience has no bearing on their use of a textbook.

What is evident from the information displayed in the graphs above is that indeed, as Nicol and Crespo (2006) puts it, teachers use textbooks differently in their teaching of mathematics (Nicol and Crespo, 2006).This data comes from a sample of 34 teachers and cannot be generalised. However, it would be useful to use this questionnaire on a much bigger scale.

Analysis of data from the observations of lessons' transcripts

A total of four teachers from the 34 who responded to the survey also participated in the class observations and were subsequently interviewed about their lessons. The table below captures their individual academic and professional qualifications and number of years' teaching experiences and their responses in the survey. It is worth noting that in this study, qualification and years of experience may not necessarily determine how an individual uses a textbook. This is in contrast to findings of Nicol & Crespo.

Teachers' qualifications in mathematics, their number of years' teaching experiences and their responses in the survey

Table 10: Academic profiles of the four teachers and their responses

Name of teacher	Qualifications	Teaching experience in years	Textbook usage for lesson preparation	Textbook usage for teaching	Textbook usage for assessing	Textbook usage for homework
Teacher 1	Degree	5	Occasionally	Occasionally	Occasionally	Occasionally
Teacher 2	Degree	8	Always	Sometimes	Sometimes	Sometimes
Teacher 4	PG Degree	19	Sometimes	Sometimes	Always	Always
Teacher 3	Degree	23	Always	Sometimes	Occasionally	Always

The four teachers in Table 10 above were observed while teaching. Each lesson was audio-taped. Their lessons range from 40 minutes to an hour each in length. In the survey as evident in Table 9, all these teachers indicated that they use textbooks in their teaching of mathematics. A clear distinction can be seen from the table on how each one uses a textbook.

A lesson observation protocol together with a checklist matrix indicating different aspects of focus in each lesson were used in all lessons observed. As mentioned earlier in Chapter 3 these two were used to record specific elements in each lesson for the enhancement of collected data. What follows below are extracts of transcripts from some of the lessons observed. Full transcripts for all lessons are contained in Annexure F.

It must be noted that none of the teachers observed had their lesson preparations with them. Whether they prepare lessons and how they prepare lessons if they did could not be verified. Therefore nothing will be said about lesson preparation in the analysis of the classroom observations.

Teacher 1's lessons

Lesson 1

Description of Lesson 1

Teacher 1's first lesson was on transformation geometry. The focus of this 40 minutes lesson was on 90^{o} rotation of a geometric shape. A total of 29 learners took part in this lesson. The teacher demonstrated the rotation of a geometric shape on the chalkboard (Definition of concepts and Example 1). Learners were not necessarily working on paper or anything to emulate the teacher but were focusing on what the teacher was doing and trying to memorise all the steps. After the demonstration, learners were given an exercise (Exercise 1) to work on after which they were given homework. Learners were referred to a textbook but at the same time asked to give feedback on the exercise. Therefore learners did not have a chance to look into the textbook (workbook) because the teacher asked them to

focus on the chalkboard where one of their peers was giving feedback to the rest of the class on how he worked out the answer to the exercise.

Definition of concepts

The definition of concept 1, rotation, was not clearly spelled out. Instead, an explanation of the procedure to be followed when rotating a geometric shape was given to the learners by the teacher. It appears like learners had already been introduced to the concept of rotation of a geometric shape.

[1]	Teacher:	So what we going to do we going to do rotation, (inaudible)… we going to rotate clockwise or anticlockwise niyangizwa (do you understand me)?
[2]	Learners:	Yes
[3]	Teacher:	When you rotate clockwise or anticlockwise what do you use? What do you use to measure (inaudible) Uh?
[4]	Learner 1:	A protractor.
[7]	Teacher:	A protractor, thank you. Why do you make noise?

a) Resource used

The explanation about the concept was done on own understanding without using or referring to any textbook.

b) Time taken

A total of 8 minutes out of 40 minutes of the lesson (**20%**) was spent explaining what the lesson is all about without using a textbook.

Example 1

Before starting with the lesson the example was already written on the chalkboard. The teacher went through the whole process of rotating a triangle clockwise at an angle of $90°$until the drawing of the image of the rotated triangle.

[8]	Teacher:	So we having ∆ABC, so we going …, when rotating, is either you rotate clockwise or anticlockwise, if you look at my protractor, if I will be, if I will be rotating clockwise in my protractor you don't write down	(*inaudible as she demonstrate on the chalkboard*)
[9]	Teacher:	If I will be rotating clockwise I am .., to use the measurement that's inside and if I will be rotating anticlockwise I use the measurement outside, niya bona (do you see)?	
[10]	Learners:	Yes.	
[18]	Teacher:	Alright, we going to rotate, we start by rotating B. We are going to rotate B 90^0 clockwise, understand?	
[22]	Teacher:	So you take your ruler and join these two points with a dotted line, (demonstrating on the chalkboard), P is the origin and B is a point that you want to rotate …,	
[23]	Teacher:	You draw the line … (*inaudible*), then I take my protractor and going to point B, and this line, a yellow line, do you see this line?	
[25]	Teacher:	It must be in line zero, must be in line zero, so I'm going to move this line rotate it 90^0 clockwise, niyangizwa (do you hear me)?	
[27]	Teacher:	So from zero, 10, 20, 30, 40, 50, 60, 70, 80, 90, and then I join P to the point that has been rotated, dotted line still.	

In this example, the teacher demonstrates to learners how to rotate a triangle around the origin. There was no escalation of questions or steps towards the final product but the whole rotation was done from start to end in one go. Rotating a shape involves a number of steps and skills which must be carried out in a particular sequence. These include among others, identifying a point of reference for measuring an angle, placing or positioning a protractor correctly and locating the position of a corresponding point or side of the required image. The teacher

instructed learners to write down steps to be followed when rotating a shape before starting on their exercise.

a) Resource used

The researcher had an opportunity later in the lesson, as learners were working on their exercise, to find out the source from which the example was taken. The teacher expressed the example as own creation. Therefore no textbook was used for this example.

b) Time taken

This demonstration took 15 minutes (**37,5%**) of the 40 minutes lesson.

c) Cognitive level

The example used by the teacher falls within cognitive level 3, the complex procedure, of the mathematics CAPS Cognitive levels.

Exercise 1

After working on the example on the chalkboard the teacher referred learners to the same triangle she was using on the chalkboard and asked them to rotate the same triangle, only this time 90° anticlockwise. Learners were given an opportunity to work on their own with the teacher intervening where necessary.

[94] Teacher: What I want to…I want you to look at ∆ ABC again. I want you to rotate for your classwork, ∆ ABC 90^0 anticlockwise at the origin. Understand?

[95] Learners: Yes.

[96] Teacher: Are you done? Remember you must start by drawing your Cartesian plane and then when, when you rotating anticlockwise you are using the same Cartesian plane as you do with the example, understand?

[99]	Teacher:	You rotating ∆ ABC anticlockwise to find ∆ A' B' C', understand?	
[100]	Learners:	Yes.	
[102]	Teacher:	You don't know how to use your protractor, you make sure you (inaudible)… your protractor	
[103]	Teacher:	If you don't know how to use your protractor, 'cause I know some of you can't, don't be afraid, come.	
[106]	Teacher:	If you done I want you to take those blue books and look at page 114, when you done.	(*illustrating on the chalkboard*)
[114]	Learners:	Yes.	
[131]	Teacher:	I want us now to look at the example in the textbook. It's page 14…, if you look page 140 … it's says…	(*reading from a textbook*)
[132]	Teacher:	I want you to start from number 1 to number 3… niyezwa?	
[133]	Learners:	Yes.	
[134]	Teacher:	You start from number 1, number 2 to number 3, niyezwa?	
[135]	Learners:	Yes	
[136]	Teacher:	Go	(*Dismiss learners*)

a) Resource used

Just like with her example the teacher did not use a textbook but used the same diagram from her example and only changed the question to rotation anti-clockwise instead of clockwise as in the example.

b) Time taken

Learners were given chance to work on the exercise for 5 minutes (**12,5%**) of the 40 minutes lesson, after which feedback or report back was done on the chalkboard by

one learner with the help of the teacher. The activity on the chalkboard lasted for about 10 minutes (**25%**).

c) Cognitive levels of the questions

The exercise given was on the same cognitive level 3 as the example thereby demanding of the learners the same level of thinking and the same level of conceptual understanding. For a grade 9 learner steps to be followed and skills to master towards the required solution are not obvious.

Breaking the triangle and putting it back together in the image after rotation requires of a learner to have developed a particular level of spatial ability to recognise and understand the concept of congruency and similarity and also the ability to make significant connections between the two figures using the positions of the corresponding sides and vertices. Finding the coordinates of the vertices of the image, working out how the coordinates of the original shape were displaced to the coordinates of the image and determine the rule for rotation require a learner's ability to read the Cartesian plane correctly and to use changes in both the x- coordinates and y-coordinates to make correct generalisations. The teacher took learners through the process of finding the rule for 90^{o} rotations. Being able to generalise in mathematics requires the ability to make correct connections between variables.

As Kilpatrick (1967) puts it being able to create generalizations is one requirement for solving complex mathematical problems (Kilpatrick, 1967 cited in Hatfield & Bradbard, 1978, p. 9). Problem-solving is the fourth and highest level in the modified Bloom's taxonomy as alluded to earlier. Therefore teaching a learner to create a general rule, that is to generalise, is creating opportunities for the learner to develop and to work towards problem-solving skills. Hence the conclusion that the example the teacher did with learners falls within the third cognitive level of the modified Bloom's taxonomy, a level just before problem-solving.

Homework 1

After working with the learner on the report back to the whole class, the teacher chose three homework questions from the learners' DBE workbook. The questions were based on the rotation of geometric figures.

a) Resource used

The teacher referred learners to their DBE workbooks for homework (page 140, nos. 1, 2 and 3), and instructed them to start by looking at the example given in the workbook before attempting their 3 homework questions.

b) Time taken

The homework given to learners would approximately take a learner of average determination 30 minutes to complete.

c) Cognitive level of questions

Just like in the example, questions in the homework were of cognitive level 3.

Teacher 1: Lesson 2

Description of Lesson 2

The teacher's second lesson was on data handling with a focus on collecting and arranging data and calculating measures of central tendency and dispersion. A total of 25 learners took part in the lesson. This was also a 40 minutes lesson. The teacher started by checking the learners' knowledge and levels of understanding of some of the aspects of the concept to be dealt with in the lesson. It appeared from the communication between the teacher and learners that learners might have dealt with the concept before. A demonstration example with learners' participation followed and later in the lesson learners are given an exercise.

Definition of concepts

In this lesson teacher 1 starting by probing the learners' understanding of some aspects of the concept of data collection before giving them definitions from own understanding. The teacher confirmed the definitions by reading definitions given in a textbook.

[1]	Teacher	As we already said, we collect data, we collect information after collecting information, what do we do? We interpret it then come to conclusion, so give me an example where people collect statistics to interpret in time.
[2]	Learner 1	Questionnaire
[3]	Teacher	What are you talking about? I am saying an example whereby people collect information to interpret it in time to come.
[4]	Learner 2	Teenage pregnancy
[5]	Teacher	Teenage pregnancy, yes right
[6]	Learner 3	Ebola
[7]	Teacher	Ebola, yes right
[8]	Learner 4	World population
[9]	Teacher	World population, right
[10]	Learner 5	People using a bus
[11]	Learner 6	People who drop out of school
[23]	Teacher	Who can tell me what is a mode?
[24]	Learner	The value of a number that appears the most
[25]	Teacher	The mode is the value of a number that appears the most. So what is the mean? Let's check if you still remember

a) Resource used

The teacher's own definition and the definition from a textbook were used.

b) Time taken

It took the teacher a total of 10 minutes (**25%**) of the 40 minutes lesson using both own understanding and a textbook to define the concept dealt with in this lesson.

Example 1

In this example, learners were allowed the opportunity to participate. She starts her lesson by asking learners to give examples of scenarios for data collection and engages her learners in the process of data collection using their own individual situations. She eventually came with her own example which she did with learners. The example was on collecting, arranging and analysing data using measures of central tendency on the number of children in learners' households. Everything was done on the chalkboard and learners' inputs and participation were prompted.

[12]	Teacher	I am sure you are not one of those people who drop out. So now we are going to collect data in class. As I asked you before we start by saying those who are the only child. One. If you are two raise up your hand. 1, 2, 3, 4, 5, 6, 7.	(*Learners raise up their hands and the teacher counts the hands and write the number on the chalkboard*)
[13]	Teacher	If you are three. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14. It's fourteen.	(*She is counting the hands and write the number on the chalkboard*)
[15]	Teacher	Then if you are five or more. Okay it's only one.	
[16]	Teacher	So what is my story? Is that after collecting your data, before you do anything you have to find the average of five students in this class. We have to arrange the data in class. So we have five terms right?	

[17] Learners Yes

[18] Teacher So now we have to arrange our data in what? In ascending order, that is from smallest number to the biggest number. So now let's arrange our data

[19] Learners 1, 1, 3, 7, 14

[20] Teacher Thank you. So how many terms do we have?

[21] Learners Five terms

[22] Teacher: Good. Now let's move on up straight to our mean. Sum of the terms let's see, it is 1 + 1 + 3 + 7 + 14 divide by 5. So how many terms do we have?

[23] Learners: 5

a) Resource used

The teacher used her own example to teach the concept of data collection.

b) Time taken

The example was worked on for 20 minutes (**50%**) of the 40 minutes allocated. For this time the teacher did not use or make any reference to a textbook.

c) Cognitive levels of questions

The type of questions she used in her examples can be rated as cognitive level 1 and level 2 of the modified Bloom's taxonomy.

Exercise 1

The questions on this exercise followed from the demonstration example. Learners were asked to calculate mean, median, mode and range of a given data. Learners worked individually with some engaging in quiet discussions.

[61]	Teacher:	I am going to give you two sets of data, then you must find the median, the mean, the mode and the range for all the data. Let's do a quick classwork.	
[63]	Teacher:	'Cause we don't have enough textbooks, we'll copy from the board. Right? What is today's date?	(*writing on the chalkboard*)
[64]	Learners:	13th	
[65]	Teacher:	Given the following data, this data, find the mean, median and mode	(*copying from the textbook and writing on the chalkboard)*

a) Resource used

A textbook was used for the exercise given to learners in this lesson. Since some learners did not have textbooks the teacher was forced to copy the questions on the chalkboard.

b) Time taken

Learners were allowed to work on the exercise for 15 minutes until the end of the period.

c) Cognitive levels of the questions

Level 2 type questions were used for the exercise. Determining or calculating the median and mean of data requires of learners to follow some pre-determined procedures. The procedures to be followed here are not complicated and in time, through practice, they become common knowledge to learners. Therefore to answer this type of questions learners need to follow simple learned procedures which are almost the same for all these types of questions.

Homework 1

Learners were dismissed without homework.

[95]	Teacher:	How many people are not done?	*(Looks around)*
[96]	Teacher:	One. Quick	
[97]	Teacher:	Right, you writing tomorrow	
[98]	Learners:	Yes	
[99]	Teacher:	Close your books and go	

Teacher 2's Lessons

Lesson 1

Description of Lesson 1

Teacher 2's first lesson was on the geometry of 3D shapes. The focus of this 40 minutes lesson was on the properties of the platonic solids. A total of 27 learners took part in this lesson. When the lesson started there were notes already written on the chalkboard by the teacher had.

Definitions of concepts

The teacher referred to the notes on the chalkboard to define the concept of platonic objects and their properties.

[2]	Teacher:	We are going to look at three dimensional objects part on geometry, that is part of geometry, it involves the analysis of different shapes, we must be in position to tell the properties of that particular shapes, but our shapes has names for example we have shape that are collection known as Polyhedrons, by definitions Polyhedrons are three dimensional objects with all its faces being polygons Poly means many, so a three dimensional object for

example a cube, it has many faces

[3] Learners: Six (6) sides

[4] Teacher: So it has six sides it is a poly , Poly means many, so we are going to look at those Poly, they subdivided by two, the are those that are regular and those that are said to be irregular, but what is the difference between, what is the meaning of regular?

[5] Learner: Sir I think like both the side of the shape have the same face

[6] Teacher: Yes, the similarities in the shapes/faces, so a regular polyhedron is an object three dimensional, with all faces being polygons it means they have fixed shapes are they are congruent to each other, are irregular the faces differ in shape and in sizes and, will give you this I just made copies from the textbook, for the different shapes so that as we proceed we will just refer to it. Can you take one each? Right.

a) Resource used

In addition to definitions in the notes, the teacher distributed copies made from a textbook with definitions of concepts to be dealt with in the lesson. The definitions as presented in the notes on the chalkboard were similar but more elaborate in explanation than the definitions and descriptions of the solids presented in the textbook. The teacher also used models in the form of a chalk-box and cool drink can, to illustrate a cube and cylinder. Therefore the teacher used both the textbook and his own creative ideas to define concepts for the lesson.

a) Time taken

This activity lasted for 4 minutes (**10%**) of the allocated 40 minutes, after which the teacher distributed more hand out copies of platonic solids made from a textbook.

Example 1

In this lesson the teacher did not necessarily do any mathematics as in calculations or construction of shapes but was actually demonstrating to learners how to identify different geometric shapes using their unit properties. Question and answer method was used in this example to keep learners involved in the process.

[8] Teacher: Right, our Polyhedron is our similar term, if we have many of them we call them, Polyhedra and regular polyhedra are called Platonic solids and these are characterized by faces which are congruent to each other. Please don't be confused by the word Polyhedra its just plural of Polyhedron just like boy, boys so we have a Polyhedron with a three dimensional object with all faces being polygon if its many of them we don't say Polyhedron we say Polyhedra, do you get that

[9] Learners: Yes

[14] Teacher: Incomplete, so you mean any point is a vertex

[15] Learner: It is a point where lines meet

[16] Teacher: Right, it is a point where two lines meet, we call that a vertex, right our platonic solids for example, tetrahedron. The word tetra- means four, are we together?

[17] Learners: Yes

[18] Teacher: Tetra- means four, so it means a Tetrahedron must have four equal faces, and for a Tetrahedron the faces are triangular in shape, so whenever you see the word Tetra you must remember it has for equal faces. Right then we go on to Hexahedron, how many sides did you say the cube have?

[19] Learners: Six (6)

[20] Teacher: Six is it? Right so the name Hexa- means 6 we have Pentagon, Penta for 5, Hexa- for 6, Hecta 7, Octa 8, Nonagon 9, Tedagon 10, right so since a cube has six (6) sides, now they given a good term, the name cube is used in lower grades now that we are advanced grade, instead of saying a cube, just to check if you say Hexahedron they will be confused, right?

[21] Learners: Yes

a) Resources used

The whole process of lecturing about properties of shapes was done using hand out copies from a textbook, notes on the chalkboard and some self-made models.

a) Time taken

The activity lasted for 16 minutes (**40%)** of the 40 minutes period.

b) Cognitive levels of the questions

Knowing the meaning of polyhedral and the properties by which these three dimensional shapes could be identified was the focus of this 4 minutes activities. Therefore learners' thinking was limited to cognitive level 1, knowledge, of Bloom's taxonomy.

Exercise 1

The exercise questions were mainly based on the identification of different shapes and their properties. Unfortunately learners ran out of time to do or finish the exercise in the classroom.

[94]	Teacher:	Right let us see if we can answer that, if you don't ask me questions then I will ask you it's either you ask me as I ask you. If you ask it means you understood everything, right. It is not difficult.
[95]	Learner:	(*Inaudible*)
[96]	Teacher:	Is the question relevant to our lessons?
[97]	Learners:	Making noise
[98]	Teacher:	I will give you a paper we are left with only one week and we still need to Right can you draw that, I want you to fill in number of faces
[99]	Learners:	(*Making noise*)

[100] Teacher: Please don't tell me it is time or break, I know when it is time for break, just copy this and go enjoy the break, we answer later name of solids, Hexahedron, number of face meeting at each vertex, shape/faces meet at each vertex, so we can do for Hexahedron, Octahedron and Hexahedron for those, just fill in numbers, make it quick please. How many faces, right once you have copied make sure nothing is left on the floor, if there is remove it.

a) Resource used

Hand-out copies made from a textbook were used in this exercise.

b) Time taken

No time was available for learners to answer the questions which were meant for an exercise.

c) Cognitive level of questions

The questions learners were supposed to do as their exercise were cognitive level 1, knowledge, questions where they were asked to name the solids or 3D shapes and to give properties of each solid like the number faces, edges, vertices and so on. These were cognitive level 1 questions because they only require a learner's ability to identify a particular solid from its properties and to know the meaning of features like a face, an edge and so on in a solid.

Homework 1

The teacher could not give learners homework because he ran out of time.

Teacher 2: Lesson 2

Description of Lesson 2

Teacher 2's second lesson was again on the geometry of 3D shapes. The focus of this 40 minutes lesson was still on the properties of the polyhedra with specific emphasis on prisms and pyramids. A total of 25 learners took part in this lesson. The lesson was, in fact, a continuation of the previous lesson with some of the concepts having been defined in the previous lesson. New definitions were done as the lesson progresses.

Definition of concepts

The teacher introduced the lesson by distributing a pair of hand out copies he made from a textbook. The teacher used the first copy to define concepts and to explain features and properties of pyramids and prisms.

[3] Teacher: As we continue with our lesson, I have just distributed some copies for you. We will start with the geometry of three dimensional objects on that page we are given the definitions, that we will notice frequently use in our geometry for example you will notice that each definition they identify the part that is named for example the Apex that's the point where the edges of the triangular faces of a pyramid meet and we have a triangular pyramid there can you see Apex please we must be in a position to know parts of our shapes, right. We go to the cylinder, we have two parallel faces remember we spoke about cylinder which has two faces and then we spoke of the curved lateral surface, so in a cylinder we have two faces then we have that curve. By edge, what do we mean by edge? It is where two faces meet. The edge it is where two faces meet for example what is the name of this?

[4] Learners: Hexahedron

[5] Teacher: For example, this hexahedron, we have this face and that face, where these faces meet we call it an edge. Are we clear?

[6] Learners: Yes

[13] Teacher: A face is a flat surface, like this is a face, this is another face, so you may be asked how many faces does a shape have, you must always know, the essence here is knowing what you mean then it is easy to identify a shape if they say how many edges, you shouldn't guess, you must know what is an edge.
The moment you know what an edge is then you are able to define how many faces does a shape have.

a) Resource used

Photocopies of a textbook were distributed learners and used in the definition of concepts.

b) Time taken

Concepts to be dealt with in the lesson were not defined all at once at the beginning of the lesson but each at its own time as the lesson progresses. In total 13 minutes (**32,5%)** was spent defining concepts.

Example 1

Teacher 2 used exercises from two of the hand-out sheets copied from a textbook as an example to demonstrate concepts. The questions were more about properties of 3D shapes and a few comments were made about calculations of area and volume. These exercises were used by the teacher as examples and learners were involved and their participation and interest elicited through the question and answer method used by the teacher. The exercises were worked out until the end of the period at which time the teacher distributed more hand out copies from the textbook.

[7]	Teacher:	I can tell you this face and that face, we can count the number of edges in a hexahedron, how many edges do we have?	
[8]	Learners:	Sixteen	
[9]	Teacher:	Let's count them together.	
[10]	Learners/ Teacher:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	(*Counting*)
[11]	Teacher:	So we have twelve of them, so the face it is a flat surface of three dimensional shapes, this is the face.	
[14]	Learner:	When you mean shape	
[15]	Teacher:	You see this, this is a shape as it is, it is a three dimensional shape	
[16]	Learners:	Inaudible	
[17]	Teacher:	Shape or faces meaning at each, right if we have this face, what is, right we can have a square shape or rectangular shape, that's what they mean	
[18]	Learners:	Oh	

a) Resource used

Examples were taken from the same copies made from a textbook.

a) Time taken

A total of 27 minutes (**67,5%)** of the 40 minutes allocated was spend on the activity.

b) Cognitive level of questions

Just like in the first lesson the teacher spend much of his time if not all on level 1 questions. Very few questions could be rated as level 2 questions. What could be seen in the lines above is a talk about a number of faces, edges and angles of shapes. Learners are referred to shapes in front of them and asked to identify different features and the number of particular features in a particular shape. These

are examples of questions that call for learners' knowledge of certain features in different shapes and therefore fall into the cognitive level 1 of the Bloom's taxonomy.

Exercise 1

Learners were not given any exercise to do on their own for the whole period, instead the teacher gave them more handouts at the end of the period with the hope that they may work on them at their own time.

Homework 1

Learners were given more hand out copies from a textbook but were not necessarily asked to do the questions as homework.

Teacher 3's Lessons

Lesson 1

Description of Lesson 1

Teacher 3's first lesson was on data handling with a focus on measures of central tendency and dispersion. A total of 36 learners took part in this lesson. The teacher introduced this 40 minutes lesson by pointing out that the lesson deals with the same concepts they did in grade 8.

Definitions of concepts

Teacher 3 starts by first prompting learners' own definitions of median and after a few learners had given their definitions he reads the definition from the textbook and writes the definition on the chalkboard. The teacher follows the same approach with the definition of mean, mode and range.

[1] Teacher: Right when we were in grade 8, when we were in grade 8 we did some bit of statistics, isn't?

[2] Learners: Yes

[3] Teacher: Where we collected some information and then tried to organize it. Isn't?

[4] Learners: Yes

[5] Teacher: When we organize our data there are three things. What was that? So in this case we will go on and organize and summarise our data alright?

[6] Learners: Yes

[7] Teacher: So let's open our textbook. We start on page 273 and 274, then we take note of where it talks about measures of central tendency. What do you understand by a median or central tendency? This we must know from grade 8. What do we understand by median, our measures of central tendency? What do we understand by median? Yes?

Resource used

The teacher used his own understanding of the concept of data handling and confirms the understanding by referring to the definitions given by a textbook.

a) Time taken

The teacher took about 10 (**25%**) minutes of the 40 minutes period to define the concepts to be dealt with in the lesson.

Example 1

The teacher worked on the example with learners. The teacher did not do the example for the learners but give learners a chance to try the questions first using the cues from definitions before intervening and guiding them to find solutions. The example was worked out on the chalkboard with full learner involvement.

[40] Teacher: Right just to remind ourselves about that , if you go to page 277 and start off, that is our example

[41] Teacher: Right, may somebody read question 3?

[42] Learner: Consider the following table. The school is doing a survey on how learners use the bus every day … (*Reads the question from the textbook*)

a) Use the table to construct a stem-and-leaf display with key:2/7 = 27
b) Determine the mode
c) Calculate the median
d) Find the mean of the table
e) Find the extremes
f) Determine the range for the data
g) What size bus should the school use every day? Motivate your answer.

[43] Teacher: Right. In other words when they say key: 2/7 what does it mean?

[44] Learners: 27

[45] Teacher: It means 27. Then it says, b) what are they asking us to do?

[46] Learner: Determine the mode, calculate the mean …

[47] Teacher: And the mean. So what do we normally have on our left? What do we have on our left

[48] Learners: Our tens

[49] Teacher: What do we call these?

[50] Learners: Stem

[51] Teacher:: Our stem, and what? This side?

[52] Learners: Leaf

a) Resource used

Learners were referred to a textbook for examples which the teacher did with the learners.

b) Time taken

This activity took him 16 minutes (**40%**) after which he again referred learners to the same textbook for exercises.

c) Cognitive levels of the questions

Level 2 and 3 questions were used in the examples given.

Exercise 1

The teacher guided learners through a few steps in the questions before letting them do the exercise on their own. This saved him and learners a lot of time because with his guidance they were able to finish the exercise quickly which gave him a chance to lead the whole class discussion of the solutions. This also benefitted learners because they were able to get feedback timeously and had an opportunity to do more questions for their homework. The teacher allowed learners about 5 minutes to continue with the exercise on their own before leading the whole class discussion on the solutions. The teacher gives learners 5 minutes to work on their own after which he works on the questions with the learners

[73] Teacher: Uh-huh, and so on and so on. Continue please.

[74] Teacher: Right. What does this one do? This one gives us? Can we have your answers?

[75] Learners: 5 5 6 9

[76] Teacher: 5 5 6 and what/

[77] Learners: 9

[188] Teacher: Our question is to find the range. I mean we go from 103,5 to …How do we find the range? It is maximum minus …

[189] Learners: Minimum

[190] Teacher: The question is saying how many learners were measured

[191] Learners: 30

[194] Teacher: Where do I find my median? What is our position?

[195] Learners: (30 +1) ÷ 2

[196] Teacher: (30 +1) ÷ 2. Isn't?

[207] Teacher: Go on and do the same thing in the next question.

a) Resources used

Just like with the examples learners were referred to a textbook for exercises.

b) Time taken

After referring them to an exercise in the textbook he gives learners some guidance on how to work on the questions before affording them an opportunity to work on their own. After 5 minutes learners are asked to give feedback on the first question. The teacher writes the learners' responses on the chalkboard and elaborates on their responses by showing and teaching them alternative approach. This lasted about 10 minutes after which learners were allowed to continue with next question. The teacher moved around checking the learners' progress and intervening where necessary. After 5 minutes the teacher leads the whole class discussion of the learners' responses again given and teaching them an alternative method to responding to the question.

The learners were therefore allowed to work on their own for 10 minutes (25%) of the 40 minutes period.

c) Cognitive levels of questions

Most of the questions in the exercise were also cognitive level 2 questions like questions in the teacher's examples. Questions a) to f) in the transcript above are level 2, routine procedure questions, according to the modified Bloom's taxonomy. Learners use simple learned steps or procedures to find the solutions. On the other hand g) requires of learners to go through a process of synthesising and analysing to come to the solution. Therefore the question falls within cognitive level 3, the complex procedure, of Bloom's taxonomy.

Homework 1

Two questions were given for homework. The first question had eight sub-questions and the second five sub-questions. The questions appeared a good practice for the work done in the lesson.

[208] Teacher: For homework go again and do exercise 22.4, question 2 and 3 on page 276

a) Resource used

The same textbook was used for homework.

b) Time taken

On average learners could take 60 minutes to complete the homework given.

c) Cognitive levels of the questions

Questions in the homework were also of level 2.

Teacher 3: Lesson 2

Description of Lesson 2

Teacher 3's second lesson was also on data handling but with the focus on data representation (bar graphs). A total of 36 learners took part in this lesson. 5 Minutes was spent on correcting homework and recapping on the previous lesson.

Definition of concepts

The teacher starts by probing learners' understanding of the concepts from previous lessons before giving them his definitions. He later referred learners to a textbook and read the definitions with them from the textbook.

[9]	Teacher:	The table here represents the pocket money each grade 9 learner in a class have. Complete that. In other words what are we saying? Those who got R10 and R20 how many are those?
[10]	Learners:	5
[11]	Teacher:	What is it that we have? We have 1 0 0 1 1 8 and what does this necessarily mean? How much do we have?
[12]	Learners:	10 ; 10 ; 11; 11 ; 18
[13]	Teacher:	And how many are those?
[14]	Learners:	5
[15]	Teacher:	Any other problem from the homework?
[16]	Learners:	No
[17]	Teacher:	Are you sure?
[18]	Learners:	Yes.
[19]	Teacher:	Ok. Let's move on to corrections, right? Now I will add the mean, mode, median and … and what name did we give to those, mean, mode, median and … what do we call those?
[20]	Learners:	Measures of central tendency.
[21]	Teacher:	Then we go on to organising and summarising data, alright?

a) Resource used

Learners' inputs were allowed before confirming their understanding by reading definitions from a textbook.

a) Time taken

For 8 minutes (**20%)** of the period the teacher was discussing the definitions of discrete data, continuous data and bar graphs. In defining these concepts he would ask learners to give their definitions of each concept and then elaborate by his own definition. He ended the discussions by reading the definitions from a textbook.

Example 1

Just like in the first lesson the teacher worked on the examples with the learners. The teacher did not do the examples for the learners but give learners a chance to try the questions first using the cues from definitions before intervening and guiding them to find solutions. The examples were worked out on the chalkboard with full learner involvement.

[52] Teacher: Let's look at that example on page 274

[53] Teacher: It says, consider the frequency table below, it contains number of learners, a sport offered at a school in a year. Note our sports netball, rugby, hockey and so on in a year.

[54] Teacher: Then we have number of learners, number of boys and number of girls.

[55] Teacher: So they say draw a bar graph representing the number of learners by sport. In other words which column am I going to use there?

[56] Learner: Number of learners.

[57] Teacher: One which says number of learners. If you look now at our answer, you see that those who play rugby are 80? That to us is a vertical bar. Are we together?

[58] Learners: Yes

[71] Teacher: We can compare one object by, for instance in our example here, we are talking about sports. Look at example on page 279 please. Note that we now have compound bar data of which you are given a blue standing for boys and for the girls. If I may ask using that compound data, how many girls play rugby and boys play rugby?

a) Resource used

The example was taken from a textbook.

b) Time taken

The teacher worked on the example with learners for 9 minutes (**22,5%)** of the 40 minutes period before giving them an exercise to do.

c) Cognitive level

The questions in the example were mostly cognitive level 1 and cognitive level 2 questions. The teacher worked out the following questions with learners:

a) Draw a bar graph representing the number of learners per sport.
b) Draw a double graph representing the number of boys and number of girls per sport in the school.

These questions fall within the knowledge, cognitive level 1 and routine procedure, cognitive level 2, of the Bloom's taxonomy because learners here are supposed to know what a bar graph and double bar graph are (level 1), and also use particular steps or learned procedures to get to the required solutions (level 2).

Exercise 1

In the same as he did with his first lesson he guides the learners through the exercise before letting them work on their own. The learners were allowed to work on the exercise until the end of the period.

[77] Teacher: There are class intervals, then let's go on to page 276, exercise 23.1. choose between a bar graph, a double bar graph and useful graph, representing data from the following terms:

[78] Teacher: Term number 1

[79] Learner: A histogram

[80] Teacher: Right. She's saying histogram. Anyone with a different opinion?

[81] Learner: Question 1 using a bar graph

[82] Teacher: Question 1 using a bar graph; is that what you're saying?

[83] Learner: Sir?

[84] Teacher: We are saying information we have, information is, become grouped, it becomes grouped data.

[90] Learners: 2006

[91] Teacher: There are class intervals, then let's go on to page 280, exercise 3.1. choose between a bar graph, a double bar graph and useful graph, representing data from the following terms:

a) Resource used

The teacher referred learners to a textbook for exercise.

b) Time taken

Learners were allowed 6 minutes to work on the exercise. Just like in the first lesson the teacher started by giving them guidance on how to go about answering the questions and intervened from time to time.

c) Cognitive level

The cognitive levels of the questions were same as in the examples given, that is, cognitive levels 1 and 2. The first part of the question in the exercise asks learners to

choose the suitable graph from the two given. This is a knowledge question (cognitive level 1). The second part asks learners to use the chosen graph to represent data. Learners here need to follow a particular procedure which they have learned and made part of their known procedures to work out the required solutions. Therefore this part of the question falls within the routine procedure, cognitive level 2, of Bloom's taxonomy.

Homework 1

For homework learners were asked to continue with questions from the exercise which was taken from the textbook.

a) Resource used

A textbook was also used for homework.

b) Time taken

The homework activities given could take learners approximately 30 minutes to complete.

c) Cognitive level

The same cognitive level 1 and cognitive level 2 of questions from the example and the exercise were given to learners for homework.

Teacher 4's Lessons

Lesson 1

Description of Lesson 1

Teacher 4's lesson was on data handling with a focus on organising and representing data. The teacher used the question and answer method to probe

learners' participation and to find out the learners' level of understanding and knowledge and then work on the chalkboard to demonstrate the procedure of representing data on a pie chart. Learners were kept actively involved in the whole process.

Definition of concepts

The teacher used the textbook right from the beginning. She first asked learners to read a definition of a pie chart from a textbook and then asked them to summarise definition from the textbook in their own words. She then went on to elaborate on the definition from her own understanding. But her definition was mainly based on the definition from the textbook.

[1]	Teacher:	Then now, we are going to start now with the, or our topic today is representing data using a pie chart or broken line graph and a scatter plot graph.	
[6]	Teacher:	A pie chart? Start again.	
[7]	Learner:	A pie chart …	(*Reading definition from a textbook*)
[8]	Teacher:	Who can summarise the whole statement for us in a few sentences or just one or two? Yes "Paul"?	
[12]	Teacher:	Yes, I want you to explain the statement that "Tebo" has read for us, just rap up for us. Just summarise for us.	
[16]	Teacher:	It means when we're talking about a pie chart …	
[17]	Learner:	A pie chart is one of the ways to summarise data using a circle to represent the whole. Each category is proportionally represented by a slice of the pie …	(*Reading from the textbook*)
[18]	Teacher:	Who can summarise ..	
[62]	Morris:	Calculate the angles of the centre of the circle.	(*Reading from the textbook*)

a) Resources used

A textbook was the main resource used to define concepts but the teacher also used own understanding to explain and elaborate.

b) Time taken

The activity took 6 minutes (**15%**) of the 40 minutes allocated time after which the teacher started with her example.

Example 1

The teacher created an example with learners. They together composed an imaginary data which they put together and use to demonstrate how data can be organised and represented. A question and answer method was used to keep all learners involved.

[69]	Teacher:	Now whatever data that you are having, for example if ever I want, I went out to collect data based on how do I use my 24 hours per day; we know that each day has 24 hours. Isn't?
[70]	Learners:	Yes.
[71]	Teacher:	I'm going to group my hours in terms of maybe sleeping, eating, uh … letting me just say playing or resting, or maybe I can say sports. No let me divide my hours into cleaning …
[72]	Learner:	Working..
[73]	Teacher:	Studying …
[74]	Learner:	Inaudible …
[75]	Learners:	Inaudible …
[78]	Teacher:	Right guys. Let me just say, I'm going to spend 8

hours, these are the number of hours … number of …

[79] Learners: Hours.

[80] Teacher: I'm going to spend 8 hours sleeping, eating?

a) Resources used

The teacher used her own example which she created with the learners on the spot.

b) Time taken

The teacher went through the example with her learners for the rest of the period which lasted for 36 minutes (**85%**) of the 40 minutes allocated time.

c) Cognitive level

In this activity, the teacher's focus was mainly on the learners' understanding of the meaning of a pie chart, what it is used for and how to construct it. The outcome of the activity would, therefore, be knowledge of a pie chart and procedure on how to construct a pie chart. This is, therefore, cognitive levels 1 and 2 of Mathematics CAPS revised-bloom's taxonomy, the knowledge, and routine procedure respectively.

Exercise 1/ Homework 1

The teacher spent the rest of the period working on the example. As a result on time was available to give learners any exercise or homework to work on.

Teacher 4: Lesson 2

Description of Lesson 2

Teacher 4's second lesson was also on data handling with a focus on representing grouped data. The teacher worked all the questions on the chalkboard with learners participating. There was no time where learners were allowed an opportunity to work on their own.

Definition of concepts

[1]	Teacher:	Yesterday we did pie charts; on the cells and procedures to follow we have to draw a pie chart. We know that in each and every pie chart that we have to draw, we can either convert it to degrees and or to percentage, we cannot convert it to both degrees and percentages at the same time are we clear on that? Now we continue again on line 9, okay then now as we are now continuing on this one, the next one which is a line graph. Now who can just read the statements which starts with `a broken line graph…` for us? Yes "Sipho".	
[2]	Learner:	"A broken line graph shows …	(*reading from the textbook*)
[3]	Teacher:	Thank you very much. Who can just summarise what he has read just right now for us because before you can nearly answer the question you need to find out the core meaning of that particular statement.	
[4]	Learner:	"A broken line graph is not exactly a straight line; it's a line that actually has data that changes over time".	
[6]	Teacher:	I think they have said a mouthful, what we are going to do we are going to join those dots am I clear about that? Now what you know is, when we draw the graph or the main thing that you need to know when you draw the graph is every graph should have a heading or a title or the name.	
[21]	Learner:	"A scatter plot shows the relationship between two sets of data that …. It shows if the values are clustered or dispersed, scatter plots allow one to see change and make predictions as well as identify outliers in the data.	(*reading from the textbook*)

a) Resources used

Just like in the first lesson the teacher asked learners to read and summarise definitions of concepts to be dealt with from a textbook after which she elaborated.

b) Time taken

A total 10 minutes (17%) of the 60 minutes allocated time was spend on the definitions.

Example 1

Both examples were demonstrations done the chalkboard with learners participating fully through question and answer method. This example, from a textbook, was on the representation of data using a bar or histogram. The teacher worked through the example with learners.

[7]	Teacher :	Then now let's take a look to the one that is given in the sleeves on number three. It says, the table shows the (inaudible)… shows the number of children that on the roads in a province in one year, the number of, that is on page 281, then here is a table given, we are given from zero to four that is H. Zero to four, five to nine, ten to fourteen, fifteen to nineteen, is this the last category? If ever the information is written as zero to four, five to nine, we call this one as a grouped data or grouped information isn't it? They have grouped the information; they avoid a situation where they are going to find a child who's zero years old meaning that maybe that particular child is eight months or nine months, one year old then now they have grouped them are we together? Those who are between zero to four, they are 1482.
[9]	Learner:	A vertical line is a line that's going straight up and a vertical line goes up and down and a horizontal line goes sideways.
[11]	Learner:	I think you should write the number of injuries in a multiplication sequence
[12]	Teacher :	In a multiplication sequence I do understand isn't it? And all of us you understand him? Then what do you think I must write just right here, because you said I mustn't write.

Which multiplication can we use? Must I start from one? What can I use? Multiplication of 1000, the next one? 2000. 4000? 3, 4, 5 up to 8. 5000, 6000, 8000 then here what is that that I must write?

Example 2

The second example was of the teacher's own creation. This was of a misleading graph.

[20] Teacher: …Now there is this thing for example: if we have or if we wanted to know the crime rate in highlands north, we do have highlands north police station, we do have the community of highlands north isn't it? In may we do have 33 cases. March April, maybe up to April isn't it? You know what, when the community is going to draw that particular graph they are going to use a bigger scale, they will just say, January February march April then they'll just say let 2 cm equals 1. They'll just measure the 2 cm they'll just say a multiple I'm going to use 10, 20, 30, 40. …

[21] Learners: Yes

[22] Teacher 4: The minister of safety and security requested the community to represent the crime rate of highlands on a graph, on a line graph or a bar graph am I clear about that one? And again requested the police to represent the very same information using the graph. You know what is going to happen? If I think things are not in favour of my side, I'll have to use a very short scare for example: starting from zero the number of crime rate maybe, this is highlands north isn't it? I'm having January; the crime happened in January, we do have maybe 20 cases. In February we do have32 cases in February only. In March we do have 40 cases.

[23] Learners: Yes

[24] Teacher 4: Now they are going to join their graph like this isn't it? But look at the police, the police will use a very short scale, the police will do this one: they'll just say January, February, march, April. They are going to say 20 okay 10, 20, 30, 40. Can you see the scaling, this is a correct measurement then when the police decided to plot this one they are going to say this one is 20, then February is 32. Look at this march? … The community and the police, the community went to the police they shared to get that information and the police are using the very same information, why will the police decided to

use that and the community decided to use that? Do you think the police should always use the small scale?

[25] Learners: No

a) Resources used

The first example was taken from a textbook and the second one was of the teacher's own creation.

b) Time taken

A total of 48 minutes (**80%**) of the 60 minutes allocated time was spend on the two examples which were both done with learners.

c) Cognitive levels

Questions used in the teacher's examples were mostly routine procedure (cognitive level 2) and only one complex procedure (cognitive level 3) question based on misleading graphs.

Exercise/Homework

The teacher spent the whole period on definitions and examples. As a result she did not give learners any exercise or homework to work on.

Summary and Discussion of classroom lessons observations transcripts

Although an in-detail discussion of the analysis of data from the interviews is deferred to a later section ('Analysis of data from the interviews'), I do use various data from these interviews to support my arguments and discussion around the analyses of the classroom lessons' transcriptions and observations in this section.

Table 11 : Time spent using content from a textbook

	Teacher 1	Teacher 2	Teacher 3	Teacher 4
Total time of lessons	80 minutes	80 minutes	80 minutes	90 minutes
Definition of concepts	5 minutes	17 minutes	18 minutes	16 minutes
Examples	0 minutes	29 minutes	25 minutes	48 minutes
Exercises	15 minutes	20 minutes	20 minutes	0 minutes
Homework	N/A	N/A	N/A	N/A
Assessment	N/A	N/A	N/A	N/A
Total time using content from textbook	20 minutes	66 minutes	63 minutes	64 minutes
% Time on content from textbook	25%	82,5%	78,8%	71%

Below is a graphical representation of the table below

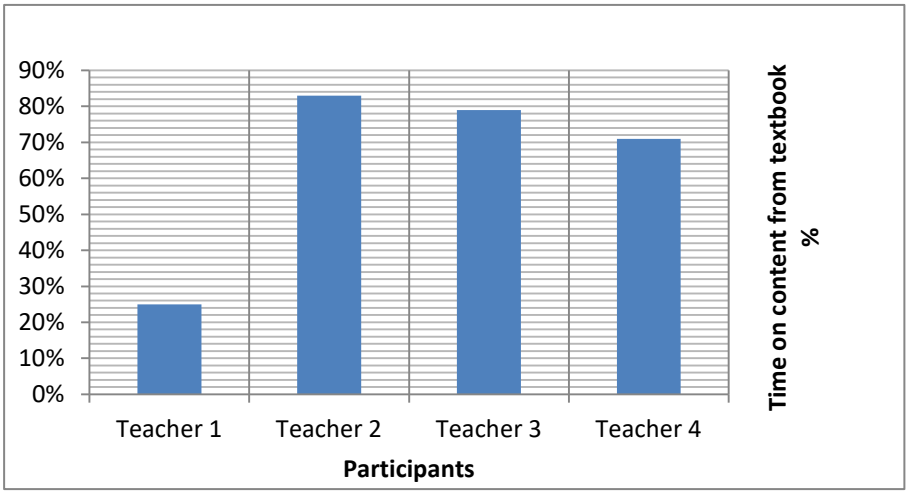

Figure 7: % Time on content usage from textbook

The graph shows that only one out of the four teachers spends less than 30% of their teaching time using content from a textbook, the second one spends about 82% of teaching time using content from textbook, the third spends about 79% of teaching time on content from textbook and the last one spent 71% of teaching time using content from textbook. Therefore only one teacher out of the four teachers uses less than 30% of teaching time using content from a textbook. The other three spend at least 70% of their teaching time using content from a textbook in the eight observed lessons.

There have been ongoing debates about the use of textbooks or what is referred to as the curriculum material by teachers. Some studies portray certain ways of using textbooks by teachers as an academically rewarding and acceptable practice whereas others portray the practice as professionally degrading. Apple (1990) makes reference to critics who argue against the use of textbooks (instructional materials) to determine what learners should learn. He points out that in these critics' view, such "strategy 'de-skills' the professional work of teaching and severely limits local discretion over curriculum" (Apple, 1990 cited in Ball and Cohen, 1996, p. 6). On the other hand, Ball and Cohen (1996) argue that: "curriculum material is often part of an agenda for improved instruction" (Ball & Cohen, 1996, p. 7). They further point out that: "well-designed materials could be a resource for teachers learning" (Ball & Cohen 1996, p.8).

South African teachers have their own individual preferences with regard to mathematics textbooks. The practice has been that authors and co-authors of good mathematics textbooks are well-known mathematics experts who are themselves school teachers, colleges of education lecturers, university professors and other professionals who might have been teachers before. Teachers, therefore, develop confidence in certain authors based on the authors' expertise and experiences with the material written by these authors. The quality of content presented in a textbook and compliance of the textbook to national curriculum seem to play a major role in a teacher's choice of a textbook and how the teacher uses a textbook. It is not uncommon therefore to see most teachers showing preference to certain textbooks and using these textbooks for each and every one of their lessons.

It has also been a practice that teachers or schools are given a number of textbooks options to choose from. For the majority of teachers, no particular curriculum material is enforced on them. It is only lately that the Department of Education is enforcing the use of certain prescribed textbooks and other resources in the schools that are identified as performing below the required overall learner pass percentage. Even then such textbooks and resources are prescribed as supplementary resources.

Johnsen classifies teachers as (1) followers of the textbook lesson by lesson, with little or no supplementary material, or (2) followers of the plan and progression of the textbook but selective in its use, or (3) those who break from content and structure and add supplementary material (Johnsen, 1993, cited in Haggarty & Pepin, 2002, p. 572).

Looking at the time spent by each teacher on content from a textbook, only one out of four teachers appears to use, to a greater extent, alternative instructional resources other than a textbook. This is one teacher who could be part of Johnsen's (1993) third classification of teachers; those who have the ability to transcend the constraints of a textbook and maximally use the supplementary material. It is also clear that three of these four teachers seem to accept and use a textbook as their primary: "knowledge storage" (Haggarty & Pepin, 2002, p. 572). These teachers could, therefore, be easily placed under Johnsen's first classification as outlined above.

The behaviour of each individual teacher with regard to how they use a textbook and the classification of each individual teacher according to different models of classifications by different researchers and authors like Johnsen (1993) should not in any way suggest any kind of judgement against any teacher and how they choose to use a textbook. Besides, no link or correlation has been established between a particular way of using a textbook and a teacher's expertise or learner performance. The debates and arguments seem to be more focused on compliance to prescribed curricula than to results and ultimate impact each kind of use may have on learner performance. The results of the lesson observation transcripts represented in the graph above reflect only the amount of time each teacher spends using content from

a textbook. It can though to some extent be interpreted to ascertain an individual teacher's dependency or non-dependency on a textbook.

CAPS Cognitive levels

The cognitive levels of questions used by each teacher for teacher examples, learner exercises, and learner homework, was another aspect of focus during each lesson observed. Table 12 below gives a summary on the cognitive levels of questions used by each teacher.

Table 12 : Cognitive levels of questions

	Teacher 1	Teacher 2	Teacher 3	Teacher 4
Total time of lessons	80 minutes	80 minutes	80 minutes	
Examples	Level 1, 2, 3	Level 1, 2	Level 1, 2, 3	Level 1, 2, 3
Exercises	Level 1, 2, 3	Level 1, 2	Level 1, 2, 3	Level 1, 2, 3
Homework	Level 1, 2, 3		Level 1, 2	
Assessment				

In the interviews, when asked about their understanding of Bloom's taxonomy as modified in the CAPS document and its role in the designing of lessons and assessment activities, all four teachers expressed their awareness and understanding of the taxonomy and what is expected of them with regard to the use of the taxonomy. The Department of Basic Education (DBE) prescribes the cognitive levels of questions to be asked when assessing learners and the percentage of each cognitive level. In mathematics, four cognitive levels are prescribed as outlined in Chapter 3. To prepare learners adequately for assessment teachers are expected to model the cognitive levels in the questions they use for their examples, for learners' practice exercises and homework.

Table 12 above shows that Teacher 1pitched the questions she used up to cognitive level 3 in her examples, learners' practice exercises and homework. Teacher 2 pitched his questions to cognitive level 2 in his examples and learners' practice exercise. He did not manage to give learners any homework because in both

lessons he ran out of time. Teacher 3 like Teacher 1 pitched his questions to cognitive level 3 for his examples and learners' practice exercises. But he only gave his learners questions up to cognitive level 2 for homework. Teacher 4 also pitched her questions up to cognitive level 3 in her examples and exercises which she worked out with her learners. There was no stage where she gave her learners an opportunity to work on the exercises on their own. Like Teacher 2 she ran out of time in both lessons and did not get a chance to give her learners any homework. None of the teachers pitched any of their questions to cognitive level 4 in any of their lessons.

Nicol and Crespo's classification

Table 13 : From Nicol and Crespo's classification

Category	**Adhering**	**Elaborating**	**Creating**
Teacher	Teacher 2	Teacher 1	
	Teacher 3		
	Teacher 4		

From Table 13 above a total of 3 out of 4 of teachers are classified under the adhering approach following a display of a level of frequency in the use of textbooks during classroom teaching. One teacher is classified under elaborating approach based on a demonstration of ability to design his own lessons using alternative resources other than a textbook. No teacher could be classified under the creating approach.

Teacher 3 and Teacher 4 refer learners to textbooks right from the beginning of the lesson. They use textbooks for definitions of concepts, for examples and also for learners' exercises and homework. At one stage Teacher 4 created own example but kept on referring learners to a textbook to verify the correctness of the definition of concepts and procedures to be followed in working out solutions to questions. They displayed a great deal of reliance on a textbook. In their interviews, they were able to confirm their reliance to textbooks citing their view for example, that for effective teaching one has to use more than one textbook and that for an understanding of concepts learners have to be taken through the definitions and procedures outlined in the textbooks.

Nicol and Crespo (2006)'s first class of teachers in their three approach classification of the teachers' use of textbooks, the adhering group, are viewed as teachers who accepts textbook as the authority and therefore follow the textbook to the latter. Teacher 3 and Teacher 4 could, therefore, be looked at, to large extent, as a good representation of teachers who could be classified under the adhering group as profiled in Nicol and Crespo's classification looking at their reliance to a textbook (Nicol and Crespo, 2006).

When it comes to Teacher 2's case, in as much as hand-out copies made from a textbook-dominated the two lessons, an evidence of the use of alternative resources was displayed. In Lesson 1 the teacher incorporated models of his own creation to demonstrate and show some properties of 3D shapes. This was done as a means to enhance learners' understanding. The teacher brought in cans of cool drinks and boxes of chalk and so on to illustrate properties of different solids and to explain the concept of nets in measurement. He also made copies from a textbook and handed them to his learners in both lessons because the learners did not have textbooks. Since learners did not have textbooks, the teacher could have used any other resource to teach without necessarily bringing in a textbook.

Even though the teacher was able to use the models effectively it became apparent that a textbook was an important and primary resource that made the teaching of the teacher's two lessons much easier. In reference to Nicole and Crespo's (2006) classification the demonstration using models was an attempt to make a few adaptions to the lesson but is not sufficient to diminish the teacher's noticeable dependency on a textbook. Looking at Nicol and Crespo's (2006) classification Teacher 2 could be another good example of a teacher who falls within the adhering class since the teacher uses a textbook as the main resource with a minor attempt to incorporate alternative resources (Nicol and Crespo, 2006).

The second class in Nicol and Crespo's (2006) classification, the elaborating are said to be those who consider a textbook as a guide or main resource but use other resources to complement what the textbook offers. The distinguishing factor in this class of teachers is that they are able to use their experiences with textbook content outside a textbook or free of a textbook to design their own lessons using other resources or self as a resource.

From the two lessons Teacher 1 displayed a great deal of independence and creativity. In both lessons, the teacher used examples of her own creation and defined concepts from her own understanding. The teacher rarely referred to a textbook throughout the two lessons. In the first lesson the textbook was only referred to at the end of the lesson for homework. The teacher came up with her own example “rotate triangle ABC $\mathbf{90}$° clockwise” and exercise “rotate triangle ABC $\mathbf{90}$° anticlockwise” without referring to a textbook or any other resource.

This was the case in the second lesson where the teacher worked with learners to create their own example of data collection and she used it to explain the concept of data collection. As the lesson progresses, definitions of concepts like mean, median and mode were given from her own understanding. In the same lesson the teacher easily thought up and used another example of her own creation to elaborate on the concept of mean instead of just using examples in the textbook as most teachers would do.

It was only later in the lesson after the teacher was satisfied with the level of the learners’ understanding of the concepts that learners were referred to a textbook and the textbooks’ definitions of mean, median, mode and range. It was as if the teacher was consulting a companion, the textbook, to confirm the correctness of the definitions given to learners earlier in the lesson. It was also at this stage that learners were given an exercise from the same textbook, which further confirms the companionship created with a textbook.

In their classification of teachers with regard to textbook usage, Nicol and Crespo (2006) view teachers who regard a textbook as a guide or main resource but use other resources to complement the textbook as the elaborating class of teachers. Looking at how she uses a textbook in both lessons as outlined above, Teacher 1created an image that models, to a larger extent, the elaborating class as presented in Nicol & Crespo’s (2006) classification model.

In all lessons observed a textbook was the main resource available for both teachers and learners. Even in the case of Teacher 2 where scarcity of textbooks was noted, the teacher made an effort to make copies from a textbook for each individual learner when this situation could have been used as an opportunity to use other resources. Of all the teachers, therefore, none of them could perfectly fit into the creating class of Nicol & Crespo's (2006) three approach classification of teachers' use of textbooks.

Analysis of data from the interviews

After all lessons' observations were completed a meeting was scheduled with each of the observed teachers where each was interviewed about their respective lessons. Closed and open-ended questions were used in the interviews. Each sub-question is linked to either one or two research questions below and therefore coded as such.

Research Questions

1. How do Grade 9 mathematics teachers use mathematics textbooks to mediate their teaching of mathematics in their classroom?
2. What type of questions according to Bloom's taxonomy do teachers select or use?

A sample of questions and answers during the teachers' interviews

The following were the main questions asked during the teachers' interviews. The questions are coded according to the two research questions above. For example, Q1SQ1 refers to research question 1 sub-question 1, Q1SQ2 to research question 1 sub-question 2, and so on; and Q2SQ1 refers to research question 2 sub-question 1, Q2SQ2 to research question 2 sub-question 2 and so on. Annexure D gives a complete interview schedule and Annexure G the actual sample interview questions and answers.

Summary and Discussion of Interview Data

Table 14-1 below captures responses of teachers on some of the sub-questions in Research Question 1. This is followed by a brief discussion of the results reflected on the table.

Table 14-1: Interviews with teachers- Research Question 1

How do Grade 9 mathematics teachers use mathematics textbooks to mediate their teaching of mathematics in their classroom?

Note: **YT** means years teaching and **YTM9** means years teaching Grade 9 mathematics

RQ1SQ1	How many years have you been teaching?			
Number of years	$\mathbf{0} < YT < 10$	$\mathbf{10} < YT < 20$	$\mathbf{20} < YT < 30$	$\mathbf{30} < YT < 40$
Number of teachers	**1**	**2**	**1**	**0**
RQ1SQ2	How many years have you been teaching mathematics in grade 9?			
Number of years	$\mathbf{0} < YTM\mathbf{9} < 10$	$\mathbf{10}\,\boldsymbol{YTM9}$	$\mathbf{10} < YTM\mathbf{9} < 20$	$\mathbf{30} < YTM\mathbf{9} < 40$
Number of teachers	**1**	**2**	**1**	**0**
RQ1SQ3	In your teaching when did you start using a textbook?			
Frequency	**Always**	**Sometimes**	**Occasionally**	**Not at all**
Number of teachers	**All four**			
RQ1SQ4	To what extent do you use a textbook to prepare a mathematics lesson?			
Frequency	**Always**	**Sometimes**	**Occasionally**	**Not at all**
Number of teachers	**All four**			
RQ1SQ5	To what extent do you use a textbook to teach a mathematics lesson?			
Frequency	**Always**	**Sometimes**	**Occasionally**	**Not at all**
Number of teachers	**3**	**1**		

RQ1SQ6	To what extent do you use a textbook for mathematics homework?			
Frequency	**Always**	**Sometimes**	**Occasionally**	**Not at all**
Number of teachers	**3**	**1**		
RQ1SQ7	To what extent do you use a textbook to assess learners?			
Frequency	**Always**	**Sometimes**	**Occasionally**	**Not at all**
Number of teachers	**3**			
RQ1SQ8	Did you use a textbook to prepare, teach and for homework in the observed lessons?			
Frequency	**Yes**		**No**	
Number of teachers	**All four**			
RQ1SQ9	Do you have any specific textbook that you using at the moment?			
Specific textbook	**Yes**		**No**	
Number of teachers	**All four**			
RQ1SQ10	Do you use any other resources besides your specific textbook(s) and other textbooks?			
Other resources	**Yes**		**No**	
Number of teachers	**All four**			

One of the teachers, Teacher 1, has 5 years teaching experience, Teacher 2 has 16 years teaching experience, Teacher 4 has 19 years teaching experience and Teacher 3 has 23 years teaching experience.

Teacher 1 has 5 years' experience teaching mathematics in Grade 9, two teachers; Teacher 2 and Teacher 3 have 10 years and Teacher 4 has 19 years' experience teaching Grade 9 mathematics. A total of three teachers, Teacher 2, Teacher 3 and Teacher 4, indicated that they always use a textbook when teaching mathematics whereas Teacher 1indicated that she uses a textbook sometimes when teaching mathematics. This was evident during the observation of lessons.

Three teachers, Teacher 2, Teacher 3 and Teacher 4, indicated that they always use a textbook for homework whereas Teacher 1indicated that she uses a textbook sometimes for homework. The claim could not be verified looking at the lesson observations transcripts where homework was given in only 3 of all 8 lessons observed and recorded. In all these instances homework was given from a textbook. A total of three teachers, Teacher 1, Teacher 3 and Teacher 4, indicated that they always use a textbook when assessing learners whereas Teacher 2 did not give a clear answer to the question. This could not be verified because none of the teachers had a readily available formal assessment task based on the lessons observed.

All four teachers indicated that for all observed lessons they used a textbook to prepare, teach and for homework. For the preparation of lessons, it could not be verified since none of the teachers had formal documented lesson plans to show.
Asked whether they use any specific textbook, all four teachers indicated that they have a specific prescribed textbook they are using. This could be verified looking at the observed lessons. Each of the four teachers referred learners to a specific textbook during all lessons observed. All these four teachers indicated that they have access to and are using alternative resources in addition to a textbook. During lesson observations, only one of the teachers demonstrated the use of alternative resources.

The above data contradicts Haggarty & Pepin's (2002) argument that less experienced teachers tend to use a textbook more than the experienced teachers who over a period of time have accumulated experience and developed a library of alternative materials other the textbook to use in their teaching. In this study, the least experienced teacher demonstrates reluctance to using a textbook as primary resource whereas her more experienced counterparts appear more receptive to using a textbook as a primary resource.

Note: RQ1SQ1 means research question 1 sub-question 1and so on.

Table 14-2 below captures teachers' responses on some of the sub-questions in Research Question 2. This is followed by a brief discussion of the results reflected on the table.

Table 14-2: Interviews with teachers-Research Question 2

What type of questions according to Bloom's taxonomy do teachers select or use?			
RQ2SQ1	How do you choose examples, exercises, homework activities and tasks?		
CAPS Cognitive levels	**Consider levels of complexity according to CAPS- revised Bloom's Taxonomy**		**As presented in used resource(s)**
Number of teachers	**3**		**1**
RQ2SQ2	When you design your assessment tasks how do the questions in the tasks relate to your examples and exercises that you give during your lessons?		
	Same	**Same with adjustment**	**Different**
Number of teachers	**0**	**All four**	**0**
RQ2SQ3	Are examples and exercises that you give in the classroom on the same cognitive level with the questions asked in assessment tasks?		
	Yes	**No**	
Number of teachers	**3**	**1**	
RQ2SQ4	Do examples and exercises in the textbooks you are using textbooks prepare learners adequately for assessment?		
	Yes	**No**	
Number of teachers	**1**	**3**	

Note: RQ2SQ1 means research question 2 sub-question 1and so on.

When choosing examples, exercises and questions for homework and formal assessment tasks, three teachers, Teacher 1, Teacher 3 and Teacher 4, indicated that they always take Bloom's taxonomy in consideration. When reference to the Mathematics CAPS cognitive levels model or taxonomy was made, all three teachers confirmed their awareness of this model which all of them understand to be the Bloom's taxonomy they were referring to. It was interesting to establish that a number of teachers tend to refer to any taxonomy as Bloom's taxonomy. Please refer to Table 6 for a copy of could be referred to as the Mathematics CAPS cognitive levels model.

The fourth teacher, Teacher 2, indicated that examples and exercises presented by CAPS aligned textbooks are structured in a way that would prepare learners adequately for assessment. Therefore according to him the sequencing or structuring of questions in textbooks from simple to complex could be followed as is when choosing examples, exercises, homework and when assessing learners.

All four teachers indicated that when designing formal assessment tasks for learners they consider examples and exercises done with learners and use such with some adjustments to model questions they choose for assessment. The assumption here could be that examples and exercises used in the classroom are a build up towards formal assessment.

One of these four teachers, Teacher 4, indicated that examples and exercises they use in their classrooms are on the same cognitive levels of complexity as the questions they ask in the formal assessment tasks. He points out that the only difference is how questions are articulated in words. On the other hand, the other three, Teacher 1, Teacher 2 and Teacher 3, indicated that assessment questions are not on the same levels of complexity as the examples and exercises they use in the classroom. Therefore most teachers consider or follow the mathematics CAPS Cognitive levels only when designing formal assessment tasks but not when they prepare and choose questions for examples and exercises.

In his view Teacher 4 regards examples and exercises in textbooks as providing enough practice to adequately prepare learners for formal assessment whereas the other three assert that textbooks give simpler questions than those questions in external formal assessment tasks. In this case, one would assume that these teachers are mostly referring to external assessments like ANA, district and provincial common examinations.

Summary of findings

The study revealed that the majority of teachers depend on a textbook for their teaching of mathematics. Teachers use textbooks to prepare lessons, to define concepts to be taught, as a source for examples and exercises for classroom instruction, for homework and assessment. Even though teachers express their awareness of other resources available and the accessibility of such alternative resources to them, it was evident that most teachers still regard and prefer a textbook, especially a prescribed textbook, as their primary resource and a representation of what Remillard (2005) refers to as the planned curriculum.

The use of three data collection methods, namely the survey, observation and interviews for triangulation was an attempt to ensure the quality of data collected. Therefore convergence of aspects of focus in the three methods was maintained. This was achieved by relating aspects of focus in the lesson observations and questions in the interviews to questions in the survey thereby avoiding or minimising

any form of divergence. Therefore aspects focused on during lesson observations were informed by responses from the survey and in turn interview questions were intended to verify responses in the survey and to clarify some aspects focused on during lesson observation sessions.

The study needed to answer the following two research questions:

1. How do Grade 9 mathematics teachers use mathematics textbooks to mediate their teaching of mathematics in their classroom?

2. What type of questions, according to the Mathematics CAPS Cognitive levels do teachers select or use for examples when demonstrating concepts, for learners' classroom exercises, for learners' homework and for assessment?

As a means to answer these questions the tools used in the three methods were designed to address the following aspects:

1. The extent of textbook usage in the preparations of lessons
2. The extent of textbook usage in teaching mathematics lessons
3. The extent of textbook usage in the teaching for learner homework
4. The extent of textbook usage for assessment
5. The use of CAPS cognitive levels

1. The extent of textbook usage in the preparations of lessons

Findings from the survey

With regard to using a textbook for preparing mathematics lessons, 24 participants out of 34 indicated that they always use a textbook, 5 indicated that they use a textbook sometimes and 2 use a textbook occasionally. A total of 3 did not give any response to this question. The survey, therefore, shows that out of a total 34 teachers 70,6% prefer and will always use a textbook when preparing their mathematics lessons.

Findings from lessons observations

One teacher out of four indicated that she uses a textbook occasionally when preparing her mathematics lessons. The other one indicated he uses a textbook sometimes and the last two indicated that they always use a textbook when preparing their mathematics lessons. Therefore a total of 2 out 4 teachers who participated in classroom lesson observation sessions demonstrated their preference of using a textbook always when preparing their mathematics lessons.

Findings from interviews

All four teachers indicated that they always use textbook when preparing their mathematics lessons. Teacher 1 in the survey indicated that she uses textbook occasionally when preparing her lessons; the claim was to a larger extent affirmed during both her two observed lessons. Teacher 1 made some revealing statements during her interview. She asserted that due to the new CAPS curriculum, using a CAPS approved textbook is a necessity since it presents the currently prescribed curriculum and provides guidance with regard to methods and approaches of teaching the prescribed content. Even though Teacher 1 showed a high level of determination to demonstrate her willingness to work independently of a textbook the change in curriculum as she points out, forces her to consult textbooks, especially CAPS aligned textbooks when preparing her mathematics lessons.

On the basis of the analysis of responses from the survey, the analysis of the classroom lesson observations transcripts and analysis of the interviews transcripts, it is evident that the majority of teachers who took part in this case study use textbook regularly when preparing their lessons. The extent of use may differ from one individual teacher to the other and from one lesson to the next, but what is apparent is that the majority are using a textbook as their primary resources, hence an indication that they always use a textbook when preparing their lessons.

2. The extent of textbook usage in teaching mathematics lessons

Findings from the survey

When it comes to the teaching of the mathematics lessons a total of 21 respondents indicated that they always use a textbook when teaching their mathematics lessons. A total of 10 indicated that they use a textbook sometimes when teaching mathematics, 2 indicated occasionally and only 1 indicated that they do not at all use a textbook when teaching mathematics.

Findings from lessons observations

The four sampled teachers' lessons were observed. The analysis of the lesson observation transcripts revealed the following: Teacher 1 who in the survey indicated that she uses textbook occasionally when teaching mathematics lessons, spent 25% of her teaching time using content from the textbook. In both her lessons she hardly referred to any textbook but preferred to demonstrate concepts and engaged learners using examples and exercises with no sources of reference. Her claim from the survey was therefore confirmed. The other four teachers who in the survey indicated that they used textbook sometimes when teaching mathematics lessons, spend more than 70% of their teaching time using examples and exercises from a textbook. One of them also used a textbook for homework activities in both his lessons. Teacher 2 spent 82%, Teacher 3 79% and Teacher 4 71% of their teaching time using examples and learners' practice exercises from a textbook. This is more than their claim in the survey where they all indicated that they only use textbook sometimes when teaching their mathematics lessons. It appears that in the observed lessons they use textbook most of the time which may translate to always.

Findings from interviews

The analysis of interviews transcripts highlighted the following: Teacher 1 had a realization that she uses textbook more frequently than she initially thought. In her interview, she indicated that she uses textbook sometimes but not occasionally as she claimed in the survey. The other three teachers indicated that they always use a

textbook when teaching their mathematics lessons. This confirmed what the analysis of lesson observations transcripts revealed.

3. The extent of textbook usage for learner homework

Findings from the survey

The analysis of responses from the survey on the use of textbook for homework revealed that 21 respondents always use textbook for homework, 7 indicated that they use textbook sometimes for homework, 2 indicated that they occasionally use textbook for homework, 1 indicated that they do not use textbook at all for homework and 3 did not respond.

Findings from lessons observations

Teacher 1 used a textbook in only one of her lessons for homework and did not give homework in the second lesson. In his two lessons Teacher 3 used textbook for homework. Teacher 2 and Teacher 4 did not give any homework in both their two lessons because they ran out of time.

Findings from interviews

Teacher 1 indicated that she uses textbook sometimes for homework. The other three teachers indicated that they always use a textbook for homework. Only Teacher 3 demonstrated consistency with regard to the use of textbook for homework. From his response in the survey, his two observed lessons and his response in the interview he maintained that he always uses a textbook for homework.

Out of all four teachers, only one was able to give homework in all two of his observed lessons. One gave homework in one and ran out of time in the second lesson. The other two teachers did not have a chance to give homework in both their lessons because they ran out of time. The performance of Grade 9 learners in 2012, 2013 and 2014 South African mathematics Annual National Assessment (ANA) as

reflected in Chapter 1; portrays mathematics as one of the problematic subjects for learners. As a result mathematics, teachers are encouraged and expected to give their learners homework every day. This would mean that in their planning of lessons teachers need to allocate time for giving homework. The following two observations from this case study are that:

(i) When planning lessons teachers do not consider the importance of time, hence they run out of time and fail to give learners homework
(ii) Homework as part of teaching is not considered essential.

4. The extend of textbook usage for assessment

Findings from the survey

A total of 20 respondents indicated that they always use textbook when assessing learners, 10 indicated that they use textbook sometimes when assessing learners and 4 indicated that they occasionally use a textbook for assessing.

Findings from lessons observations

No formal assessment was given to learners during the observation of lessons.

Findings from interviews

Teacher 1 indicated that she always uses a combination of different textbooks and other resources when setting assessment tasks for her learners. Teacher 2 indicated that he always uses demonstration examples and practice exercises that he uses and gives to learners during teaching time to model the assessments questions. Since he demonstrated confidence in textbook use in his teaching and his responses in the survey and during an interview with him, it could be concluded that he uses a textbook as a source when setting assessment tasks. Teacher 3 indicated that he is always selective when using a textbook for assessment. He only uses questions from textbook if those questions cover his intended cognitive levels. What could be concluded is that he has other resources he uses together with a textbook. Teacher

4 indicated that she uses different textbooks together with other resources when setting assessment tasks.

It is, therefore, clear that all four teachers use a textbook as one of their resources when setting assessment tasks. What could differ is the degree of use for individual teachers.

5. The use of CAPS cognitive levels

Three teachers out of the four pitched questions in their examples and in learners' practice exercises to cognitive level 3. Two of the three also pitched questions in homework to cognitive level 3. One of them ran out time in both her lessons and was unable to give learners homework. The fourth teacher only pitched questions he used in his examples and learners' practice questions to cognitive level 2. He also ran out time in both his lessons and therefore could not give learners homework. None of the teachers pitched any of their questions to cognitive level 4 in all of their lessons.

CHAPTER 5: CONCLUSION

Introduction

As alluded to earlier it must be emphasised that this is a descriptive case study with a focus on a small sample of teachers in one of the fifteen districts under the Gauteng Department of Education (GDE) in South Africa (SA). The findings of the study cannot, therefore, be generalized. Instead, the study should be viewed as an initial investigation into the use of textbooks by teachers. Its tools and methodology can be used to do further research on a larger scale into the use of textbooks in SA schools.

Three categories of teachers' use of a textbook

The use of textbooks in the teaching of mathematics can be divided into three categories. The first category who constitute 57,6% of all respondents to the survey, is a group of teachers who always use a textbook when preparing their mathematics lessons, when teaching their mathematics lessons, for homework and when assessing their learners. For this category of teachers, it can be concluded that a textbook is one of the primary resources if not the only one that they use. This may be an indication of a high level of confidence these teachers have in a textbook for their mathematics instruction.

A second category is a group of teachers who constitute 23,7% of the total number of respondents. They indicated that they use a textbook sometimes for one or more of the four activities above. The assumption here is that this group of teachers may be using other resources as well. Therefore it can be concluded that a textbook is not used alone but with other resources in preparing, teaching, homework and assessment of learners.

The third category which comprises a very small number of teachers (7,9%) indicated that they use a textbook occasionally. What can be concluded here is that this category of teachers has a primary resource other than a textbook or a number of other resources they use; a textbook is one of their resources. As Nicol and Crespo put it, this could be a category of teachers who use a textbook as a model for creating their own classroom activities (Nicol & Crespo, 2006). A total of 9,3% of the respondents indicated that they do not use any textbook in their teaching of mathematics.

The role of experience and academic and professional qualifications

In all lessons observed, there is evidence of textbook usage. What could be clearly noticed is the difference in the extent to which each participant uses a textbook. The usage ranges from 25% to over 80% of the teaching time. What is also clear is that only one of the participants, Teacher 1with a maximum of 5 years teaching experience and a degree in Mathematics Education uses a textbook minimally. For her two lessons, her usage of content from a textbook could be approximated to 25% of her allocated teaching time. The three other participants, Teacher 2 with 10 years teaching experience and a degree in Mathematics Education, Teacher3 with 23 years teaching experience and a degree in Mathematics and Teacher 4with 19 years teaching experience and a post graduate degree spend over 70% of the classroom instruction engaging with content from a textbook. This may be indicative of the widespread use of a textbook by mathematics teachers in Gauteng. However, these results may be indicative of the practices in Quintile 5 schools in which all the observed teachers teach.

The study, therefore, revealed amongst others that individual teachers' academic and professional qualifications and a number of years teaching experience do not have much influence on how an individual teacher uses a textbook. What is clear is that teachers use prescribed textbooks chosen by their individual schools from a list of CAPS aligned textbooks provided by the Department of Education. In addition to

the prescribed textbooks, teachers use other textbooks of their choice to complement prescribed textbooks.

Textbook content factor

During interviews with the four teachers in the mini sample, all indicated that they use one or more textbooks to prepare and to teach their mathematics lessons, for homework and assessment. From their responses, it was evident that a total of three of four prefer to use a textbook, whereas only one indicated her scepticism with regard to reliance on existing textbooks for mathematics instruction. From the participants' responses, the extent to which each participant chooses to use a textbook appears to be influenced by the quality and relevance of content presented in a textbook. As for preparations of lessons it could not be verified during the lesson observations because none of the teachers had their lesson preparations on paper.

Despite the claims by some teachers of their minimal textbook usage or non-preference of a textbook in their teaching of mathematics, all four teachers indicated that they started using a textbook when they started teaching. In their view, a mathematics textbook has always formed a critical resource for the teaching and learning of mathematics. Hence some teachers experience a sense of frustration when there is a shortage of learners' textbooks. Certainly, many teachers would experience great difficulties if confronted with a situation where they may be expected to teach without a textbook.

The study shows that teachers use a textbook to define concepts to be taught, for examples, exercises and for homework. In cases where teachers use examples of their own initiative, there is evidence that they model such examples against the examples taken from their respective textbooks.

The study also reveals that teachers spend an average of 21% of their teaching time defining concepts from a textbook and an average of 24% on examples from a textbook. Learners are given an average of 25% of teaching time to do exercises from a textbook. It is, therefore, evident that teachers do not give learners enough time to work on their own and to engage with their textbooks in cases where learners

have a textbook; instead, teachers spend most of the instruction time talking and lecturing using content from a textbook or content from other resources. The rest of the time, almost 30% of teaching time, is spent on explaining and elaborating on definitions from a textbook, feedback from learners on exercises, corrections and whole class discussions led by the teacher.

In their preparation of lessons, time appears to be of less significance. Most of the lessons observed ended abruptly without a proper conclusion. As a result, learners were dismissed without homework. Teachers are aware that CAPS require them to consider and use the mathematics CAPS Cognitive levels when designing assessment tasks which therefore informs their preparation of lessons, choice of examples, exercises and questions for homework. However in contrast to the CAPS guidelines the study shows that teachers hardly used cognitive levels 4 examples and exercises in all lessons observed. In actual fact, teachers do not consciously choose questions based on the questions' cognitive level but take and use questions presented by textbook without necessarily grading them.

Limitations

Even though a survey was used as one of the data collection tools, this remains a descriptive case study on the basis of the use of a mini sample of four teachers for direct observation and interviews and on the basis that all surveyed teachers came from one district in Gauteng. Therefore, as pointed out earlier, the findings of this study are limited to a specific context and cannot, therefore, be generalized. It is worth mentioning that the study was not intended to and therefore did not explain the results but only gave a description of events as they unfolded. There is a need therefore for further research with much larger samples spread over all sorts of schools. This research report makes a sound contribution since it provides and presents methods of data collection which could be used with much larger samples.

Only lessons on three topics were observed. One would wish to observe how teachers use textbooks when teaching other topics and when teaching other grades. Samples of assessment tasks on the lessons observed were not yet available. Therefore nothing conclusive could be said about formal assessment tasks designed

by teachers. It would be interesting to see how examples and exercises used in the classroom relate or contribute to the formal assessment given to learners.

Future Research

Learner performance in Grade 9 mathematics is of great concern nationally. A number of intervention programmes are established nationally and provincially for the sole reason of improving learner performance in Grade 9 mathematics. Textbook provisioning for both teachers and learners seems to take the lead looking at materials used in these programmes. Two big questions still wait to be answered. The first question seeks to know the benefit towards learner performance resulting from teachers' use of textbooks. The second question needs to know whether textbook itself or the use thereof has any potential to provide improved learner performance in Grade 9 mathematics.

There is a need therefore for further research with much larger samples spread over all sorts of schools using the same methodology used in this case study. There is also a need to study how teachers integrate alternative resources like smart boards and tablets with prescribed textbooks in their teaching of mathematics and how this integration impact on the quality of teaching and possibly on learner performance.

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APPENDICES

ANNEXURE A: Questionnaire Format

Name: _____

Specify your academic and professional qualifications. e.g. BSc

Highest Qualification	Certificate	Diploma	Degree	Post Grad. Degree	Other

Specify your academic and professional qualifications. e.g. STD Maths 3

Highest Qualification in Mathematics	Certificate	Diploma	Degree	Post Grad. Degree	Other

How many years' experience do you have as a mathematics teacher? _____

In which Grades have you taught Mathematics in the last two years	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12	Other: Specify

Does the school give you a textbook(s) to use in your mathematics lessons?	Yes	No

Please give title(s) of any textbook that you use, and indicate who provided the textbook. (e.g. school, self, GDE, etc.)

Title of the textbook	Provided by school	Not by school. Provided by:

Indicate your choice by a tick

	Always	Sometimes	Occasionally	Not relevant	Not at all
I use a textbook(s) to prepare my lessons					
I use a textbook(s) to teaching class					
I use a textbook(s) to assess					
I use a textbook(s) for homework					

Do you use other resources e.g. DVDs to teach mathematics?	Yes	No

If yes state the resources.

_____

_____

Thank you very much for investing your time on this questionnaire and for providing valuable information.

ANNEXURE B: Class Observation Protocol

School: _____

Gender	Male	Female

Highest Qualification in Mathematics	Certificate	Diploma	Degree	Post Grad. Degree	Other

Observer: _____ Class: _____Date: _____

Number of learners: _____ Girls _____ Boys _____

Topic: _____ Concept: _____

Lesson:

1		2		3		4	

Scheduled time for this class: From _____ to _____.

Time instruction actually began: _____

Explain if different from scheduled time.

_____

Time instruction actually ended: _____

Explain if different from scheduled time.

_____

ANNEXURE C: A check list matrix

Aspects for observation	Time in minutes											
	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
DF-TEX												
DF-ALT												

EXL-TEX												
EXL-ALT												
LV-1												
LV-2												
LV-3												
LV-4												

EXS-TEX												
EXS-ALT												
LV-1												
LV-2												
LV-3												
LV-4												

AT-TEX												
AT-ALT												
LV-1												
LV-2												
LV-3												
LV-4												

HW-TEX												
HW-ALT												
LV-1												
LV-2												
LV-3												
LV-4												

List of resources:

_____
_____
_____
_____
_____

ANNEXURE D: Interview Protocol

- The teacher's previous education
- Prior experience in teaching mathematics
- The teacher's history in the use of textbooks
- The teacher's use of textbooks in lesson preparations
    - Generally
    - In observed lesson
- Specific textbook/resource used and why?
    - Generally
    - In observed lesson
- Specific examples and tasks used by teacher in observed lesson
    - Where did teacher get these examples or tasks from e.g. which textbook, or was it made up by teacher himself, etc.
    - Why were they chosen?
- Specific practise activities and why?
    - Where did teacher get these practice activities from eg which textbook, or was it made up by teacher himself, etc.
    - Why were they chosen?
- Specific assessment tasks and why?
    - Where did teacher get these assessment activities from e.g. which textbook, or was it made up by teacher himself, etc.
    - Why were they chosen?

ANNEXURE E: Lesson Observation Transcripts

Carina's lessons

Carina Lesson 1

[1]	Teacher:	So what we going to do we going to do rotation, (inaudible)… we going to rotate clockwise or anticlockwise niyangizwa (do you understand me)?	
[2]	Learners:	Yes	
[3]	Teacher:	When you rotate clockwise or anticlockwise what do you use? What do you use to measure (inaudible) Ah?	
[4]	Learner 1:	A protractor.	
[5]	Teacher:	A what?	
[6]	Learners:	A protractor	
[7]	Teacher:	A protractor, thank you. Why do you make noise?	
[8]	Teacher:	So we having ∆ABC, so we going …, when rotating, is either you rotate clockwise or anticlockwise, if you look at my protractor, if I will be, if I will be rotating clockwise in my protractor you don't write down	(*inaudible as she demonstrate on the chalkboard*)
[9]	Teacher:	If I will be rotating clockwise I am .., to use the measurement that's inside and if I will be rotating anticlockwise I use the measurement outside, niya bona (do you see)?	
[10]	Learners:	Yes.	
[11]	Teacher:	When you rotating, obviously you know how to rotate clockwise, clockwise is that direction and anticlockwise is that direction.	(*illustrating on the chalkboard*)
[12]	Teacher:	And your measurement we are measuring what … in degrees. Alright, thank you.	
[13]	Teacher:	So we having Δ ABC and our point of rotation is zero which is the origin, which is (0;0). Remember the origin is the where the x-axis intersect the y-axis, so we call that point P, that's the origin we call it P.	
[14]	Teacher:	So let's look at the example that we have then we (inaudible) … so rotate Δ ABC 90^0 clockwise at the origin, the origin is where x is zero and y is …	
[15]	Learners/Teacher:	Zero.	(*together*)
[16]	Teacher:	Right (*inaudible*)… close the door	(*instructing one learner*).
[17]	Teacher:	So there …	(*sound of intercom*)
[18]	Teacher:	Alright, we going to rotate, we start by rotating B, we are	

		going to rotate B 90^0 clockwise, understand?	
[19]	Learners:	Yes.	
[20]	Teacher:	Yes?	
[21]	Learners:	Yes.	
[22]	Teacher:	So you take your ruler and join these two points with a dotted line, (demonstrating on the chalkboard), P is the origin and B is a point that you want to rotate …, (*sound of intercom*).	
[23]	Teacher:	You draw the line … (*inaudible*), then I take my protractor and going to point B, and this line, a yellow line, do you see this line?	
[24]	Learners:	Yes.	
[25]	Teacher:	It must be in line zero, must be in line zero, so I'm going to move this line rotate it 90^0 clockwise, niyangizwa (do you hear me)?	
[26]	Learners:	Yes.	
[27]	Teacher:	So from zero, 10, 20, 30, 40, 50, 60, 70, 80, 90, and then I join P to the point that has been rotated, dotted line still.	(*working on the chalkboard*)
[28]	Teacher:	We start again, right?	
[29]	Learners:	Yes.	
[30]	Teacher:	So there, from here to there, niya bona (do you see)?	
[31]	Learners	Yes.	
[32]	Teacher:	So I join P to this point the rotated point from this line (*pointing to the line on the chalkboard*), so if you look there you can see that this line has been rotated 90^0 clockwise, right?	
[33]	Learners:	Yes.	
[34]	Teacher:	Right?	
[35]	Learners:	Yes.	
[36]	Teacher:	I take my ruler, I must measure BP, so I'm going here, I'm trying to find B' which is point B rotated, B rotated 90^0 clockwise. Understand?	(*she is working on the chalkboard*)
[37]	Learners:	Yes.	
[38]	Teacher:	If I measure BP, I find BP is 17, so this one point B, point B what?	
[39]	Learners:	Point B'.	
[40]	Teacher:	Point B', niya bona (*do you see*)?	
[41]	Learners:	Yes.	
[42]	Teacher:	Right. This line has been rotated 90^0 clockwise so what I'm going to do now again, what we do now again, do that … my point B, what are, what are the coordinates of B again?	
[43]	Teacher/Learners:	1 for x and 3 for y	(*answering together*)
[44]	Teacher:	Niya bona (do you see)?	
[45]	Learners:	Yes.	
[46]	Teacher:	Now let's move on, again that's from point P.	
[47]	Teacher:	We going to rotate now this point, we going to rotate 90^0 clockwise with reference to P, understand?	(*pointing at point A*)
[48]	Learners:	Yes.	
[49]	Teacher:	With dotted line again, take your protractor, so you're one rotating this line AP	
[50]	Learners:	Yes.	
[54]	Teacher:	So you going to measure (inaudible)…, Then you join with dotted line, niya bona (do you see)	(illustrating on the chalkboard)
[55]	Learners:	Yes.	
[56]	Teacher:	One step now is to measure AP to find A', measure AP	(working on the chalkboard)
[57]	Teacher:	(Inaudible)…, must be the same length, right?	
[58]	Learners:	Yes.	
[59]	Teacher:	This point is on point what?	

[60]	Teacher/Learners:	On point A'.	(*answering together*)
[61]	Teacher:	What are the coordinates of point A'?	
[62]	Teacher/Learners:	6 and 5	(*answering together*)
[63]	Teacher:	What point is left to rotate?	
[64]	Teacher/Learners:	Point C.	(*answering together*)
[65]	Teacher:	I want one of you to come and rotate point C. John come, come and try, yes?	(*calling one learner not real name*)
[66]	Teacher:	This is the line that we want to rotate right? Go to point C	(*Assisting John and giving him instruction as they rotate point C*)
[67]	Teacher:	Remember this, the line that you are going to rotate must be the line zero (inaudible)…, you must rotate 90^0 clockwise	
[68]	Teacher:	So what is the point?	
[69]	John:	C'	
[70]	Teacher:	What are the coordinates for point C'?	
[71]	Learners/ Teacher:	4 for x and 1 for y	
[72]	Teacher:	Niya bona (do you see)?	
[73]	Learners:	Yes.	
[74]	Teacher:	But we are not done, remember we are rotating a triangle, we must join … we were rotating these points (inaudible)…, then triangle A'B'C', we rotated tringle…	
[75]	Learners:	∆ ABC	
[76]	Teacher:	Niya bon (do you see)?	
[77]	Learners:	Yes.	
[78]	Teacher:	If you see the yellow, it shows you that you moved the line, this point here, 90^0, B the red one 90^0 clockwise there, the other one 90^0 clockwise there, niya bona (do you see)?	(*demonstrating on the chalkboard as she explains*)
[79]	Learners:	Yes.	
[80]	Teacher:	Tell me what do you notice about the coordinates?	
[81]	Teacher:	Yes. Ok not the same hands.	(*Stopping learner 1 from responding*)
[82]	Learner 2:	Inaudible	
[83]	Teacher:	Sorry?	(*Indicating she can't hear*)
[84]	Learner 2:	Inaudible	
[85]	Learner 2/ Teacher:	x becomes y and y becomes x	(*teacher assisting learner 2*)
[86]	Learner 3:	Inaudible	
[87]	Teacher:	Sorry?	(*Indicating she can't hear*)
[88]	Learners:	Negative …	
[89]	Teacher:	Negative what?	(*interrupts the learners*)
[90]	Learners:	Positive for x, negative for y	
[91]	Teacher:	You mean the coordinates swapped and after they swapped in this case because remember we… (inaudible)	
[92]	Teacher:	The, the coordinates, x becomes y any becomes x and in this case the sign for x changes, meaning if we look here at A' x became y and y became x but now we look there, this 5 is no longer negative, this 5 is now positive. You see?	(*pointing to the triangles on the chalkboard*)

[93]	Learners:	Yes.	
[94]	Teacher:	What I want to…I want you to look at ∆ ABC again. I want you to rotate for your classwork, ∆ ABC 90^0 anticlockwise at the origin. Understand?	
[95]	Learners:	Yes.	
[96]	Teacher:	So what we going to do, I'm going to do one example with you	
[97]	Learners:	Yes	
[98]	Teacher:	So first thing we are rotating this yellow one, right?	
[99]	Learners:	Yes	
[100]	Teacher:	So it's the same thing now, let me take out my protractor. The other time I was rotating this point 90^0 clockwise, so now I'm going to rotate it 90^0 anticlockwise. It will go somewhere there, somewhere there and I'll get B'. Understand?	
[101]	Learners:	Yes	
[102]	Teacher:	I'll only do one and the other one you will do it. So that point B…what we do is now, I'll place my protractor the other way around, remember you must… (inaudible)	
[103]	Teacher/Learners:	10, 20, 30, 40, 50, 60, 70, 80, 90	(*together*)
[104]	Teacher:	So I'm moving this line 90^0 anticlockwise so it will go somewhere there. Now we… (inaudible)	(*illustrating on the chalkboard*)
[105]	Teacher:	So this here will be point B' coordinates are -1 for x negative -3 for y. Niya bona (do you see)?	
[106]	Learners:	Yes	(*illustrating on the chalkboard*)
[107]	Teacher:	So what I've done is, I rotated, I rotated PB, I rotated PB there 90^0 anticlockwise, then I measured PB to find B', understand?	
[108]	Learners:	Yes	
[109]	Teacher:	I want you to do the same with that now, you must do the same with point A to get A', rotate point A anticlockwise at the origin to get A' and C to get C', understand? Right?	
[110]	Learners:	Yes	
[111]	Teacher:	Ah…Inaudible	*(sound of intercom*).
[112]	Teacher:	There are questions before we move on. Now we're rotating using the origin, right? Right?	
[113]	Learners:	Yes	
[114]	Teacher:	Are you done? Remember you must start by drawing your Cartesian plane and then when, when you rotating anticlockwise you are using the same Cartesian plane as you do with the example, understand?	
[115]	Learners:	Yes	
[116]	Teacher:	So you must only… (inaudible)… are we done?	

[117]	Teacher:	You rotating ∆ ABC anticlockwise to find ∆ A'B'C', understand?	
[118]	Learners:	Yes	
[119]	Teacher:	Good	(*leave learners to for about 5 minutes*)
[120]	Teacher:	You don't know how to use your protractor, you make sure you (inaudible)… your protractor	
[121]	Teacher:	If you don't know how to use your protractor, 'cause I know some of you can't, don't be afraid, come.	
[122]	Teacher:	Are you done? Who's having problems? Uh? How people are done?	
[123]	Teacher:	Stop writing something else. Do what you're supposed to do.	(*reprimanding a learner*)
[124]	Teacher:	If you done I want you to take those blue books and look at page 114, when you done.	(*illustrating on the chalkboard*)
[125]	Teacher:	For those who do not understand… (inaudible), just finish with this.	(*pointing to the chalkboard and a learner coming to the chalkboard)*
[126]	Teacher:	If you look there at the board, Thabo is rotating point A 90^0 anticlockwise, right? Right?	(*not his real name*)
[127]	Learners/ Teacher:	Point C.	
[128]	Teacher:	Right? Join your points.	(*Working with the learner at the chalkboard*)
[129]	Teacher:	If you look there we have ∆ A''B''C'' and that triangle A''B''C'' is ∆ ABC rotated 90^0 anticlockwise at point P, at the origin, understand?	
[130]	Learners:	Yes.	
[131]	Teacher:	Sometimes it might happen that you are rotating a shape and the point of rotation is on the shape itself, niyezwa?	
[132]	Learners:	Yes.	
[133]	Teacher:	So sometimes it might happen that, something…(inaudible)	
[134]	Teacher:	I want to do something differently… I want to show you something, don't be excited about the measurement, is a rough thing	(*Working at the chalkboard*)
[135]	Teacher:	So this is point B, this is point C and this is point …	
[136]	Learners:	A	
[137]	Teacher:	Niya bona (do you see)?	
[138]	Learners:	Yes	
[139]	Teacher:	Ah… here, this triangle was rotated 90^0 anticlockwise niya bona (do you see)?	(*demonstrating on the chalkboard*)
[140]	Learners:	Yes.	
[141]	Teacher:	It might happen that the question say rotate ∆ ABC clockwise at point B, you must rotate this triangle this direction at point B, niya bona (do you see)?	
[142]	Learners:	Yes.	
[143]	Teacher:	At point B, so we move that direction, is clockwise, niya bona?	
[144]	Learners:	Yes.	
[145]	Teacher:	If it's anticlockwise you have that direction neh? You might also be at point C, anticlockwise you have that direction, clockwise you have that direction, right?	(*demonstrating on the chalkboard*)
[146]	Learners:	Yes.	
[147]	Teacher:	Even at point A clockwise you have that direction and anticlockwise you have that direction, niya bona?	(*demonstrating on the*

			chalkboard)
[148]	Learners:	Yes.	
[149]	Teacher:	I want us now to look at the example in the textbook. It's page 14…, if you look page 140 … it's says…	(*reading from a textbook*)
[150]	Teacher:	I want you to start from number 1 to number 3… niyezwa?	
[151]	Learners:	Yes.	
[152]	Teacher:	You start from number 1, number 2 to number 3, niyezwa?	
[153]	Learners:	Yes	
[154]	Teacher:	Go	(*Dismiss learners*)

Carina Lesson 2

[1]	Teacher	As we already said, we collect data, we collect information after collecting information, what do we do? We interpret it then come to conclusion, so give me an example where people collect statistics to interpret in time.	
[2]	Learner 1	Questionnaire	
[3]	Teacher	What are you talking about? I am saying an example whereby people collect information to interpret it in time to come.	
[4]	Learner 2	Teenage pregnancy	
[5]	Teacher	Teenage pregnancy, yes right	
[6]	Learner 3	Ebola	
[7]	Teacher	Ebola, yes right	
[8]	Learner 4	World population	
[9]	Teacher	Wold population, right	
[10]	Learner 5	People using a bus	
[11]	Learner 6	People who drop out of school	
[12]	Teacher	I am sure you are not one of those people who drop out. So now we are going to collect data in class. As I asked you before we start by saying those who are the only child. One. If you are two raise up your hand. 1, 2, 3, 4, 5, 6, 7.	(*Learners raise up their hands and the teacher counts the hands and write the number on the chalkboard*)
[13]	Teacher	If you are three. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14. It's fourteen.	(*She is counting the hands and write the number on the chalkboard*)
[14]	Teacher	Then if you are four. 1, 2, 3. Is only three	(*She is counting the hands and write the number on the chalkboard*)
[15]	Teacher	Then if you are five or more. Okay it's only one.	
[16]	Teacher	So what is my story? Is that after collecting your data, before you do anything you have to find the average of five students in this class? We have to arrange the data in class. So we have five terms right?	
[17]	Learners	Yes	
[18]	Teacher	So now we have to arrange our data in what? In ascending order, that is from smallest number to the biggest number. So now let's arrange our data	
[19]	Learners	1, 1, 3, 7, 14	

[20]	Teacher	Thank you. So how many terms do we have?	
[21]	Learners	Five terms	
[22]	Teacher	Five terms right? Now we are going to do what we call measuring of circum …measures of circu … is when you try to find a middle numbers and there are many ways to find a middle number. The first way is to find a median number. What is the median number? It is a middle number, it is a middle value. So when we move on, we going to do our measure of circ … and look at the data that we collected in our class. After finding our median number we go to the second one that is the mode.	(*The teacher is trying to say measures of central tendency*)
[23]	Teacher	Who can tell me what is a mode?	
[24]	Learner	The value of a number that appears the most	
[25]	Teacher	The mode is the value of a number that appears the most. So what is the mean? Let's check if you still remember	
[26]	Learner	I think is the total of numbers	
[27]	Teacher	It is a sum, right? What is the sum? It is the number that you get when you add. The sum of all the terms, the sum of all your values divided by the number of terms that you have in your data. So the mean is the sum of all the values divided by the number of terms that you have, right? Let's look at our example, let's find our median. Remember you must write your data down in ascending order every time before you find anything, right? So we having 1, 1, 3, 7, 14. So let's find our median. If you look there, median is a middle number, right? In this case terms must be equal on the left hand side and on the right hand side.	
[28]	Teacher	How many terms do we have?	
[29]	Learners	Five terms	
[30]	Teacher	Which one is our median number?	
[31]	Learners	3	
[32]	Teacher	How many numbers came before 3	
[33]	Learners	2	
[34]	Teacher	How many numbers came after 3	
[35]	Learners	2	
[36]	Teacher	So what will be our median?	
[37]	Learners	3	
[38]	Teacher	I want to tell you something. When you are given a set of data to give a median, if your data is an odd data, meaning you have four terms, five terms and so forth, we call them odd data, meaning you have the number of terms that you have, not that they are odd terms, let's say you have four terms, five terms and so forth. We call them odd data.	
[39]	Teacher	Say you have three terms, you'll have one middle number, five terms, one middle number, seven terms, one middle number, nine terms one middle number. Right? Hey wena "Tlaki", vuka (you "Tlaki" wake up).	(*Reprimanding one learner*)
[40]	Learners:		(Laughing)
[41]	Teacher:	9 Term, one middle number, right. So on let's move on. When our data is 4 terms, our middle number is going to be 2, you must add them together and divide them by 2 niyabona (do you see)?	
[42]	Learners:	Yes.	
[43]	Teacher:	Add term number 2 and term number 3, add them together and divide them by 2, niyabona (do you see)?	
[44]	Learners:	Yes.	
[45]	Teacher:	8	
[46]	Learners:	Term number four and five	
[47]	Teacher:	You have three terms that come before, if you have ten	

terms, add them together and divide them by 2. Term number five and six add them and divide by 2.

[48] Teacher: In this case how many terms do we have?

[49] Learners: Five.

[50] Teacher: So term number what will be our median number?

[51] Learners: 3

[52] Teacher: 3 because 5 is an odd number. Good. So now let's move on to our mode. Do we have a mode?

[53] Learners: Yes.

[54] Teacher: What is it?

[55] Learners: 1.

[56] Teacher: The number that appears the most is 1, niyabona (do you see)?

[57] Learners: Yes

[58] Teacher: Good. Now let's move on up straight to our mean. Sum of the terms let's see, it is 1 + 1 + 3 + 7 + 14 divide by 5. So how many terms do we have?

[59] Learners: 5

[60] Teacher: This thing is the same as, let's say you write a test and the test was out of 100 and the average of this class is 55%, meaning now do I get to 55%. I add all the percentage you got of, of 100. If you got 50 marks, or 60 marks or 30 marks or 70 marks, I add them and divide them by the number of learners in a class that is how you get the average.

[61] Teacher: If you can look at your reports (learner progress reports), they show you the average. And how did they get your average? They took all your marks and add them together and divided by the number of learners in grade 9, Understand?

[62] Learner: In grade 9 or in class?

[63] Teacher: No, grade average, the whole of grade 9, right? So let's look here. What is our mean, what is the sum of these terms?

1 + 1 = 2

2 + 3 = 5

5 + 7 = 12

12 + 14 = 26

= $\frac{26}{5}$. Five goes how many times into 26?

[64] Learner: 5 times

[65] Teacher: Remainder?

[66] Learners: 1

[67] Teacher: Over?

[68] Learners: 5

[69] Teacher: $5\frac{1}{5}$ in decimal form 5,2

[70] Teacher: Do you know how to do decimals?

[71] Learners: Yes.

[72] Teacher: How come Is 5,2? What is $\frac{1}{5}$ as a decimal?

[73] Learners: 0,1, …….. 0,2

[74] Teacher: We have 5^{th} of 5, add them together it will give you 1. Do you know how to change fractions into decimal?

[75] Teacher: When it comes to decimal 0,1 + 0,1 + 0,1 + 0,1 + 0,1 will give what?

[76] Learners: 0,2

[78] Teacher: What is 0,2 + 0,2?

[79] Learners: 0,4

[80]	Teacher:	0,4 + 0,2?	
[81]	Learners:	0,6	
[82]	Teacher:	0,4 + 0,2?	
[83]	Learners:	0,8	
[84]	Teacher:	0,8 +0,2?	
[85]	Learners:	1	
[86]	Teacher:	0,2 and 5 will give 5,2 cause we have 5 and a 5^{th}, the same as 5 + 0,2 which is 5,2.	
[87]	Teacher:	Now let's move to measures of dispersion. Those that tell us how our data is spread. Do you have any questions before we move on? Any questions borrow me your Platinum textbook.	
[88]	Learners:		(*Making noise as they take out textbooks*)
[89]	Teacher:	We are going to do different types of graphs, if you turn to page 274, if you look there, summarising of data in the previous lesson we learned that measures of central tendency or the mean, shut up. Numbers that distract the values of a set of a data the three ways we use are the ones we write on the board, the median the middle value so the median is, we must first arrange our data, right? The second one is the mode, the value of a number that appears the most and the third one is the mean, the average of all data which is the same as the sum of all the terms divided by number of terms, right?	(*Reprimanding the learners*)
[90]	Learners:	Yes.	
[91]	Teacher:	Before we divide we have a measures of dispersion, so with measures of dispersions it tells us how data is spread, so meaning if you have an outlier that is far away from other ones or the number that is not the same as others, like if you have smaller number like 1, 3, 4, 7 and 100. So 100 will be outlier	(*writing on the chalkboard*)
[92]	Teacher:	Let's start with measures of dispersion, we start with the range. The range tells us how spread our data is. What is the range? How do you find a range if you are given a data?	
[93]	Teacher:	Obviously our data must be from the smallest number to the biggest number. Right? How do you find a range? You didn't learn this in grade 8?	
[94]	Learners:	Noooo	
[95]	Teacher:	To find a range, we take highest value and subtract the lowest value. So you subtract the lowest value from the highest value. Right?	
[96]	Teacher:	Let's find our range from this example	
[97]	Learners:	14 – 1 = 13	
[98]	Teacher:	So our range is 13. So now what I'm going to do before we move on, we'll talk about outliers with scatter plots…, let's see how many people understand.	
[99]	Teacher:	I am going to give you two sets of data, then you must find the median, the mean, the mode and the range for all the data. Let's do a quick classwork.	
[100]	Teacher:	Shut up and sit down.	(*reprimanding an unruly learner*)
[101]	Teacher:	'Cause we don't have enough textbooks, we'll copy from the board. Right? What is today's date?	(*writing on the chalkboard*)
[102]	Learners:	13^{th}	
[103]	Teacher:	Given the following data find ….	(*copying from the textbook and writing on the*

			chalkboard)
[104]	Learners:	Inaudible	(*Laughing*)
[105]	Teacher:	…. if you need help you raise up your hand	
[106]	Teacher:	The sum of all values, how many terms do we have?	
[107]	Learners:	Six	
[108]	Teacher:	Is that an even data or odd data	
[109]	Learners:	Odd data	
[110]	Teacher:	Why are you not writing the example	
[111]	Teacher:	How many people are not done?	*(Looks around)*
[112]	Teacher:	One. Quick	
[113]	Teacher:	Right, you writing tomorrow	
[114]	Learners:	Yes	
[115]	Teacher:	Close your books and go	

Mohau's Lessons

Mohau Lesson 1

[1]	Teacher:	Right when we were in grade 8, when we were in grade 8 we did some bit of statistics, isn't?
[2]	Learners:	Yes
[3]	Teacher:	Where we collected some information and then tried to organize it. Isn't?
[4]	Learners:	Yes
[5]	Teacher:	When we organize our data there are three things. What was that? So in this case we will go on and organize and summarise our data alright?
[6]	Learners:	Yes
[7]	Teacher:	So let's open our textbook. We start on page 273 and 274, then we take note of where it talks about measures of central tendency. What do you understand by a median or central tendency? This we must know from grade 8. What do we understand by median, our measures of central tendency? What do we understand by median? Yes?
[8]	Learner:	Sir, median is a number, when you arrange the numbers from small to the biggest then take the middle number
[9]	Teacher:	Then the middle number is our median
[10]	Learner:	Yes
[11]	Teacher:	What she is saying neh, we are arranging our numbers in terms of size and our middle number is our median
[12]	Learners:	Median
[13]	Teacher:	Now, suppose I have ten numbers right? Which means they are even am I right?
[14]	Learners:	Yes
[15]	Teacher:	Which one is my middle number?
[16]	Learner:	Sir you add the numbers and divide them by 2
[17]	Teacher:	I add the two middle numbers and divide them by 2
[18]	Learners:	Yes
[19]	Teacher:	Right. From our textbook quickly please let's look at those notes from page 274, page 274. We write down what we understand by median. Right what do I understand by mean/ What do we understand by mean?
[20]	Learner::	Sir is like uh, when you add up all the numbers and the highest, when you add up all the data and the total of the data …
[21]	Teacher:	Uh, it's not clear what you want to say.
[22]	Learner:	It is the average
[23]	Teacher:	It is the average. How do we get that average? Yes?

[24]	Learner :	Sir we add and divide by the number of numbers	
[25]	Teacher:	We add the numbers and divide by the number of numbers	
[26]	Learner:	Yes	
[27]	Teacher:	In other words our mean is equal to the sum of all the numbers … (*inaudible*)	
[28]	Teacher::	What about the mode? What do we mean by mode? Mode. What do I remember about mode? Yes?	
[29]	Learner:	Sir, it is the number that appears the most.	
[30]	Teacher:	It is the number that what? Appears the most.	
[31]	Teacher:	Suppose I'm given data on the frequency table. Then what is the mode, what is our mode?	
[32]	Learners:	(*Inaudible*)	
[33]	Teacher:	We are given information on a frequency table, then what would be our mode?	
[34]	Learner:	(*Inaudible*)	
[35]	Teacher:	Remember we are saying the number that appears the what?	
[36]	Learners:	The most	
[37]	Teacher:	In other words when we talk in terms of the mode it is the number with the highest what?	
[38]	Learners/ Teacher:	Frequency	
[39]	Teacher:	So we say our mode is the number with highest frequency.	
[40]	Teacher:	Right just to remind ourselves about that , if you go to page 277 and start off, that is our example	
[41]	Teacher:	Right, may somebody read question 3?	
[42]	Learner:	Consider the following table. The school is doing a survey on how learners use the bus every day …	(*Reads the question from the textbook*)
[43]	Teacher:	Right. In other words when they say key: 2/7 what does it mean?	
[44]	Learners:	27	
[45]	Teacher:	It means 27. Then it says, b) what are they asking us to do?	
[46]	Learner:	Determine the mode, calculate the mean …	
[47]	Teacher:	And the mean. So what do we normally have on our left? What do we have on our left	
[48]	Learners:	Our tens	
[49]	Teacher:	What do we call these?	
[50]	Learners:	Stem	
[51]	Teacher::	Our stem, and what? This side?	
[52]	Learners:	Leaf	
[53]	Teacher:	I was saying 2/7 but take into account I got numbers like (*inaudible*)… What numbers are that?	
[54]	Learners:	0 , 5 , …	
[55]	Teacher:	What?	
[56]	Learners:	0 , 5	
[57]	Teacher:	Here we have 0 and what other number?	
[58]	Learners:	5	
[59]	Teacher:	Uh-huh	
[60]	Learner/ Teacher:	1	
[61]	Teacher:	Ok	
[62]	Learners:	Yes	

[63] Teacher: Our 2/7 means 27. So here then is my 2
[64] Learners: 3
[65] Teacher: Then 3, then …
[66] Learners: 4
[67] Teacher: Correct
[68] Learners: Yes
[69] Teacher: Quickly in our exercise books let's go… Remember what we say first of all, first of all what we go on and order them in any order. What are we writing here? For instance we write?
[70] Learners: 5
[71] Teacher: Then
[72] Learners: 5

[73] Teacher: Uh-huh, and so on and so on. Continue please.

[74] Teacher: Right. What does this one do? This one gives us? Can we have your answers?
[75] Learners: 5 5 6 9
[76] Teacher: 5 5 6 and what/
[77] Learners: 9
[78] Teacher: Can someone give us the next one?
[79] Learner: 0 2 5 5
[80] Teacher: Organize now, yes organize
[81] Learner: 0 2 2 3 4 5 5 8 8 9
[82] Teacher: 0 2 2 3 4 5 5 8 8 9. Next one? Yes?
[83] Learners: 0 0 0 0 0 0
[84] Teacher: How many zeros do we have there?
[85] Learners: Six
[86] Teacher: Six of them isn't? Then next?
[87] Learner: 1 3 3 4 4 5 7 8 9
[88] Teacher: The here?
[89] Learner: 0
[90] Teacher: Then we go on and answer question a). What is our mode?
[91] Learners: Yes.
[92] Teacher: The number that appears what?
[93] Learners: The most
[94] Teacher: Which one is that?
[95] Learners: 28
[96] Teacher: Are we correct? Median? What is it we do to find median?
[97] Learners: Median
[98] Teacher: Median. Yes median. How many numbers do we have?
[99] Learners: 32
[100] Teacher: 32. Please note once we have done that, we have already arranged them in order of size.
[101] Learners: Size. Yes
[102] Teacher: What is our position? How do I get my position? For the median? How do we get the position for the median? Yes?
[103] Learner: Sir we look at the middle number
[104] Teacher: We look at the middle number. Which one is our middle number?
[105] Learners: 19 and 30
[106] Teacher: How do I get that middle number? Are we counting them?
[107] Learners: Yes
[108] Teacher: Here we talking in terms of … how many numbers do we have?
[109] Learners: 32
[110] Teacher: So what is the position? Know what, if there are 32 numbers it means we add 1. (32 + 1) ÷ a. How many numbers do we have?
[111] Learners: 32
[112] Teacher: 32. So normally to get the position it is (n + 1) ÷ 2
[113] Learners: 2

[114] Teacher: That will give me position. Are we together?
[115] Learners: Yes
[116] Teacher: Right. If we've got 3 students, there are 3. Are we together?
[117] Learners: Yes
[118] Teacher: So which one is our median? How many do we have?
[119] Learners: 3
[120] Teacher: Plus 1
[121] Learners: 4
[122] Teacher: Divide by 2. Now the position is number what?
[123] Learners: 2. Oh….
[124] Teacher: Are we together now?
[125] Learners: Yes
[126] Teacher: Now my position is (n + 1) ÷ 2. In this case my position is (32 + 1) ÷ 2 which is?
[127] Learners: 16,5
[128] Teacher: Is 1, 2, 3… 16, 16,5. Are we together? So I have two middle numbers. Are we together?
[129] Learners: Yes
[130] Teacher: I've got two middle numbers. So how do I find our median?
[131] Learners: (19 + 30) ÷ 2
[132] Teacher: That gives me my median. The answer is 19,5. Then what about our mean? How do we calculate our mean? We're saying?
[133] Learner: We find the sum of …
[134] Teacher: We find the sum of all the values that we have. Isn't?
[135] Learners: Yes.
[136] Teacher: Then we divide by?
[137] Learners: The number of the values
[138] Teacher: Which is? So if we add what are they giving us/ Please don't forget to write the key. Right?
[139] Learners: Yes
[140] Teacher: Our key. What is it?
[141] Learners: 555
[142] Teacher: 5 hundred what?
[143] Learners: And 55
[144] Teacher: 55. We are diving by?
[145] Learners: 32
[146] Teacher: Then answer is?
[146] Learners: 17,3
[147] Teacher: 17 what?
[148] Learners: 3
[149] Teacher: Right. The next question is saying?
[150] Learners: Find the extremes
[151] Teacher: Find the extremes. What do you understand by the extremes?
[152] Learners: Minimum and maximum
[153] Teacher: Minimum and the maximum. So we are saying, what is our maximum?
[154] Learners: 30
[155] Teacher: And the minimum?
[156] Learners: 5
[157] Teacher: I will just, before we talk of the measures of central tendency we have a measure of dispersion, where we are saying how we calculate our range. How do we find our range?
[158] Learner: We subtract maximum by minimum
[159] Teacher: Maximum minus the …
[160] Learners: Minimum
[161] Teacher: Maximum minus the minimum. What does it give us?
[162] Learners: 25
[163] Teacher: 30 – 5 which is 25. Right the last question. They use a 13, 15 or 30 seater. What is your answer?
[164] Learners: 30 Seater
[165] Teacher: Let's take into account our numbers

[166] Learner: 30 Seater, so there is enough space
[167] Teacher: So we say 30 seater because most or half the time more than 19 students use the bus. Let's go on to page 276. Once more exercise 22.2 page 275 and answer all those questions, question 1, 2 and 3
[168] Teacher: Right, when they say arrange from shortest to tallest, we are arranging in order of?
[169] Learners: Size
[170] Teacher: Then what do you understand when they say determine the median? What are we supposed to do? Median, what do we do?
[171] Learner: Sir we find the middle number
[172] Teacher: We find the middle number after arranging them in order of size. Understand?
[173] Learner: Sir, I want to ask you about the hundreds
[174] Teacher: It all depends on what you want to do. If you're drawing a stem-and-leaf it all depends on my key. Like now you talk in terms of hundreds. We count starting off by 10 and then 7. It means 107. Ok?
[175] Learners: Yes
[176] Teacher: Are we together?
[177] Learners: Yes
[178] Learner: Sir if you saying when we find median it is (n + 1) ÷ 2 …
[179] Teacher: She is asking if we find median whether it is (n + 1) ÷ 2. (n + 1) ÷ 2 is the position not the median. It only gives the position of the median. Are we together there?
[180] Learners: Yes
[181] Teacher: Now let's go on and answer those questions
[182] Teacher: Right what is my smallest number there?
[183] Learners: 103,5
[184] Teacher: Then if we arrange them I will have …
[185] Learners/ Teacher: 103,5; …
[186] Teacher: Give us the answer
[187] Learners: 140,7; …
[188] Teacher: Our question is to find the range. I mean we go from 103,5 to …How do we find the range? It is maximum minus …
[189] Learners: Minimum
[190] Teacher: The question is saying how many learners were measured
[191] Learners: 30
[192] Teacher: It's only 30. Isn't?
[193] Learners: Yes
[194] Teacher: Where do I find my median? What is our position?
[195] Learners: (30 +1) ÷ 2
[196] Teacher: (30 +1) ÷ 2. Isn't?
[197] Learners: Yes

[198] Teacher: So what do we say?
[199] Learner: 31,5
[200] Learners: 15,5
[201] Teacher: 15,5. That's my position
[202] Learners: 163,7 and 164
[203] Teacher: What are my two? So what are we saying? 15,5, so what does it give us
[204] Learners: 163,5 Plus 164
[205] Teacher: 163,5 Plus 164 divided by …
[206] Learners: 2
[207] Teacher: Go on and do the same thing in the next question.
[208] Teacher: For homework go again and do exercise 22.4, question 2 and 3 on page 276

Mohau Lesson 2

[1] Teacher: The last one was the odd … it was 33 right?
[2] Learners: Yes
[3] Teacher: Seeing 32,5 then (e), it was a matter of finding the frequency of that. Between

10 and 20 equal 5, 30 and 30 equal 7, 30 and 40 equals 5, 40 plus 50 equals 4, 50 plus 60 equals 2

[4] Learner: No
[5] Teacher: Ah let's not just say no, Yes if you have a problem lift up your hand
[6] Learner: Sir don't understand question 3 (e)
[7] Teacher: You don't understand question 3 (e)?
[8] Learner: Learner: Inaudible
[9] Teacher: The table here represents the pocket money each grade 9 learner in a class have. Complete that. In other words what are we saying? Those who got R10 and R20 how many are those?
[10] Learners: 5
[11] Teacher: What is it that we have? We have 1 0 0 1 1 8 and what does this necessarily mean? How much do we have?
[12] Learners: 10 ; 10 ; 11; 11 ; 18
[13] Teacher: And how many are those?
[14] Learners: 5
[15] Teacher: Any other problem from the homework?
[16] Learners: No
[17] Teacher: Are you sure?
[18] Learners: Yes.
[19] Teacher: Ok. Let's move on to corrections, right? Now I will add the mean, mode, median and … and what name did we give to those, mean, mode, median and … what do we call those?
[20] Learners: Measures of central tendency.
[21] Teacher: Then we go on to organising and summarising data, alright?
[22] Learners: Yes.
[23] Teacher: Right. Now we want to go on and represent that data by means of graphs.
[24] Learners: Inaudible.
[25] Teacher: See 3 it gives us time. Remember when we introduced this topic we talked about discrete data. Who remembers what discrete data is? What do you remember by discrete data?
[26] Learner: Data that can be counted
[27] Teacher: Data that can be counted. Give us examples of discrete data.
[28] Learner: Bar graphs
[29] Teacher: She says bar graphs
[30] Learner: Sir like we can show discrete data and by using diagrams
[31] Teacher: But then what is discrete data? What I am saying is give me an example.
[32] Learner: Tangible, like things you can touch, like cars
[33] Teacher: So what you saying is cars, right? Then when we talk of continuous data, what type of data is that?
[34] Learner: Measurement
[35] Teacher: Right that is where there's measurement and time. We are measuring that. Then what do we remember about data from previous grade 8 and 7 or a compound data?
[36] Learner: Sir, a bar graph has bars that don't touch each other.
[37] Teacher: Bars that don't touch each other, what do you mean touch?
[38] Learners: Laughing
[39] Learner: Inaudible
[40] Teacher: Come again
[41] Learner: There are vertical and horizontal bars
[42] Teacher: There are vertical, horizontal bars?
[43] Learner: Data connected on the y-axis
[44] Teacher: So what is that?
[45] Learner: Sir, it also has a constant scale
[46] Teacher: It also has a constant scale. In other words what are we saying? Bar graphs are used to compare categorical data. We are talking in terms of our discrete data. A bar graph is a visual display (writing on the board)
[47] Teacher: We also written that definition, so let's go on to page 278 of our textbook. It gives us all our definitions and examples. A fine graph that uses vertical or horizontal bar to show a data, then we also saying, about bar our data, who

can read that?

[48] Learner: A graph that uses two sets of bars

[49] Learners: Laughing

[50] Teacher: A graph that uses two sets of data and what we know of discrete data is all about?

[51] Learner: Data that can be counted

[52] Teacher: Let's look at that example on page 274

[53] Teacher: It says, consider the frequency table below, it contains number of learners, a sport offered at a school in a year. Note our sports netball, rugby, hockey and so on in a year.

[54] Teacher: Then we have number of learners, number of boys and number of girls.

[55] Teacher: So they say draw a bar graph representing the number of learners by sport. In other words which column am I going to use there?

[56] Learner: Number of learners.

[57] Teacher: One which says number of learners. If you look now at our answer, you see that those who play rugby are 80? That to us is a vertical bar. Are we together?

[58] Learners: Yes

[59] Teacher: Please note with my bar graph I am leaving equal spaces between my bars and that distance should be the same for every bar. Note that the width of my bar should be the same, they should be all the same with my bars, if you can look at that

[60] Learners: Laughing

[61] Teacher: But we are saying the width should be the same, the distance between the bars should be the same.

[62] Teacher: What is the difference now when we talk about compound data?

[63] Learner: (*Inaudible*)

[64] Learners: Shouting

[65] Teacher: Don't shout at him, give him a chance

[66] Learner: It's a bar that has a normal graph

[67] Teacher: How can you …

[68] Learner: I think the bars, the two bars …(*inaudible*)

[69] Teacher: She is saying that we've got 2 bars, so what it is that we can say in general…

[70] Learner:

[71] Teacher: We can compare one object by, for instance in our example here, we are talking about sports. Look at example on page 279 please. Note that we now have compound bar data of which you are given a blue standing for boys and for the girls. If I may ask using that compound data, how many girls play rugby and boys play rugby?

[72] Learner: 8 Girls play rugby while … play rugby

[73] Teacher: Then in terms of hockey?

[74] Learner: 60 Boys play hockey while 75 girls play hockey

[75] Teacher: Therefore we are saying for compound bar data and bar graph, we are talking in terms of discrete. We use an histogram when we drawing a continuous data, when we are measuring in terms of distance, note with our histogram what happens here?

[76] Learner: Sir, the bars are close to each other.

a) Draw a bar graph representing the number of learners per sport.
b) Draw a double graph representing the number of boys and number of girls per sport in the school.

[77] Teacher: There are class intervals, then let's go on to page 276, exercise 23.1. choose between a bar graph, a double bar graph and useful graph, representing data from the following terms:

[78] Teacher: Term number 1

[79] Learner: A histogram

[80] Teacher: Right. She's saying histogram. Anyone with a different opinion?

[81] Learner: Question 1 using a bar graph

[82] Teacher: Question 1 using a bar graph; is that what you're saying?
[83] Learner: Sir?
[84] Teacher: We are saying informationwe have, information is, become grouped, it becomes grouped data.
[85] Teacher: We are grouping in terms of various groups, like those who are five years and less than seven, or those who are seven but less than nine. There is an interval now; all the information now is grouped. Question 2
[86] Learner: (*Inaudible*)
[87] Teacher: Why are you saying that? Answer that. Why are we going to use the grouped data
[88] Learner: Compare
[89] Teacher: Compare what?
[90] Learners: 2006
[91] Teacher: There are class intervals, and then let's go on to page 280, exercise 3.1. choose between a bar graph, a double bar graph and useful graph, representing data from the following terms:
[92] Teacher: Let's go on and answer question 2 quickly
[93] Learner: Inaudible

Thami's Lessons

Thami Lesson 1

[2] Teacher: We are going to look at three dimensional objects part on geometry, that is part of geometry, it involves the analysis of different shapes, we must be in position to tell the properties of that particular shapes, but our shapes has names for example we have shape that are collection known as Polyhedrons, by definitions Polyhedrons are three dimensional objects with all its faces being polygons Poly means many, so a three dimensional object for example a cube, it has many faces

[3] Learners: Six (6) sides

[4] Teacher: So it has six sides it is a poly , Poly means many, so we are going to look at those Poly, they subdivided by two, the are those that are regular and those that are said to be irregular, but what is the difference between, what is the meaning of regular?

[5] Learner: Sir I think like both the side of the shape have the same face

[6] Teacher: Yes, the similarities in the shapes/faces, so a regular polyhedron is an object three dimensional, with all faces being polygons it means they have fixed shapes are they are congruent to each other, are irregular the faces differ in shape and in sizes and, will give you this I just made copies from the textbook, for the different shapes so that as we proceed we will just refer to it. Can you take one each? Right.

[7] Teacher: What is with this late coming? (*Reprimanding learners coming in*)

[8] Teacher: Right, our Polyhedron is our similar term, if we have many of them we call them, Polyhedra and regular polyhedra are called Platonic solids and these are characterized by faces which are congruent to each other. Please don't be

confused by the word Polyhedra its just plural of Polyhedron just like boy, boys so we have a Polyhedron with a three dimensional object with all faces being polygon if its many of them we don't say Polyhedron we say Polyhedra, do you get that

[9] Learners: Yes

[10] Teacher: Right, what is the plural for stadium?

[11] Class: Stadiums, … inaudible

[12] Teacher: (I*naudible*)… but not for all the plurals, when you see Polyhedra you must remember that it is a plural for polyhedron, we don't need to add s, right then what is the characteristics of this Platonic solids, the faces are regular and are congruent to each other, but I've just given you copies of platonic solids, right eh the general characteristics of these platonic solids the first one is faces are common are they are regular polygons, if you check these faces are the same, you turn it whichever way you face them you find that they are tri-angular, right that is the general characteristics of platonic solids, the other characteristics is that the edges are of the same length, in other words the length of this side and the length of the other side are the same, we have the same number of edges that meet at each vertex?

[13] Class: It is a point

[14] Teacher: Incomplete, so you mean any point is a vertex

[15] Learner: It is a point where lines meet

[16] Teacher: Right, it is a point where two lines meet, we call that a vertex, right our platonic solids for example,tetrahedron.The word tetra- means four, are we together?

[17] Learners: Yes

[18] Teacher: Tetra- means four, so it means a Tetrahedron must have four equal faces, and for a Tetrahedron the faces are triangular in shape, so whenever you see the word Tetra you must remember it has for equal faces. Right then we go on to Hexahedron, how many sides did you say the cube have?

[19] Learners: Six (6)

[20] Teacher: Six is it? Right so the name Hexa- means 6 we have Pentagon, Penta for 5, Hexa- for 6, Hecta 7, Octa 8, Nonagon 9, Tedagon 10, right so since a cube has six (6) sides,now they given a good term, the name cube is used in lower grades now that we are advanced grade, instead of saying a cube, just to check if you say Hexahedron they will be confused, right?

[21] Learners: Yes

[22] Teacher: Hexahedron, we are naming this according to the number of faces

[23] Teacher: Hexahedron has got six faces, let's count and see it has 6 faces

[24] Teacher/ Learners: 1, 2, 3, 4, 5, 6 (*Counting*)

[25] Teacher: It has 6 faces so from now on let's avoid calling cubes, cubes, we use the word Hexahedron it is characterised by six square faces like this box of chalk, we would say a Hexahedron. Now we go on to Octahedron, do you remember the structure of an Atom in areas, structure of Atoms, the first shell we

scientifically say the shells must reach an Octato stage, where does the word octate come from?

[26] Class: Eight (8)

[27] Teacher: It comes from eight, I'm combining, I know you do NS, so we need to co-relate our subjects, so Octahedron, octa stands for eight, so whenever we talk of Octahedron we simply means a shape that has eight faces, eight regular faces, remember we are referring to Platonic Solids. Platonic are characterised by faces being congruent to each other, and they are regular, so we are saying octahedron has eight faces. So what is the next one?

[28] Class: Dode.., …, dod.., inaudible

[29] Teacher: It's just one word but I am hearing more than twelve names

[30] Learners: Inaudible

[31] Teacher: Please we should not do it the way we feel suits us. It's just one word but I am hearing more than fifteen words. Right how many regular faces does it have?

[32] Learners: Twelve

[33] Teacher: It has twelve regular faces, but the shape is shown

[34] Leaner: Sir, wait how do you pronounce that?

[35] Teacher: I avoided to pronounce, I thought you'd not notice somebody gave a proper pronunciation, who gave the proper pronunciation?

[36] Teacher: You are swallowing some words there

[37] Learners: Inaudible

[38] Teacher: Alright, it pronounces as it spells there, dodecahedron, yes. Right the last one?

[39] Learners: Icosahedron

[40] Teacher: Right how many sides do we have?

[41] Learners: Twenty (20) sides

[42] Teacher: Please what matters is that you must know the name, you must know the sides so that in the exam situation, you are asked about for example octahedron you must know how many sides that shape has, how many faces actually, it has and you must also remember it is an example of platonic solids, don't forget that. What are the main characteristics, the faces are congruent to each other…

[43] Teacher: Right we have on our board there, I have written some notes for you, about our three dimensional shapes

[44] Learner: Sir, it says characterised by faces being congruent to each other, right, is it congruency the similarity for two triangles, so how can you say a hexahedron is congruent to …

[45] Teacher: Right, she's actually, her definition of congruency is only with reference to triangles

[46] Teacher: It applies to, it can even apply to other shapes like, this Hexa, what is it called?

[47] Learners: Hexahedron

[48] Teacher: Hexahedron, we have this side, we have that side, six sides, so these sides are the same, and this side is congruent …, (*inaudible*). Who can correct her? Does congruent apply only to triangles?

[49] Learners: No

[50] Teacher: It applies to, it can even apply to other shapes like, hexa…, what is this called?

[51] Learners: Hexahedron

[52] Teacher: Hexahedron, we have this side, we have that side, six sides, so theses sides are the same, this side is congruent to that

side, it's not only on triangles do you understand, so congruent is not only limited to one shape. The term congruent does not only apply to one shape, like she's actually limiting her definition congruency applies to other shapes. Are you understanding?

[53] Learner: Yes I understand but I was told that congruency means similarity between two or more triangles

[54] Teacher: I hope uh … we have different shapes, like different properties, the sphere, the sphere you can think of a soccer ball, then once you think of the shape, the properties will just flow, I don't think anyone would say ,the moment you think of a soccer ball, you will give me the properties of a hexahedron, you will be having a problem is it so all that matters is when we are describing these properties of shapes, first of all, have the picture of that shape, then the rest will flow. If you think of a soccer ball, as a sphere the properties will just flow so it looks the same from all angles like a soccer ball it is circular in shape, if I'm observing from this side it will just be the same from the other side, that's why they say it looks the same from all shapes. Then each point on the surface is the same distance from the centre, what name do you give from the end point on the surface to the centre?

[55] Learner: Could you please repeat sir?

[56] Teacher: The distance (we have a circular shape, we have the centre) the distance from the centre to any point of the that shape

[57] Learner: Radius

[58] Teacher: It is called the radius, you must revise otherwise vat the level of knowing that a cube is a cube, hexahedron and you don't know about radius you will be lower in your standard. So we are saying each point is the same distance from the centre and that distance is called the Radius. And what is the difference between the radius and the diameter?

[59] Learner: Sir

[60] Teacher: What is the difference between the radius and the diameter can you please draw a circular shape. I want you to show me the radius, and the diameter just draw the shape and I will move around just to check and when I come there you should show me the circumference, you just say this circumference this, this is the radius, this is the diameter so that we are clear on that, otherwise we might have problems in future. I expect people to call me not to avoid me, I see people are avoiding me, call me please.

[75] Learners: *(Inaudible)*

[78] Teacher: Right guys. Let me just say, I'm going to spend 8 hours, these are the number of hours … number of …

[79] Learners: Hours.

[80] Teacher: I'm going to spend 8 hours sleeping, eating?

[81] Learners: Inaudible

[82] Learner: 1 Hour

[83] Teacher: Oh let me just use 2 hours.

[84] Learner: Inaudible.

[85] Teacher: Okay, fine, fine. Let's hear what you saying

[86] Learner: 24 Hours just to (inaudible) ..eating uh mam.

[87] Teacher: Okay, fine, fine. Okay. Let's say, ok sports. How many hours? Maybe I should take 3.

[88] Learner: (Inaudible)

[89] Teacher: Okay. Let's have one person at a time. Yes "Paul"?

[90] Learner: 2 Hours

[91] Teacher: 2 Hours for sports. Studying?
[92] Learner: 5 Hours.
[93] Teacher: 5 Hours.
[94] Learners: (Inaudible)
[95] Teacher: Okay. 5 Hours, then let's hear …
[96] Learners: 2 Hours
[97] Teacher: 1 Hour
[98] Teacher: How many hours can I spend on my studies?
[99] Learners: 3 Hours
[100] Learners: 2 Hours
[101] Learners: 1 Hour
[102] Teacher: Ok. Let's take 2 hours. Let's count them if they give us 24 hours.
[103] Learner: No ...no…
[104] Teacher: 10, 15, 17, how many hours left?
[105] Learner: Gushota 2 (2 short)
[106] Learner: 7
[107] Teacher: No. 10, 12, 15
[108] Learner: 17
[109] Teacher: Let's me just say homework …
[110] Learner: Mam (inaudible)
[111] Teacher: How many hours can I spend on homework?
[112] Learner: 1 Hour
[113] Teacher: Let me just say 3 hours, and let me say other which is 4 hours. All in all is 24. Now, can I draw a pie chart using 8?
[114] Learners: Yes.
[115] Learners: No, no
[116] Learners: Yes, yes
[117] Teacher: Can I draw a pie chart using 8?
[118] Learners: No, no
[119] Teacher: What can we or what must I do first?
[120] Learner: Uh mam. First you must convert number of hours into degrees.
[121] Teacher: I can either convert to degrees or …
[122] Teacher/Learners: Percentage
[123] Teacher: Mind you, you must read the statement. If they say convert into degrees and you convert into percentages, are you correct?
[124] Learners: No mam.
[125] Teacher: Let me just convert these to degrees, to degrees. 8% how do I convert to degrees? Let's hear.
[126] Learner: 8 over 100 times 360^0.
[127] Teacher: You said $\frac{8}{100} \times 360^0$ (*writing on the chalkboard*)
[128] Learner: Over 1.
[129] Teacher: Over 1. Is this correct?
[130] Learners: Yes, yes …
[131] Learners: No, no …
[132] Teacher: Okay, fine. Let's hear first those who say is 100, let them motivate their answer and let also hear those who say no, then I will reconcile the two statements. Are you with those who say yes?
[133] Learner: No.
[134] Teacher: Those who say just explain to me why do you say 8 over 100 multiplied by 360^0? Okay, let's hear those who say yes.
[135] Learner: Uh mam because …
[136] Teacher: Let's hear "Mlambo"
[137] Learner: The sum of all values is 25
[138] Teacher: It's 24.
[139] Learner: Oh yes, it's 24.
[140] Teacher: Yes.

[141] Learner: Yes it's 24.
[142] Teacher: How must I write this one?
[143] Learner: It's 8 over 24 …
[144] Teacher: 8 Over 24 …
[145] Learner: Times 360^0 over 1
[146] Teacher: Is he correct?
[147] Learners: Yes.
[148] Teacher: What we have to do, we have to add the total values of all the numbers. They give us a total of 24. It means each slice or each sector is out of 24.
[149] Learners: 24.
[150] Teacher: For me to get how many degrees is sleeping, I'm going to say the total hours that I used to sleep divided by the total hours allocated for this, which is 24. I multiply it by?
[151] Learners: 360^0
[152] Teacher: Then what is the answer there?
[153] Learner: 120
[154] Teacher: Yah?
[155] Learners: 120
[156] Teacher: Is it 120?
[157] Learners: Yes it is 120^0.
[158] Teacher: It is 120^0.
[159] Learner: Yes.
[160] Teacher: Then we write 120^0. It means this particular person is using 120^0 for sleeping. Then what about eating? Uh yes?
[161] Learner: 2 Over 24 times 360^0.
[162] Teacher: 2 Over 24 …
[163] Learner: Times 360^0.
[164] Teacher: 360^0. Then what will be my final answer? It's how many …
[165] Learner: $98{,}3^0$
[166] Teacher: 98^0?
[167] Learners: Yes.
[168] Teacher: Do you think it's 98^0?
[169] Learners: Yes, No, Yes, No, …
[170] Teacher: Let me get another answer.
[171] Learner: 30^0.
[172] Teacher: 30^0?
[173] Learners: Yes, yes.
[174] Teacher: 30^0. Obviously is two … will be 30^0, obviously this will be 30^0.
[175] Learners: Yes, yes.
[176] Teacher: Let's get this one. 3… Yes?
[177] Learner: 3 Over 24 times 360^0 over 1.
[178] Teacher: 360^0 Over 1. This is equal to how many degrees? Yes?
[179] Learner: 45^0.
[180] Teacher: 45^0. Obviously this three will be 45^0. Isn't.
[181] Learner: It is.
[182] Teacher: What about 4?
[183] Learner: 60.
[184] Teacher: How many degrees?
[185] Learners: 60^0.
[186] Teacher: Let's check if all the degrees will be, will add up to 360^0. It's 120 plus 30 is how much?
[187] Learners: 150.
[188] Teacher: Plus 30?
[189] Learners: 180.
[190] Teacher: Plus 45?
[191] Learners: 225.
[192] Teacher: 255 Plus 45?
[193] Learners: 300, 300, 300
[194] Teacher: 60?

[195]	Learners:	360.	
[196]	Teacher:	It is 360. It means our answers are correct.	
[197]	Learners:	Correct.	
[198]	Teacher:	Let's go and draw this particular pie chart.	
[199]	Learner:	Mam you said it's a pizza chart.	
[200]	Teacher:	It's a pizza chart?	
[201]	Learners:	Laughing.	
[202]	Teacher:	Okay. Fine then. What is that, that we are supposed to use to draw a , … shall we use a lid of a vicks?	
[203]	Learners:	No, no, no, …	
[204]	Learner:	It's too small.	
[205]	Teacher:	Is it too small?	
[206]	Learners:	Yes.	
[207]	Teacher:	Then if have that …	
[208]	Learners:	Lid	
[209]	Teacher:	Big vicks lid. Shall we use that one?	
[210]	Learners:	Yah, yah.	
[211]	Teacher:	Shall we use that it?	
[212]	Learners:	No, no, no …	
[213]	Learner:	Mam we should use (*inaudible*)	
[214]	Teacher:	Okay. A lid of polish?	
[215]	Learners:	Yah, yah.	
[216]	Teacher:	Shall we use it?	
[217]	Learners:	No, no, mam, mam	
[218]	Teacher:	So what is it that we must use to draw a pie chart?	
[219]	Learner:	A protractor.	
[220]	Teacher:	A protractor?	
[221]	Learners:	No, no, a compass.	
[222]	Teacher:	A pair of compass.	
[223]	Learners:	Yes.	
[224]	Teacher:	Why are we supposed to use a pair of compass?	
[225]	Learner:	Because mam a compass can easily make a perfect circle.	
[226]	Teacher:	A compass can make a perfect circle, or what?	
[227]	Learner:	It can show you a centre part of the circle.	
[228]	Teacher:	It can show you the centre part of the circle. But if we use that lid of a vicks or a polish, do we know where is the centre?	
[229]	Learners:	No, no, no, …	
[230]	Teacher:	If I use just my hand?	
[231]	Learners:	(Inaudible)	
[232]	Learner:	You won't draw a circle by heart.	
[233]	Teacher:	Uh? The main aim is to get the centre, isn't?	
[234]	Learners:	Yes.	
[235]	Teacher:	Now if we have to determine …; this is in the form of degrees, isn't? How will I measure the degrees because, suppose I have … this is my pair of compass.	*(showing learners her hand)*
[236]	Learners:	Laughing.	
[237]	Teacher:	Eh(Yes). This my pair of compass and maybe this is my centre, isn't it?	
[238]	Learners:	Yes	
[239]	Teacher:	Though I want to connect or I want to have this 120˚. What must I do? Yes?	
[240]	Learner:	Use a protector	
[241]	Teacher:	Use a?	
[242]	Learners:	A protector	
[243]	Teacher:	How do we measure degrees and an angle? Here we measure an angle isn't?	
[244]	Learners:	Yes	
[245]	Teacher:	Now, with a protector. Do you have a protector with you?	
[246]	Learners:	Unavailable, No	
[247]	Teacher:	Guys, okay, okay then fine. In case I don't have a protector,	

		you need to divide your…	
[248]	Learner:	Pie	
[249]	Teacher:	Into how many parts?	
[250]	Learners:	Four	
[250]	Teacher:	Four? Is this one conventional to angles, how many parts, how many degrees in each angle?	
[251]	Learners:	90˚, 90˚…	
[252]	Teacher:	It means it is 90˚, 90˚ 90˚, 90˚	
[253]	Teacher:	The question is, do I have all the 90's here?	
[254]	Learners:	No, no	
[255]	Teacher:	Then for me to determine 120˚, must I just rub this and say this is 120˚?	(showing on the board)
[256]	Learners:	No, no, no	
[257]	Teacher:	What must I do? Okay fine, let's hear what Learner 1 is saying. What must I do Learner 1?	
[258]	Learner 1:	Increase one line.	
[259]	Teacher:	Draw a line like this?	
[260]	Learners:	Yes	
[261]	Teacher:	Just a line?	
[262]	Learners:	No	
[263]	Learner 1:	Rub the other one	
[264]	Teacher:	Okay, I must rub/ this and just add…	
[265]	Learner 1:	No	
[266]	Teacher:	No, no? What must I do?	
[267]	Learner 1:	Unavailable	
[268]	Teacher:	Okay fine. They don't have a protector	
[269]	Learner 1:	Okay, you say quarter…	
[270]	Teacher:	Okay this one is quarter, its 90	
[271]	Learner 1:	No, you say 90-40…	
[272]	Teacher:	90-40, which is 50	
[273]	Learner 1:	Yes. And so that other side	
[274]	Teacher:	Oh, must I take how many pieces from this? This is 90	
[275]	Learners:	Yes, 90˚	
[276]	Teacher:	To make 120	
[277]	Learners:	30	
[278]	Teacher:	30 isn't it?	
[279]	Learner:	Yes. You take 30˚	
[280]	Teacher:	It means if this is 90 isn't it	
[281]	Learners:	Yes, it's 90	
[282]	Teacher:	From the other 90 I need 30…	
[283]	Learner:	30, yes	
[284]	Teacher:	Isn't it?	
[285]	Learners:	Yes	
[286]	Teacher:	And in the middle, like, like for this one, this will be 45, isn't it?	
[287]	Learners:	Yes	
[288]	Teacher:	It means 30 will be somewhere	
[289]	Learners:	Yes	
[290]	Teacher:	It must show a sign of reality even though it is not drawn according to the scale.	
[291]	Learners:	Yes	
[292]	Teacher:	Am I clear about that that one?	
[293]	Learners:	Yes.	
[294]	Teacher:	When I say this is not drawn according to the scale it means I did not do the exact measurement but is looks approximately the same.	
[295]	Learner:	Approximately the same?	
[296]	Teacher:	That means I'm going to rub this out	
[297]	Learner:	This one.	
[298]	Teacher:	This part is 120˚. This is meant for?	
[299]	Learners:	Sleeping. This is for sleeping	

[300]	Teacher:	Isn't it?	(writing on board)
[301]	Learners:	Yes	
[302]	Teacher:	Now if I took 30 from the other 90, it means this part is how many degrees?	
[303]	Learners:	41˚	
[304]	Teacher:	Ah, ah, ah (no, no)	
[305]	Learners:	60˚	
[306]	Teacher:	Its 60˚, isn't it?	
[307]	Learners:	Yes	
[308]	Teacher:	It's 60˚	(writing on board)
[309]	Learners:	Yes, for other, just for other	
[310]	Teacher:	Then now for this 60˚ you are not forced to write it in this order	
[311]	Learner:	Oh…	
[312]	Teacher:	Isn't it?	
[313]	Learners:	Yes	
[314]	Teacher:	It means it took 30, I'm left with how many?	
[315]	Learners:	60…	
[316]	Teacher:	Then this one is meant for?	
[317]	Learners:	Other	
[318]	Teacher:	Other, then which is how many degrees?	
[319]	Learners/ Teacher:	60…degrees	
[320]	Teacher:	I'm clear about this one?	
[321]	Learners:	Yes	
[322]	Teacher:	Now let me go to the next one, it means I'm left with how many degrees?	
[323]	Learners:	180˚	
[324]	Teacher:	180˚. Then how, what do you think I must do?	
[325]	Learner:	Mam, can't you write it in percentage?	
[326]	Teacher:	No, I'll do it but now we are still using the degrees	
[327]	Learners:	Yes... (inaudible)	
[328]	Teacher	Junior?	
[329]	Learner(Junior):	Mam by the other degrees, you gonna divide by 3	
[330]	Teacher:	By 3	
[331]	Junior:	Yes. To eating, sports and cleaning.	
[332]	Teacher:	That is eating which is 30%, sports and cleaning. It means into three equal…	
[333]	Teacher/Learners:	Parts	
[334]	Teacher:	Which will be this and this	(*illustrating on the board*)
[335]	Teacher:	Almost equal. This will be how much?	
[336]	Learners:	(inaudible)	
[337]	Teacher:	Which is 30%, 30˚, what's next?	
[338]	Learners:	Sports	
[339]	Teacher:	Sports and…	
[340]	Learners:	Eating	
[341]	Teacher:	Eating. Each is 30˚	
[342]	Learners:	30˚	
[343]	Teacher:	30˚	
[344]	Learners:	Yes	
[345]	Teacher:	I'm left with the other quarter which is 90˚	
[346]	Learners:	90˚	
[347]	Teacher:	Then now…	
[348]	Learners:	Homework	
[349]	Teacher:	What must I do then	
[350]	Learners:	Half, half…	

[351]	Teacher:	Yes?	
[352]	Learner:	Divide it into half for…homework	
[353]	Learners:	Homework	
[354]	Teacher:	It means half of 90 is?	
[355]	Learners:	45˚,45˚,45˚	
[356]	Learner:	45˚	
[357]	Learners:	(Laughing)	
[358]	Teacher:	45˚, which is what?	
[359]	Learners:	Homework	
[360]	Teacher:	Homework…	
[361]	Learner:	Homework and studying	
[352]	Teacher:	Homework and studying	(writing on the chalkboard)
[353]	Teacher:	Which is how many degrees?	
[354]	Learners:	41	
[355]	Teacher:	45˚?	
[356]	Learners:	Yes.	
[357]	Teacher:	Now, you are requested to draw this thing. Your pie chart doesn't have a name. Do you think if I take this pie chart and give it to the principal and said analysis this pie chart, what will he say?	
[358]	Learners:	(inaudible)	
[359]	Teacher:	Yes	
[360]	Learners:	(inaudible)	
[361]	Teacher:	The heading? You need to give it the title, a heading or the name. What is the name? What is the name of our pie chart?	
[362]	Learners:	(inaudible)	
[363]	Teacher:	Before we come to the name where are going to get the name of our pie chart?	
[364]	Learners:	From what we were given	
[365]	Learner:	From the table	
[366]	Teacher:	It's entire from the table from a…	
[367]	Learner:	Pie chart	
[368]	Learners:	(inaudible)	
[369]	Teacher:	Are we clear about this one?	
[370]	Leaner:	Yes	
[371]	Teacher:	If I say, can say from two tables I'm going to say sleeping, eating whatever?	
[372]	Learner:	No	
[373]	Teacher:	No. You get that one from the statement.	
[374]	Learner:	Which statement mam?	
[375]	Teacher:	The statement will be given on top, maybe they can say a pie, I hear this representing a pie chart is…(inaudible) 24 hours or each day	
[376]	Learners:	(inaudible)	
[377]	Teacher:	Whatever, isn't it?	
[378]	Learners:	Yes	
[379]	Teacher:	Now. This is the way we use to distribute as have sliver of our pie based on degrees. Now if I want to use the very same information and convert it to percentages. What must I do? What are others now?	
[380]	Learner:	They are here.	
[381]	Teacher:	Tumelo? Give us the answer. If I want to convert to percentage, what must I do? Doctor? Okay	
[382]	Learners:	Divide by 100	
[383]	Teacher:	I have to divide by 100?	
[384]	Learners;	Yes	
[385]	Teacher:	What must I write here	(pointing to the chalkboard)
[386]	Teacher:	Give me an example.	

[387]	Learner:	Okay mam (inaudible)	
[388]	Teacher:	No	
[389]	Learner:	(inaudible)	
[390]	Teacher:	No. Just give him a chance so that he can give us the answer. What must I write?	(sound of syringe)
[391]	Teacher:	Okay fine, let me just, now we are not requested to convert it to degrees but instead to percentages, then what must I write?	
[392]	Learner:	Mam…	
[393]	Teacher:	Doctor?	
[394]	(Doctor):	It's 8 over 24 times 100 over 1	
[395]	Teacher:	8 over 24 multiplied by 100	
[396]	Learner:	Over 1	
[397]	Teacher:	By the way why I, we supposed to divide this 8 by 24	
[398]	Learner:	Because it's number of hours divided(unavailable)	
[399]	Teacher:	The total number of hours. Then if I divide or if I convert into percentages 8 divided by 24 multiplied by 100 it's how much? How many percentages?	
[400]	Learner:	33	
[401]	Learner:	Is it just…	
[402]	Leaners:	33.3	
[403]	Teacher:	33 comma all these 3's isn't it? If I want to convert it into one decimal unit, it will be?	
[404]	Learners:	33.3	
[405]	Teacher:	It will be 33.3 isn't it? Now two, for this one…? (inaudible)	
[406]	Learner:	You say two over twenty-four	
[407]	Teacher:	2 over 24?	
[408]	Learner:	Times 100	
[409]	Teacher:	Times 100?	
[410]	Learner:	Which equals to 8.3%	
[411]	Teacher:	8.3, to one decimal unit?	
[412]	Learners:	Yes	
[413]	Teacher:	What is the next number after this 3? It is (inaudible)	
[414]	Learners:	Yes	
[415]	Teacher:	Then it will be 8.3. It means this one again 8.3, 8.3	
[416]	Learner:	Percent.	
[417]	Teacher:	Yes. Then what about this one? 3 out of 24?	
[418]	Teacher:	Yes "Benny"?	
[419]	Learner:	3, it's 12 over…	
[420]	Teacher:	No, let's give "Benny" a…	
[421]	Learners:	A chance…	

Pontsho'sLesson 2

[1]	Teacher:	Yesterday we did pie charts; on the cells and procedures to follow we have to draw a pie chart. We know that in each and every pie chart that we have to draw, we can either convert it to degrees and or to percentage, we cannot convert it to both degrees and percentages at the same time are we clear on that? Now we continue again on line 9, okay then now as we are now continuing on this one, the next one which is a line graph. Beginning of this year we have been drawing the line graph using these patterns and functions etc. we know that one isn't it? And we have been drawing a straight line graph. Today's graph is not so different from that we did earlier on; the only difference is you may find that our lines are not straight but we are going to use a co-ordinate form, I

hope you know what the co-ordinates are, do you know what are the co-ordinates? Thank you very much. Now who can just read the statements which starts with `a broken line graph…` for us? Yes "Sipho".

[2] Learner: "A broken line graph shows information by plotting points of information on a graph and connecting the points with a line, they are not the same as a straight line graphs that are drawn using the equation of a line. Broken line graphs are used to represent data that changes continuously over time and they display the general trend within the set of data and can help us make choices". (*reading from the textbook*)

[3] Teacher: Thank you very much. Who can just summarise what he has read just right now for us because before you can nearly answer the question you need to find out the core meaning of that particular statement.

[4] Learner: "A broken line graph is not exactly a straight line; it's a line that actually has data that changes over time".

[5] Learner: "A broken line graph, it shows information where you plot a dot and you connect those dots to see where the information leads you to".

[6] Teacher: I think they have said a mouthful, what we are going to do we are going to join those dots am I clear about that? Now what you know is, when we draw the graph or the main thing that you need to know when you draw the graph is every graph should have a heading or a title or the name.

[7] Teacher: Then now let's take a look to the one that is given in the sleeves on number three. It says, the table shows the (inaudible)… shows the number of children that on the roads in a province in one year, the number of, that is on **page 281**, then here is a table given, we are given from zero to four that is H. Zero to four, five to nine, ten to fourteen, fifteen to nineteen, is this the last category? If ever the information is written as zero to four, five to nine, we call this one as a grouped data or grouped information isn't it? They have grouped the information; they avoid a situation where they are going to find a child who's zero years old meaning that maybe that particular child is eight months or nine months, one year old then now they have grouped them are we together? Those who are between zero to four, they are 1482. (*referring learners to the textbook*)

[7] Learner: No, 1342.

[8] Teacher: 1342, which is number of … You can see that there are lot of young ones who are involved in accidents because the number is very high and five to nine? 3094 and this one? 943, the other one? 8816 and I have requested to present this information on a line graph, you know when we draw a line graph, am I going to use a circle or the axis? Am I going to use a circle if they said present this information on a line graph, must I use a circle? Must I use an x-axis and y-axis isn't it? If I have to draw those axis, which one represents the vertical line?
The vertical, you know a vertical line? Okay before that, how will I differentiate the vertical line and the horizontal line? Explain to your sibling at primary, because they said

you must go and draw a vertical line and a horizontal line. What is a vertical line?

[9] Learner: A vertical line is a line that's going straight up and a vertical line goes up and down and a horizontal line goes sideways.

[10] Teacher: That's the difference between the horizontal line and the vertical line; it goes like this and this way. Which line represents the x-axis?
Can I write my x? The horizontal line represents the x-axis and this one represents the y-axis. Now then what do you think is the name of my graph? Can I give my graph a name or can I just leave it like this? Age groups. Can I say age groups? What do you think I can say Maduna? Number of children involved in an accident or number of children injured in a particular in a particular province.
Because if I can say in a year it means I'm dealing with all the learners in all the provinces but if I say find in a particular province, am I clear about that one? Must I write it on top or underneath? On top isn't it?
Number of children in a particular year isn't it?
Now I want to draw my graph isn't it? I've drawn the axis then what must I do there?
I label my axis isn't it? The horizontal; axis can be: Age group, then the vertical one: Number of injuries. Then what must I do again? The values. I want to put the values isn't it? Mind you will use the correct scale and the correct measurement isn't it? Like this one; number of injuries then now I write 3042, 3094 is it correct? Why not? Because if I check here I'm given those numbers. Why am I not supposed to write these numbers? They are not in ascending order. By the way, what is ascending order? I want to put my data in ascending order, what is ascending order?
If they say write this data in ascending order what do they mean? From the smallest to the biggest, I started from the smallest I go up. Am I wrong?

[11] Learner: I think you should write the number of injuries in a multiplication sequence

[12] Teacher: In a multiplication sequence I do understand isn't it? And all of us you understand him?
Then what do you think I must write just right here, because you said I mustn't write.
Which multiplication can we use? Must I start from one? What can I use? Multiplication of 1000, the next one? 2000. 4000? 3, 4, 5 up to 8. 5000, 6000, 8000 then here what is that that I must write?

[13] Learner: Ma`am why didn't you put the zero first there?

[14] Teacher: Thank you, now zero means it's a multiplication of a thousand then here I write the ages: 0 – 4, 5 – 9, 10 – 14, 15 – 19. Now we are going to plot this isn't it? Who can come and plot this for us? Who can plot this one for us? Thank you. Is he correct? What is that that you are doing right now? Broken line graph. If you drew this kind of a graph, what do you think is this kind of a graph? No

maybe he's going to join them up until, what is this kind of a graph? Histogram? Not a bar graph? Where lies the difference? Where lies the difference?

[15] Learner: A bar graph has spaces between the bars

[16] Teacher: It means this one is not correct. Who can come? Is he correct? Why just here, not here and here? Because its zero to four and 3042, why not 2? Can I say it again? It's on the line, this line. Are you satisfied with his explanation? That's where the two points meet; when the two points meet we then put it at their meeting point, their assembly point.
The next one: this one is 3094; do you think it can be here? He is correct, the third one.
Thank you, this one is correct. Another one let me join the third and the fourth one, the last one is 8616, it's above this one its somewhere there isn't it? It's here.
Now we are going to join these dots, we use a ruler: we go from point one to point two, point two point it won't be straight, point three to the last point. This joins them up until… Why don't we start at zero? Why can't we start at zero?

[17] Learner: Because number of injuries doesn't start at zero

[18] Teacher: Number of injuries doesn't start at zero; shall we take it as our answer?

What do you think the answer is? Zero to four is already which is not like zero and to zero isn't it? This is an age group; if ever we had 0, 1, 2 its then that we are going to start at zero. We have any which represent any group zero and zero or zero?

[19] Learner: No.

[20] Teacher: Don't forget our line, the lines that we are drawing or the graphs that we are drawing can either be horizontal graph. Do you still remember with the bars and the histogram? Can either be horizontal or vertical. Now if I want to draw this in A, is this one in a vertical or horizontal one? Vertical. Then now if I want to put it on a horizontal maybe they said draw a horizontal line graph, am I going to change the axis? Then now I can say this is the x-axis, this is the y-axis? Why? Why not? The y-axis will always be on a vertical line so we don't have, what is that you are supposed to change? This is my y, will remain my y, this will be my x. He is right, I have just to swop what? Here I can write age group, here what is that I can write? Number of injuries. Now I think we cannot or sometimes we may not use a group data to represent the information on a line graph, I think if we don't want to use a grouped data still ungrouped data will be used again. Again on page 285: they said display the following data in the heart rate, given the heart rate of a patient in hospital on a broken line. Ungrouped data now. On a broken line, mind you there are some basics that you need to know when you draw whatever the graph, am I clear about that one? The heading, correct scaling: which I can say this are the correct measurements, the correct multiple, mind you

when you draw the graph, because of that measurement, the distance from here should be equal from the distance from here up until here to here am I clear about that one? Now there is this thing for example: if we have or if we wanted to know the crime rate in highlands north, we do have highlands north police station, we do have the community of highlands north isn't it? Everyone. The minister of safety and security requested the community to represent the crime rate of highlands on a graph, on a line graph or a bar graph am I clear about that one? And again requested the police to represent the very same information using the graph. You know what is going to happen? If I think things are not in favour of my side, I'll have to use a very short scare for example: starting from zero the number of crime rate maybe, this is highlands north isn't it? I'm having January; the crime happened in January, we do have maybe 20 cases. In February we do have32 cases in February only. In March we do have 40 cases.

In may we do have 33 cases. March April, maybe up to April isn't it? You know what, when the community is going to draw that particular graph they are going to use a bigger scale, they will just say, January February march April then they'll just say let 2 cm equals 1. They'll just measure the 2 cm they'll just say a multiple I'm going to use 10, 20, 30, 40. Let's represent this on a graph, on a broken line graph from 0 is 20 isn't it? January is 20, February is how much? It's somewhere here, 32. March 40, April is somewhere here.

Now they are going to join their graph like this isn't it? But look at the police, the police will use a very short scale, the police will do this one: they'll just say January, February, march, April. They are going to say 20 okay 10, 20, 30, 40. Can you see the scaling, this is a correct measurement then when the police decided to plot this one they are going to say this one is 20, then February is 32. Look at this march?

March is 40. April 33. Then they are going to join the dots like this. Then when you look at the 2 graphs, what can you see? Are the graphs different? Look at the first this one, this is the graph which was done by the police, this is the graph done by the community. What is the difference between the 2 graphs? The police graph is short. Why will the police do this small scaling and the police with the bigger scale? Are they different? Do we have different information between the 2 graphs?

Okay fine, this is 20, 32, 40 and 33 something like this. Why will the community use a bigger scale? If you are a member of the community why are we supposed to use that large scale as compared to the police? So everyone can see.

The community and the police, the community went to the police they shared to get that information and the police are using the very same information, why will the police decided to use that and the community decided to use that? Do you think the police should always use the small scale? No. So basically, no let's forget about the (???). This one is from the police station and this one all of us, the community and the police are going to present the information, the very same information to the minister.

When you look at this one while you are in (???) isn't it? You may think that there is less crime at Norwood or highlands police stations, here the community want their voices want to be heard by the minister for `we are having a lot of crime look at this one`. It portray a sign as if at highlands north they do have some restless nights, sleepless nights etc. am I clear about that one? So if you want to present your information which is good to you, normally we are going to use a bigger scale, am I clear? For example if your parents requested you to present your term 3 marks on a graph, because you did well you are going to use a bigger scale, those who didn't do well will use a small scale as if everything it should be like that, am I clear? Am I clear about that one? You think the community wants to be heard, this one the police want to protect themselves. Anyway this is fine. Who can say the minister we do have less crime at our area? But the community will say no, but when you analyse this the two are the same, the only difference is the scaling, am I clear about that one? Any question before I continue? No question.

Let's turn over to the next page, the scatter plot graph. The scatter plot graph, who can read the statement which start with "a scatter plot…"?

[22] Teacher: Who can just summarise this thing for us? We are now going to deal with the scatter plot, basically when we are dealing with the scatter plot; we are going to join the dots isn't it?

Sometimes they call it a dot graph. We are not going to join those dots, it is the same procedure that we use to draw a broken line it's the same procedure we are going to use to draw a scatter plot or a dot graph but, we don't join those dots, am I clear about that one?

[23] Learners: Yes.

[24] Teacher: It is only in the pie chart which cannot be drawn vertically or horizontally, all the graphs that we use can be presented on vertically or horizontally, even the scatter plot graph.

Basically, when we draw these scatter plot graphs we want to determine the relationship or co-ordination, the relationship between two events am I clear about that one?

[25] Learners: Yes.

[26] Teacher: Now let's have a look to the example given: don't forget every graph must have a heading, we must label all the axis, am I clear about that one?

[27] Learners: Yes.

[28] Teacher: The correct scaling, whether it's a scatter plot or broken line graph or whatever the graph, we must have the correct scaling, don't forget that one. Don't get confused because some of you I know during the test or whatever, they are now confused they are going to write 1342, 30 as if they been using a certain measurement or scaling. Am I clear about that?

[29] Learners: Yes.

[30] Teacher: Then now, let's have a look to this one: the height and

mass of 12 people who were measured and recorded in a (???) by a dietician, or I can just measure your height and I weigh you again, I compare your height and your weight am I clear about that one?
Immediately when I measure your height and your mass then I records this one on a table, I think we know how to fill in the table isn't it?

[31] Learners : Yes.

[32] Teacher: We know how to fill it in we know how to read from the table isn't it? Now the height is in meters or is the height in km? Maybe we can measure you, you are 1.3 km isn't it we measure the height in meters isn't it?

[33] Learners : Yes.

[34] Teacher: You know what, one day I was at a party with my friend I just said "my friend, they have (???) Few kg's, they said oh yes plus I've been exercising, you know how many km I've lost?
I've lost 7 km". And we must know the unit we use to measure the weight or mass. What is the unit that we use to measure the weight? Is it a kg? Yes. The unit. So it means if I got 900 g of milk means that's not a weight? No it is. But you said it's a kg, the grams are used to measure the weight, because everything has a g: kg, hg, dg etc. cg, mg it means the gram is a unit to measure that one. Now we have measured the height and the mass of a particular patient, now: when we plot this thing on a scatter plot it's the same procedure as this one like the co-ordinates issue isn't it?

[35] Learners : Yes.

[36] Teacher: Now looking at this one, the scatter plot showing the height and mass of 12 people, after they have presented them on that one, can you see there are some dots up and down etc. but if you can check from patient 1 to the last patient, this is moving to the right hand side, then now thereafter let me just draw this for us. Correct scaling, correct measurement, don't be too exited or want to charm us some days and you decided that this is the x, this is the y. (Inaudible). Because we are living in a miraculous situation then people write miracles. They will just give you miracles or they'll just show you miracles. Then they write the x here and the y here isn't it?

[37] Learners : Yes.

[38] Teacher: Don't ever change my axis, this will represent the y, this will represent the x. Now the correct measurement, I do have, look at this one: 1.52, 1.57, which multiple do you think I can use?

[39] Learners : 5, 8

[40] Teacher: Which multiple do you think I can use? Can I use: 2, 4, 6, 8, 10?

[41] Learners : No.

[42] Teacher: Look at the height: 1.52, 12.57, 1.60 etc. Or must I just write 1, 2? 0, 1, 2? Which multiple do you think I can use?

[43] Learners (*Inaudible*)

:

[44] Teacher: 152, 157?

[45] Learners Yes.

:

[46] Teacher: I can just write 1.52, 1.57, and 1.60?

[47] Learners No.

:

[48] Teacher: Mind you, don't get confused, the multiple, the correct scale is very much important.
(???) Because if you don't use the correct multiple, this information will not reflect a true reflection of what is happening here.

[49] Learners Yes.

:

[50] Teacher: Yes because I've realised its one comma whatever, one comma isn't it? Starting from 1.52 isn't it? I can use my decimal can use a multiple of 5 which will say that, mind you scaling the distance should be the same. I can start by saying 1.50, 1.55, 1.60, 55, 60, 65, 1.65, 1.70, 1.75 up to etc. am I clear about that one? Now let me check again, the mass: lets is in kg, if I check at this one I'm having 59, 61.2, 68.0, then now I ask myself, I do have the 50`s, 60`s, 70`s. which multiple you think I can use?
Why not multiple of 5.

[51] Learners No.

:

[52] Teacher: Why not?

[53] Learner: It's too small.

[54] Teacher: Okay fine here this one represents the height, look at this one they've written height in meters, it means whatever the number I see here its 1.5m not in km isn't it? You must specify that. The mass: this mass is not in meters. Am I clear about that one? It's in kg`s, it means it's not in grams, it is not in dg, it is in kg. Then whatever the number I see, if it is 51.2, I know it is 51.2kg. Then so we are going to use 50, 60, 70, 80, 90. Let's plot this one; mind you the correct scaling will give us at least a true reflection of our data. If your scaling is not correct, if your labelling is not correct, it is not going to give us a true reflection of what transpires on our table.
Am I clear?

[55] Learners Yes.

:

[56] Teacher: The mass should always be in kg`s? Not necessarily, the mass can be in kg, can be in mg, especially when you can see it or check the weight of a pill is in mg. am I clear?
Have you ever checked the ingredients of any

[57] Learners (Inaudible)

:

[58] Teacher: Because the units are given… (inaudible).

[59] Teacher: This one is milligrams, like in this (inaudible), the total sodium its 47mg in this drink. You need to check the ingredients; whatever we do in mathematics we can apply it in real situations or its applicable in everyday life situations because people will say "we are always solving x in maths but we`ll never meet x in the street." There is x there: x represents the unknown, but after they've constructed the road, look at those lines, those divide the

road, it's correctly measured. You'll never go to Limpopo and find a barrier line its 5cm thick, you'll never, all he units are the same.
That's where maths comes in in that case.
Then now let's do this one, the first one is, 1.52m correspond with 61.2kg. 1.52 this is one point its means one point (???) its 1.53, 1.52 can be here isn't it? And what? 61.2… 61.2 can be here isn't it? Now I plot it like this and this am I correct?

[60] Learners: No, yes.

[61] Teacher: How do I plot this? No what is the procedure? How can I plot this one? I want to plot this thing and complete this one, that is 1.52 and 61.2, is that the correct way of plotting our graph?

[62] Learners: No.

[63] Teacher: How can I plot that one?

[64] Learners: Can I show you on the board?

[65] Teacher: Yes no problem.

[66] Learner: (Inaudible) (*Working on the chalkboard*)

[67] Teacher: Thank you very much, let's just not intimidate him, he said I must put the 1st dot here for 1.52 and 1.62 and the dot here, is he correct?

[68] Learners: No.

[69] Teacher: I'm getting confused I don't know what to do now. Continue where to put the dots. Is he correct?

[70] Learners: Yes.

[71] Teacher: You can see, we must have one meeting point or the assembly point, mind you if the (inaudible) then you decided to go this way then while you are going this direction I'm telling you'll meet (inaudible) on your way. Assembly point should be one isn't it?

[72] Learners: Yes.

[73] Teacher: For the 2 points, this 1.52 should go to the direction of 61.2 and 61.2 should go to the direction of 1.52 and the 2 will meet here, this is where the 2 meet, their assembly point isn't it?

[74] Learners: Yes

[75] Teacher: Now let's continue to the next one, the next one is what? 1.57 Its above 1.55 isn't it?
Just somewhere in the middle 1.57 should correspond with 59.8 is next to 60 isn't it?
Look at this one, it's not always the case that if I plot it here, the first point then it means I should go to this direction, can you see now I'm going back? Then its 59 with 57, it goes to the direction of 57, 1.57 goes to the same direction of 59, this is their assembly point, don't join these dots in a scatter plot or a dot plot graph, am I clear about that one? Now the 2nd one is? 1.60 And 68, it should go to the direction of 68 next to 70, here this is where they meet.

[76] Learner: Mam why don't you join the lines in a scatter plot?

[77] Teacher: What we wanted to find out is the relationship of those

particular dots, in which direction do they lead or are they just scattered all over? Or do they form a certain relationship or correlation, am I clear on that one? Now the fourth one it will be?

[78] Teacher: 1.65 And 63, somewhere here, there is it. Am I clear about that one? Then another one? 1.65 And 72.6, it's here, then another one?
1.68 is in the middle here, 1.68 and what? 70.8 is just close to 70. Then another one? 1.70, 1.7, the numbers after the comma we call them one by one, 1.70 because if its 70 comma this we cannot say 70 comma 70. We can say 70 comma seven zero because we normally have the large numbers after the comma. In your line you are going to say 70.1376000. 70.1234, then another one said its 70, 1.70 to 65 is in the middle, 65.8, 70 is here. And another one? 1.73 And what? 68.9. No before the comma is then you can say 68 call them in that term, 68.90 or .95 not 68.95. Then 68.95, 68 is next to 70, there is it. Another one? 1.78 It's here, and what 70.3just next to 70. 70.3 will be here. Another one? 1.78, by the way here we are still 1.78 isn't it? 1.78 And what? 76.2, 76 is here comma 2. Is it the last point?

[79] Learners: No.

[80] Teacher: The last point: 1.83 it means here it's 1.80, 1.85, 1.83 it's here then another one with what? Corresponds with 81.60 here, there is it. The last one: 1.88 it's above it its 1.88 there is it and 80.7 it's here. Then we drew this particular graph, mind you these ones are not (???), must be invisible, then you don't have to join these dots. Now we are going to have what we call a line of best fit

[81] Learners: Inaudible

[82] Teacher: Okay fine before you draw a line of best fit, now they said a line of best fit is a straight line that best fits along most of the marked points. Yes. The line of best fit, after drawing the scatter plot graph, make sure you draw the line of best fit, how are we going to draw the line of best fit? They said that the line of best fit is a straight line that best fits along most of the marked points, this straight line can be used to estimate the value from one set of data when the corresponding value of the other set is known, a data value that is much larger or smaller than the rest of the that's is called the outlier, we know what is an outlier isn't it?

[83] Learners: Yes.

[84] Teacher: Now when we draw a line of best fit we are going to check our points. We can see that majority if I can draw a straight line like this, the majority of my dots are here, unlike drawing this because this won't be a straight line. Here that line will touch most of the points, you need to draw that line of best fit, and after drawing the line of best fit if I had my ruler, `that is the line of best fit.
If you didn't do the correct measurement, the correct scaling I'm telling you, you are going to have a problem with a line of best fit.

[85] Learner: In the exam are we going to do like (inaudible)?

[86] Teacher: No, no you mustn't draw 2 graphs; on the very same graph you draw the line of best fit. You can see now this

in the upper part I do have the majority of my dots it means this has a positive co-ordination before we go into, I think it's time now. (Inaudible). Okay.
Now I think it's (inaudible)

[87] Learner: The line it starts from zero always?

[88] Teacher: Not from zero always, not from 50 always, you just check from your graph where are you going to have most of your points in a straight line, most of the point is this one and majority of the points are in the upper part that goes in the lower part (inaudible). I think it's time up boys. Please (inaudible). You are going to get either 2, then I make this by tomorrow. (Inaudible). But tomorrow you must come
Thank you very much.

ANNEXURE F: Interviews Transcripts

Carina's interview

[1] Researcher: Right. I think … so we can start to save time
[2] Carina: All right
[3] Researcher: Eh yeah like I said neh, we're just going to focus on the two lessons neh
[4] Carina: Uhm…
[5] Researcher: Yeah. But the … eh maybe the first group of questions will be on the history … uhm, your history as a teacher
[6] Carina: Okay
[7] Researcher: Mm just to establish how you have been doing in terms of your teaching particularly of maths … yeahw'll be concentrating on maths
[8] Carina: Okay
[9] Researcher: And maybe as we go down w'll check your lessons and all that
[10] Carina: Okay
[11] Researcher: And maybe as we go down w'll check your lessons and all that
[12] Carina: Okay
[13] Researcher: Just some aspects of your lessons
[14] Carina: Okay
[15] Researcher: Like I'm saying is not like I'm looking for particular answers and all that
[16] Carina: Uhm
[17] Researcher: It's just generally your views and opinion and all those things
[18] Carina: Uhm
[19] Researcher: And maybe sometimes why you doing certain things
[20] Carina: All right
[21] Researcher: Uhm so it's just .. on the history neh
[22] Carina: Uhm
[23] Researcher: Uhm … can you tell me how how many years have you been teaching? Just teaching not necessarily maths.
[24] Carina: Four
[25] Researcher: It's four years?
[26] Carina: Yes
[27] Researcher: Alright, then then maths grade 9?
[28] Carina: It's four
[29] Researcher: Oh you've been teaching grade 9 since..
[30] Carina: Grade 9 since I started yes
[31] Researcher: And in other grades? Maybe like eh … Inaudible … except grade 9 what other grades have you … did you teach … mathematics? (Inaudible)
[32] Carina: Uhm not maths literacy?
[33] Researcher: No maths literacy is fine
[34] Carina: Then grade 8 I taught it for two years
[35] Researcher: For two years
[36] Carina: Then grade 11 … grade 10 for two and grade 11 for two years and grade 12 maths literacy for two years
[35] Researcher: For two years okay
[36] Researcher: And then in your … in your teaching neh in your teaching because you still remember neh the … when we started neh I said I'm interested mostly in the way you using your textbook and resources and all that
[37] Carina: Uhm uhm
[38] Researcher: So in your teaching when did you start using a textbook as a teacher?
[39] Carina: When I started working
[40] Researcher: (Inaudible)
[41] Carina: From the from the … four years ago
[42] Researcher: From the very beginning
[43] Carina: Beginning, yes
[44] Researcher: Uhm
[45] Carina: In … actually then cause the … the textbooks were more because there was no

CAPS and stuff so we were using the textbook effectively cause every learner had the textbook then.

[46] Researcher: Okay, alright
[47] Carina: Uhm
[48] Researcher: And then so you say since you have started you've been using a textbook
[49] Carina: Uhm
[50] Researcher: There's no year when you decided not to use a textbook?
[51] Carina: It's only this year we do use it but you don't use it as much because we having a shortage
[52] Researcher: Okay
[53] Carina: So we do refer to it sometimes but not as often as we used to because we have a shortage of textbooks
[54] Researcher: But it's not by choice that you don't like to use
[55] Carina: Yeah, uhm ..
[56] Researcher: It's like you don't want to use it
[57] Carina: Yeah it's not like I don't want to use it it's because there is limitation
[58] Researcher: Okay
[59] Carina: You know in mathematics you have to give them homework everyday so you can't say they should do your homework in a textbook because lots of them do not have them
[60] Researcher: Okay
[61] Carina: Uhm …
[62] Researcher: Alright then in your preparation neh of whatever lesson, that's the maths lesson
[63] Carina: Uhm
[64] Researcher: Then to what extent do you use a textbook to prepare a lesson?
[65] Carina: Uhm I do use a textbook when I, especially when it comes to … cause with the, with the, with the CAPS that we having now I can't plan my lessons as I used to because some things have changed. So I have to I look at the textbook I see that if the textbook go hand in hand with the CAPS document
[66] Researcher: Uhm
[67] Carina: So I do I do I do especially some things I get some examples there
[68] Researcher: Okay
[69] Carina: May change some numbers there and there but do similar examples
[70] Researcher: You use it for examples
[71] Carina: Examples and also for …
[72] Researcher: For exercises?
[73] Carina: Exercises yeah
[74] Researcher: Okay, alright … and then err do you have any specific textbook that you are using?
[75] Carina: We using Platinum
[76] Researcher: Platinum
[77] Carina: Throughout from grade 8 up to grade 12 it's Platinum
[78] Researcher: Why do you use Platinum
[79] Carina: I don't really know why we use Platinum but because we just … what happened is they ordered books and they said we must choose not me specifically so teachers were saying Platinum. But so far it's a good textbook, it's not a very bad textbook
[80] Researcher: Okay
[81] Carina: Uhm. In terms of a new curriculum
[82] Researcher: Okay. Oh does it , it addresses the …
[83] Carina: Yeah the … yes
[84] Researcher: The topics …
[85] Carina: Yes
[86] Researcher: As outlined in the
[87] Carina: Yes
[88] Researcher: CAPS document
[89] Carina: Yes in the CAPS document yes
[90] Researcher: So it's not a bad textbook?
[91] Carina: No it's not Platinum is not
[92] Researcher: Ok. And then … so you saying you are using it because it's a …

[93] Carina: To refer to it ..
[94] Researcher: It's CAP aligned it's CAPS aligned
[95] Carina: It's CAP aligned it's CAPS aligned yes and it's also … some examples there they are good that's why I use it
[96] Researcher: Okay
[97] Carina: Uhm
[98] Researcher: And any other resource that you use except maybe Platinum …(Inaudible)
[99] Carina: Uhm some textbooks that I use I use cause I also use some old textbooks it's just that I see if the questions go hand in hand
[100] Researcher: Okay
[101] Carina: With the CAPS cause some questions actually the topics are still the same it's just that some things are … differ there and there but I still use my classroom mathematics and I also … for the high for the for the for GET for FET Siyavula something … this other one I also use it, yeah and other resources will be my own resources
[102] Researcher: Okay
[103] Carina: From the notes that I have from university some of the notes from the internet sometimes
[104] Researcher: Okay, okay for instance this let's look at the two lessons
[105] Carina: Uhm
[106] Researcher: The lesson on rotation
[107] Carina: Uhm
[108] Researcher: And the other one was on data handling
[109] Carina: Uhm
[110] Carina: Yes, yes I did … what happens is with grade 9s I usually prepare for a week
[111] Researcher: Okay
[112] Carina: So like have a rough sketch on how to introduce the lesson and when teaching looking at my CAPS document I should teach until … for, for a certain grade they should know until this level understands?
[113] Carina: I do prepare but not in (inaudible) having lesson plans
[114] Researcher: Okay
[115] Carina: Like your formal lesson plans
[115] Researcher: Okay
[116] Carina: With me I usually do for a week
[117] Researcher: Okay
[118] Carina: So that if I'm not done … but usually sometimes you take it that … my plans for a week last for a week and half because it depends on the learners
[119] Researcher: Uhm
[120] Carina: How they …
[121] Researcher: Uhm
[122] Carina: Tackle the topics and if they understand
[123] Researcher: And then for …let's take them one by one
[124] Carina: Uhm
[125] Researcher: For the lesson on rotation neh
[126] Carina: Uhm
[127] Researcher: Which resource did you use?
[128] Carina: For rotation I looked at Platinum and I also looked at the notes that we have yeah … the notes that we have when we were doing this err broadcast lessons
[129] Researcher: Broadcasting lessons ok alright
[130] Carina: Uhm
[131] Researcher: And then for data handling, lesson on data handling
[132] Carina: Data handling
[133] Researcher: Uhm …
[134] Carina: I used uhm there's another textbook that uhm … I used Platinum for some of the questions and I used another textbook … I forgot the name of the textbook
[135] Researcher: Okay
[136] Carina: Yeah and also I used some notes that I used to have
[137] Researcher: Okay
[138] Carina: Uhm …
[137] Carina: Uhm …

[138] Researcher: Uhm. I realised that when you start your lessons you always start by giving your own definitions of concepts without referring to any document
[138] Carina: Uhm …
[140] Researcher: But then later you refer learners to a textbook
[141] Carina: Uhm ..
[142] Researcher: For, for the same definitions.
[143] Carina: Uhm
[144] Researcher: Uhm. yes.
[145] Carina: Why do you do it like that?
[146] Researcher: Cause you know what? To be honest neh in most cases one thing I've realised if we rush … with CAPS when you teaching maths I don't like having my textbook as if I'm teaching history
[147] Researcher: Uhm
[148] Carina: So I want the learners to hear what I'm saying because usually when you refer every time you refer then to a textbook they don't even get what you saying but it's just written there
[149] Researcher: Uhm okay.
[150] Carina: That's why most of the , cause I will tell them something and I will tell them that uhm you can also check it in your textbook there as you do it
[151] Researcher: Uhm
[152] Carina: And you know in most cases if you just say the definition and you read exactly from the textbook it becomes boring for them and they also don't learn mostly because they just it's just there and it's written ok so that's why.
[153] Researcher: Okay
[154] Carina: I don't know may.. it might I might be wrong
[155] Researcher: No, no, no, I just wanted to understand.
[156] Carina: (Laughing) Yeah cause
[157] Researcher: That's why I …
[158] Carina: Yes especially like with … I also do it like this until FET, like when we do theorems and staff I don't like I don't want us to look at the textbook and do the theorem. What happens is they close their textbooks and do you know .. when we do Grade 11 Euclidean geometry I just tell them I just I just tell the theorem and what we must prove, write it on the board, prove it for them … I refer them back to the textbook
[159] Carina: Because most if you look at the learners that we have now if you use the textbook more
[160] Researcher: Uhm
[161] Carina: Than doing things practically with them
[162] Researcher: Uhm
[163] Carina: They don't learn, with the learners that we have now.
[164] Researcher: Uhm
[165] Carina: Some of them will just say I learn it from the textbook and don't even go and refer to that textbook
[166] Researcher: Okay
[167] Carina: So that's why
[168] Researcher: Okay
[169] Carina: Cause some …
[170] Researcher: But then in most instances you … you … you or you have your own understanding of the concepts and from the definitions from the textbook …
[171] Carina: Yes, but … but sometimes I take the definitions from the textbook ..
[172] Researcher: Okay
[173] Carina: And see if I can change it there and there to see … to make it easier for them
[174] Researcher: Okay
[175] Carina: Yeah
[176] Researcher: While trying to explain what the definition is saying and all that
[177] Carina: Yeah
[178] Researcher: Okay. Alright
[179] Researcher: And then also what I have seen is you referred learners to the DBE books
[180] Carina: Uhm
[181] Researcher: Yeah. So how do you use those?

[182] Carina: Thank you
[183] Researcher: The workbooks
[184] Carina: Okay
[185] Researcher: The DBE workbooks …
[186] Carina: It's easy, it's easier to use the workbook because they all have it
[187] Researcher: Okay
[188] Carina: Yes, and I look at the topic especially with transformations the DBE book have some … have more … some examples like …
[189] Researcher: Uhm
[190] Carina: So , what happens is when I'm .. my lesson … if I see that the book uhm that book eh the DBE book has more … has … is in line with how I'm teaching.
[191] Researcher: Uhm …
[192] Carina: That's when I use it.
[193] Researcher: Uhm
[194] Carina: Some mathematics topics
[195] Researcher: Okay
[196] Carina: I use it
[197] Researcher: Okay
[198] Carina: With some mathematical topics I don't use it because it's … sometimes it's limited
[199] Researcher: Okay
[200] Carina: I'm not sure if … when they were doing the DBE workbooks they did take into consideration about the CAPS
[201] Researcher: Okay
[202] Carina: Cause if I look at questions the DBE book is similar though, it's similar to the previous years' one.
[203] Researcher: Okay
[204] Carina: So there is really no difference cause that's why sometimes I don't use it. I use the DBE workbook with topics that I see that there's … there are more exercises and that the exercises are in line with how I'm teaching
[205] Researcher: Okay. All right and then uhm ..
[206] Researcher: Now the examples that you using
[207] Carina: Uhm
[208] Researcher: Uhmuhm … and the exercises that you using … you said you mostly, not mostly, some you take from the textbook and some you take them you just have them from your notes and …
[209] Carina: Yes
[210] Researcher: Alright
[211] Researcher: And the other thing is that when you designing eh maybe an assessment task
[212] Carina: Uhm …
[213] Researcher: Then how do the questions in the task relate to your examples and exercises that you do in your lessons?
[214] Carina: We do … when I'm setting my task usually I look at the examples that we have done
[215] Researcher: Uhm
[216] Carina: Then I won't set exactly what we did in class I look at similar examples changing it there and there
[217] Researcher: Uhm
[218] Carina: Then I also look at some diffe … I also look at different textbooks
[219] Researcher: Okay
[220] Carina: Yes
[221] Carina: And I also look at questions from my other friend who is a teacher too. Like we usually exchange questions
[222] Researcher: Okay
[223] Carina: So I look at other schools how they're having their questions, how they're setting. That's what I do actually.
[224] Researcher: Okay
[225] Carina: And I also refer obviously refer obviously referring to the CAPS document
[226] Researcher: Uhm
[227] Carina: Uhm

[228] Researcher: But then let's look at the CAPS document and the textbook neh
[229] Carina: Uhm
[230] Researcher: And the assessment I just want to relate that because …
[231] Carina: Uhm
[232] Researcher: Uhm, … the exercises I mean the examples that you give neh
[233] Carina: Uhm
[234] Researcher: Let's say for instance you design maybe a lesson and isn't that you have your examples neh
[235] Carina: Uhm
[236] Researcher: And then you have the exercises that you are going to give them
[237] Carina: Uhm
[238] Researcher: And then also maybe you thinking of then later on then you have to assess them
[239] Carina: Uhm
[240] Researcher: Right
[241] Carina: Uhm
[242] Researcher: And then when you teach the examples that you give, that's what I wanted to say, the examples and exercises that you give in the classroom, are they on the same level with the questions that you setting in a task?
[243] Carina: In the task?
[244] Researcher: Yeah
[245] Carina: Yes … but some with a task you don't want learners to be … to get to get used to getting things easy
[246] Researcher: Yeah
[247] Carina: So the tasks are not the same but they are similar there and there adding some difficult a bit so that we so that is not obvious for them
[248] Researcher: Uhm
[249] Carina: Cause you know at the end of the year they write the … when we have having tasks like bo your term test
[250] Researcher: Uhm
[251] Carina: We try to make it at least … I .. I still use bloom's taxonomy
[252] Researcher: Okay
[253] Carina: You know that ah the levels
[254] Researcher: **1.**
[255] Carina: So maybe you'll find if the test is out of 50 you make maybe the first question not be difficult, the second question to be in the middle there and the last .. that's the sub-questions, that's what I do
[256] Researcher: Uhm
[257] Carina: I don't make it to be easy for them
[258] Researcher: Yeah
[259] Carina: Cause then … cause sometimes you get those that are clever and it becomes boring for them
[260] Researcher: Yeah
[261] Carina: Yes
[262] Researcher: Yeah
[263] Researcher: Okay
[264] Carina: So it's not exactly but it's similar and adding some more difficult questions
[265] Researcher: But then when you do your examples and exercises
[266] Carina: Uhm
[267] Researcher: That's the class exercises where they practise
[268] Carina: Uhm
[269] Researcher: Do they have those type of questions or maybe prefer to have them in the assessment tasks?
[270] Carina: Sometimes you do have them, sometimes you do have them
[271] Researcher: Uhm
[272] Carina: It's just that with the topics we were doing
[273] Researcher: Uhm
[274] Carina: The difficult questions you wouldn't have much, finding the median, the mean and the mode
[275] Researcher: Uhm

[276] Carina: You'd those things you … you even if you can give them statistics but you can't make it to be difficult cause they can all find them in a way
[277] Researcher: Okay
[278] Carina: So I , there are … there are questions that you can make difficult but it also depend on the topic
[279] Researcher: Uhm
[280] Carina: Some topics you can't change things
[281] Researcher: Yeah hat much
[282] Carina: You can't. The only thing they must understand the mathematical concept behind in order … so that when they having other … other questions to apply it
[283] Researcher: Uhm
[284] Carina: Cause in most you can't
[285] Researcher: Uhm
[286] Carina: Cause in most cases …
[287] Researcher: Okay
[288] Carina: It's just that unfortunately we didn't have enough time because after the lesson we were doing stem and leaf diagram the we were doing eh … we were doing stem and leaf diagram interpreting it we were also doing bits of graphs there and there but we couldn't finish because of time constraints … starts of exams
[289] Researcher: Okay, okay …
[290] Carina: Uhm
[291] Researcher: And then the other thing is this neh … when you look at Platinum in particular
[292] Carina: Uhm
[293] Researcher: Cause you're using it
[294] Carina: Uhm
[295] Researcher: And the use the look at the DBE workbook
[296] Carina: Uhm
[297] Researcher: Do they give enough examples if you look at them, are those examples enough or can they prepare the learners adequately for what you …
[298] Carina: Uhm
[299] Researcher: You intend to … intend them to understand and which you … when you assess them and you saying I'm assessing them on this concepts and then if I have to use the textbook that textbook the Platinum and then this DBE workbook
[300] Carina: Uhm
[301] Researcher: And then those examples and exercises will prepare them enough
[302] Carina: Uhm
[303] Researcher: So do you see that in those textbooks
[304] Carina: Uhm. You know what? To be honest the DBE books they are … they do not have challenging questions
[305] Researcher: Uhm
[306] Carina: Their questions are just they are just there explicit. It's easy to …
[307] Researcher: Okay to …
[308] Carina: Yeah. With Platinum some questions there and there but both of them combined. I wouldn't say they are hundred percent accu … uhm maybe
[309] Researcher: Adequate
[310] Carina: Adequate to … to
[311] Researcher: Prepare learners
[312] Carina: To prepare learners no, they're not. That's why I use I also use some of the old textbooks as long as they are in line with CAPS
[313] Researcher: Okay
[314] Carina: Uhm
[314] Researcher: No, no, I think we can just leave it here
[315] Carina: Uhm
[316] Researcher: Thank you very much and if I think of something I will come back to you

Thami's Interview

[1] Researcher: How many years do you have in teaching… just teaching not necessarily maths

[2] Thami: Okay. I started teaching in 1996, then it means it's eh sixteen (16) years
[3] Researcher: That's sixteen (16) years
[4] Thami: Yes sixteen (16) years
[5] Researcher: Then teaching maths?
[6] Thami: Teaching maths, eh…I was teaching Physical Science I've been always been always allowed to here and there maths different grades
[7] Researcher: Okay
[8] Thami: I would say it's around ten (10) years
[9] Researcher: Ten (10) years
[10] Thami: Ten
[11] Researcher: And in grade nine (9)? Grade nine (9) maths, how many years roughly?
[12] Thami: I would say two (2) years, two (2) years because normally I would teach grade eleven (11), ten (10) and eleven(11), jah then do extra lessons for grade twelve(12),grade 12 teachers
[13] Researcher: Okay. Alright. And then in your teaching say of mathematics say grade nine (9) or any other grade when did you start using a textbook. Like in your years of teaching mathematics.
[14] Thami: For all the time that I've been teaching, I've always been using a textbook, yeah, for me as a teacher I've always used a textbook. The problem comes with the learners
[15] Researcher: Okay
[16] Thami: Sometimes you teach in the situation where learners do not have textbooks. But as a teacher at least every time when I'm teaching
[17] Researcher: Uhm
[18] Thami: A textbook will be available
[19] Researcher: So there's no time in your teaching when (unavailable) use other resources without a textbook?
[20] Thami: Uhm…Depending on the lessons. But the textbook will always be available
[21] Researcher: Yeah

[23] Thami: And so if I check that this lesson uhm does not (*inaudible*) a textbook I will just …if the textbook is not available then I will just use other methods but the textbook is always been there when I teach maths
[24] Researcher: Alright. Okay. And then your preparation of lessons neh, the maths lessons, to what extent do you use a textbook?

[25] Thami: Uhm… Normally make particular reference to the work schedule and then I normally refer to the textbook when I'm checking some examples that are appearing in the textbooks and then also giving extra work to the learners especially homework in cases where learners also have textbooks.
[26] Researcher: Okay. Alright. Any other resources that you using and except the textbook?
[27] Thami: Normally based on papers, yeah making use of previous papersto check the questions how they present then. So that I compared it with what I have in the textbook to check if the way the questioning technique is in the textbook is in line with the questioning in the papers
[28] Researcher: Uhm
[29] Thami: A textbook will be available
[30] Researcher: So basically you prefer to use a textbook?
[31] Thami: Yeah in the textbook because if that textbook is the same textbook the learners have it becomes easy because they will first of all refer to an example and from the example normally the textbook will give questions that are relevant to the example that would have been given, so that will enhance their understanding
[32] Researcher: Okay. And then any specific textbook that you using for grade nine (9).
[33] Thami: For grade nine (9) I normally, in (inaudible)I use Platinum
[34] Researcher: Okay, Platinum?
[35] Thami: Yes, I use Platinum. I find it in, in line with the work schedule.
[36] Researcher: Any other resources expert that one?
[37] Thami: (Search around for other resources). This is Platinum
[38] Researcher: Okay. Platinum, okay
[39] Thami: Then we have other booklets, small booklets, just one that we pick

[40] Researcher: Okay
[41] Thami: But there ones, they depend on the topic some are just particular to particular topic. So we just pick them like for probability and yeah
[42] Researcher: Alright
[43] Thami: So we, we also use those
[44] Researcher: Okay. And now how do you access those?
[45] Thami: Uhm some of the information we google, through the internet I can just uhm identify the topic that I'm going to deal with and I can just, from the internet I can source more of the information
[46] Researcher: Okay
[47] Thami: As our extra assistance or as an addition to, to word the textbook will be having, yeah
[48] Researcher: Okay. And then besides a textbook do you have any other resource that you may use, may say (unavailable)
[49] Thami: Yes, I normally use the internet
[50] Researcher: Okay
[51] Thami: Normally the internet yes
[52] Researcher: Okay. And then uhmyour lessons neh
[53] Thami: Yes
[54] Researcher: I realised that you were using a chalkboard when you started
[55] Thami: Yes
[56] Researcher: There was quite a number of definitions and examples that you have from the chalkboard
[57] Thami: Yes
[58] Researcher: So there ones were then your own designs or creations or did you pick them up from some resource, textbook or any?
[59] Thami: Yes, normally with definitions I use different resources, like I make use of the internet, then refer to different textbooks that I'll be having, then I come up with a definition that I feel the learners, it will be easy for learners to understand. You know at time you use one textbook and give a definition that becomes a bit uhm (inaudible) to learners
[60] Researcher: Okay
[61] Thami: But when you make use of different textbooks, even as an educator you can come up with your own definition based on the definitions that I would have actually seen from the textbooks.
[62] Researcher: (Phone rings)
[63] Researcher: And then ah, the other thing is ah if you have to, when you prepare the lesson, neh
[64] Thami: Yes
[65] Researcher: Basically the ones that we observed, and then how do you maybe choose your examples and your…, your examples and your exercises? How do you choose them?
[66] Thami: Uhm. normally its concept related. If I start on this concept I must, before I proceed to the next one I must have an example then maybe two (2) or so problems based on that.
[67] Researcher: Uhm
[68] Thami: And then I move on to the next one an example two or so problems based on that concept so that learners don't mix. They will know that if such a question comes it is based on this point, and if a question comes it is based on this other point.
[69] Thami: So generally it's a examples for any aspect that I come up on the lesson
[70] Researcher: The lesson, okay
[71] Thami: Yeah
[72] Thami: And what uhm normally we refer to the…cause we have in the CAPS we have what we call that ah ATP
[73] Thami: Yes
[74] Researcher: The ATP, the annual teaching plan
[75] Thami: Yes, yes, I make reference to that
[76] Researcher: You make reference to that?
[77] Thami: I make reference to that

[78] Researcher: Okay. And then also the exercises, say they are related to the examples
[79] Thami: Yes
[80] Researcher: And then, in a case where you have to set a task how is it related to the examples and the exercises that you do in your lesson?
[81] Thami: Normally in task, uhm we… it's usually given when you are actually integrating the may be three or four aspects that you taught in class. So we give an uhmuhm an task on uhm combining those examples and activities that we would have given, uhm given before so that you check the understanding of the learners…, are they able to relate this output to this one and to this other one
[82] Researcher: Uhm
[83] Thami: So the task is normally after covering
[84] Researcher: Uhm
[85] Thami: All the outputs related to the particular topic to that you are here that there learners they are able to link what we just did first day or first output*, second day and so on
[86] Researcher: Uhm
[87] Thami: So the task is normally given at the end to integrate the whole topic
[88] Researcher: To integrate the whole topic
[89] Thami: Yeah
[90] Researcher: And then because you dealing with the 3D shapes neh
[91] Thami: Yeah
[92] Researcher: And then you were giving the learners the handouts
[93] Thami: Yes
[94] Researcher: So there hand-outs were the (unavailable) and as you were working on the chalkboard and you gave them and also (unavailable)
[95] Thami: Yes
[96] Researcher: And these hand-outs are they from a particular source or different sources?
[97] Thami: Uhm, I checked from different sources and I was the ones that I would uhmthink for the particular aspect they are uhm relevant or they are easy to understand. I will make copies for the whole class. But then if I notice that this other aspect is easily uhm explained, it's explained in detail in this other textbook I just make copies from the other textbook.
[98] Researcher: So basically there hand-outs are from different textbooks?
[99] Thami: Yes. They are from different textbooks
[100] Researcher: Okay. And then in terms of the, when you, like the, the task. What do you look for? When you give them a task, to say that this is the task I'm going to give them?
[101] Thami: Uh, I'm guided by the schedule
[102] Researcher: Okay
[103] Thami: Yes, I focus on the objectives; I focus on the content that they must cover. Then when I then, I'm expects of them at the end of the year
[104] Researcher: Okay
[105] Thami: Yes
[106] Researcher: Okay. I will look at the CAPS document neh
[107] Thami: Yes
[108] Researcher: There's uhm I think where they clarify some concepts, the content classification
[109] Thami: Yes
[110] Researcher: You also refer to that
[111] Thami: I also refer to it
[112] Researcher: And then you…
[113] Thami: Normally I refer to content classification during the teaching process
[114] Researcher: Okay
[115] Thami: Yes. To say my lesson must be… when I'm teaching I must make sure that when I'm dealing with this aspect this is what I must cover
[116] Researcher: Okay
[117] Thami: In addition to other things I may add but these ones the, the CAPS document require there, there must also be included
[118] Researcher: Okay
[119] Thami: Yes
[120] Researcher: Okay, when I look at the textbooks that you're using, then do you see them

giving enough examples and exercises to prepare learners adequately for whatever you may need to give them?

[121] Thami: Uhm in my view Platinum gives enough

[122] Researcher: Gives enough?

[123] Thami: Yeah, it's enough because even the, the presentation it is uhm, it is topics are according to the CAPS document, topic one (1) you may find is chapter one (1) topic chapter two (2) and now according to the document the CAPS

[124] Researcher: Okay

[125] Thami: It's only unfortunate they don't have textbooks, but otherwise if they all had these textbooks and the use of Platinum I think teaching would be much easier, yeah

[126] Researcher: And then when you look at the topics in Platinum, the way they structure their examples and their exercises do you think that it's the way you like it to, lookup at may the way what CAPS require to know all the skills and the concepts that they need. Do you still remember the concepts and skills that the learners need to know?

[127] Thami: Yeah yeah, uhm, their examples, I have a problem with their examples because normally they given level two (2) or level uhm, lower level examples, yet as they go deeper they would end up getting to high level questions

[128] Researcher: Yes

[129] Thami: I think they should also include examples that are of high level

[130] Researcher: Uhm

[131] Thami: So that when learners revise…you know it's easy when they understand a high level question you would expect them to be familiar with their low level questions. But if examples are of a low a level then it means it will be a problem for them to, to answer high level questions

[132] Researcher: Yeah

[133] Thami: Yes

[134] Researcher: But then looking at examples themselves, let's say they give examples and they also give learners some exercises

[135] Thami: Yes

[136] Researcher: Do they relate somewhere?

[137] Thami: The exercises are also of low levels but there some exercises there the levels is high yet the example of the low level

[138] Researcher: Okay

[139] Thami: Yes

[140] Researcher: Then that translate also to the*

[141] Thami: Yes

[142] Researcher: I can imagine that maybe if you have to, or whoever has to, they might not use Platinum but use other…

[143] Thami: Other textbooks, yes, yes

[144] Researcher: Then in that case how do you make sure that your learners are adequately prepared?

[145] Thami: That's when we make use of the internet, we make use of the past papers to say okay this is the topic I've done and this topic let me now all the past papers, let me revise all the questions from the past papers that are particular to that topic, is then that the learners get to know what to expect in the examination about that particular topic

[146] Researcher: Okay

[147] Thami: Yes

[148] Researcher: But then in your opinion do you think maybe, maybe whoever writes a textbook, whatever the textbook that we have do they consider maybe like ah at the end of it all that ahh there are the types of questions that ah…like in grade nine (9) we have ANA

[149] Thami: Uhm

[150] Researcher: And the ANA is been there for some time now. I think the textbook that we are using now are new textbooks and then in my opinion I would, or in my thinking maybe I would think that maybe they refer like you say you do, they refer to past papers and so on so that the types of questions, so that whatever the

types of resources they give or they write, whether it's a textbook or (unavailable) it should be able to address some of those concepts especially when it comes to (*inaudible*), the way we (*inaudible)*

[151] Thami: Yeah, I think that for that's where we are, I think there's a problem there

[152] Researcher: Uhm

[153] Thami: Because the, the questions that they have in their textbooks are only meant to, to check the undertaking not the application

[154] Researcher: Okay

[155] Thami: We will find at times after every topic the exercises that come one just to check if they did understand only. You know with maths it goes further than understanding

[156] Researcher: Uhm

[157] Thami: It stretches to the application*

[158] Researcher: Okay

[159] Thami: And if you check past papers a learner who's only using a textbook at times it's difficult for that learner to answer those questions

[160] Researcher: Okay

[161] Thami: He will, the learner will only answer maybe it's A, B, C, D maybe if it's (a) up to (f) he only manage to answer (a), (b), (c). that's what comes straight from the textbook, and then as we processed (d) to whatever you find that now it's application, the textbook did not take note of the application part of the, of the…yes. That's where now we have learners getting into trouble

[162] Researcher: Okay. So in your opinion then using, as a teacher using maybe one textbook or the textbook alone might not be advisable or maybe?

[163] Thami: Yeah, the use of…relying on the textbook alone for me it's not advisable especially for our, there science subjects, math and physical science, ah I think especially considering the, the exercises that appear in the textbooks, it's not adequate to prepare the learners for the examination, given the type of equations that are set for final examinations

[164] Researcher: Okay

[165] Thami: Yeah

[166] Researcher: So in your opinion who do you think the people who write textbook should do?

[167] Thami: I would suggest of maybe their questions could be based on…the content is time, I'm satisfied with the content but I would suggest that when they are… their questioning must they must pick questions from the past papers. Then that way it will actually even the learner even when, the learner sees some of the questions from the past paper, he sees it in the textbook, the learner actually feels I have a source of information because what I got here is what is appearing in past papers and all the steps will be shown because in the textbook the textbook will show step one (1), step two (2) up to step three (3). When that same learner sees the same question in the textbook, in the past paper it becomes easy for the learner to, to that question

[168] Researcher: Okay, it might be the examiner and the, the

[169] Thami: The authors

[170] Researcher: The authors of the textbook, there no….

[171] Thami: There is no coordination, and of some sort

[172] Researcher: Of some sort….

[173] Thami: Yeah

[174] Researcher: Okay

[175] Thami: Maybe if the authors could be advised that for your equation please eh always refer to what the examiners ah have set for that particular topic, it will help and maybe enhance the pass rate

[176] Researcher: Okay. Or the other way round

[177] Thami: Or the other way round

[178] Researcher: (Laughing). But when you say, look, take your other two books, is it the same situation or maybe other are

[179] Thami: Uh

[180] Researcher: Do you see the same, the same maybe structure or in terms of examples, questions, level of questions and so on and so on, or maybe the, the other textbook is more the you know the, the, the type of questions that we find

in the , that the other or maybe if you, just generally, on average

[181] Thami: Yeah in general the, if one textbook is more towards the question on this topic you will find it's not the same on the next topic, maybe for the next topic is this other textbook that is better

[182] Researcher: Okay

[183] Thami: There textbooks, the, the depth of coverage is not consistent, for this topic you may find the depth is satisfactory for the next topic you find that it's just superficial, jah just on the surface

[184] Researcher: So it's very difficult maybe to, to just use one…

[185] Thami: To use one textbook, it becomes difficult to use one textbook

[186] Researcher: Alright, Thami, thank you very much

Pontsho's Interview

[1] Researcher: So mam, just a few questions, it's not that much. In actual fact, what I just need to establish is your views about (inaudible) maths in terms of your teaching and all that. It's not like I have answers for (inaudible). I don't have any answer for anything so it's just your views and your opinion about certain things especially regarding the teaching of mathematics. So I just need you to be as free and open as possible. And the first question is on the … your experience as a teacher. How many years now have you taught?

[2] Pontsho: 19 Years.

[3] Researcher: And then teaching mathematics, say grade 9 especially?

[4] Pontsho: I've started since then.

[5] Researcher: In teaching grade 9?

[6] Pontsho: Yes.

[7] Researcher: Alright, and then other grades?

[8] Pontsho: Since then.

[9] Researcher: Maybe except grade 9 which other grade did you teach?

[10] Pontsho: Grade 10 to 12

[11] Researcher: Grade 10 to 12?

[12] Pontsho: Hmm.

[13] Researcher: Okay. No grade 8?

[14] Pontsho: No. I haven't taught grade 8.

[15] Researcher: Alright. And then … let's see. And then in your teaching, uhm …when did you start using a textbook?

[16] Pontsho: Since I started teaching, 1995.

[17] Researcher: So you've been using a maths textbook?

[18] Pontsho: Yes.

[19] Researcher: Alright. And then any time reason for that maybe?

[20] Pontsho: Uhm … the reason is, from my first experience, I can say we are from a very poor school without resources. We could not use any kind of electronic means. Textbook was the only resource we have, different textbooks. And that according to me, I think it was much productive because then learners relied much on the textbook. They had to go through the textbook, read and try to understand the concepts.

[21] Researcher: So if you had an option you would opt for other maybe resources or …

[22] Pontsho: Yeah. I think especially with the explanation of the resources. I mean the explanation of the concepts and again the other alternative methods because we rely much on the methods that are there on the textbooks. Few that we can take from outside. Maybe those that I think that can access maybe from textbook A and textbook B.

[23] Researcher: And then in your training for instance, maybe when you did your training as a teacher, did you have any experience of other resources other than the textbook?
[24] Pontsho: No. No access to internet.
[25] Researcher: So the textbook was the only source …
[26] Pontsho: Was the only source uhm.
[27] Researcher: And then in your …, when you prepare your lessons, to what extent do you use a textbook?
[28] Pontsho: I can say 95% of my preparation is based on the textbook.
[29] Researcher: On the textbook?
[30] Pontsho: Yes.
[31] Researcher: Alright. And 5% maybe?
[32] Pontsho: 5% is (inaudible) I can google. Especially with the explanation of the concepts because I've realized that if learners don't understand the concepts, the whole lesson will be (inaudible)
[33] Researcher: And then any, do you have any textbook, specific textbook that you are using at the moment for teaching mathematics?
[34] Pontsho: Yes. I'm using Spot On for grade 9. This is the textbook they're using. Then for my … for me, I can go an extra mile. I use Classroom Maths. This revised one and the old Classroom Maths because you might find that sometimes they explain the concept in different ways. They …, the way they use their calculations at least like the olden one it has, … the calculations are in detail, like the revised one.
[35] Researcher: And then uhm, then you saying maybe you can sometimes maybe use other resources like internet and so on?
[36] Pontsho: Yes.
[37] Researcher: And then in terms of the lessons that we observed, those particular lessons, the one I think was on data handling, most of it and all that …
[38] Pontsho: Yes. It was based on data handling.
[39] Researcher: Did you do any preparations for those lessons?
[40] Pontsho: Yes I did.
[41] Researcher: And then what resources did you use if you did?
[42] Pontsho: Pardon?
[43] Researcher: What resource did you use for those lessons? The ones that we observed?
[44] Pontsho: Uhm the other one I've used … do you still remember (inaudible) was still allocating the budget?
[45] Researcher: Yes.
[46] Pontsho: Based on the pie-chart [lesson]. There is a pie-chart. There is a pie-chart where you allocated the budget for education, for so much billions. That's the pie-chart I used and the other one I let them go watch TV normally when we watch the news during … between 7:00 and 7:30. The time when they are supposed to or maybe when they are talking about weather, three days weather, where they are going to use a double pie chart. Yesterday the weather was like this, this one ….The use of electricity that they normally see it on television and again I have some other charts based on the bar graph.
[47] Researcher: Or the ones that you were, is from the other resources other the textbook
[48] Pontsho: Yes, yes.
[49] Researcher: Alright.
[50] Pontsho: This took, tools I mean to stress the issue that whatever you're doing in this, is there in the real life situation. People are still using that to present their events or whatever.

[51] Researcher: And then in the two lessons what I've observed is that you prefer to take your definitions from the textbook.

[52] Pontsho: Yes.

[53] Researcher: Why is that?

[54] Pontsho: Basically, using the textbook needs learners to be able to read, to analyse the statement. Whatever they have read can they be able to analyse. Some (inaudible) to statement …. That's why I said let's read in the textbook and let's hear what they're saying. My, or the other knowledge that I'm having is just there to supplement them. What is written in the textbook or maybe to write it in a simple way that the learners will understand.

[55] Researcher: And then uhm, in the first lesson neh, then the example that you gave, looks like it was your own example, and then in lesson 2 you had examples from the textbook.

[56] Pontsho: Yes

[57] Researcher: The why do you have that?

[58] Pontsho: So our, my main aim to have my own example is to let the learners see or show them that whatever we are doing is there in a real life situation. It's not a matter of you just to think because what we know is that we in data handling, we have to collect data in different ways. Will they be able to collect data there after school? That was my aim. My own example rather than the one in the textbook. Then by going to the textbook was just to stress what I did with them, to show them that this is there in the textbooks. It is there in the real life situation.

[59] Researcher: Okay. Then which means you would maybe consider context whenever you come up with examples of your own?

[60] Pontsho: Yes, so that even if they check in the question paper or even if they are writing the exams (inaudible) they mustn't say we never did this in class. They should know that this is there, it's everywhere.

[61] Researcher: And then the exercise, first one on the first lesson your exercise was your own. You still remember that one on (inaudible) transport?

[62] Pontsho: Yes.

[63] Researcher: So what is for the same reason that you saying …

[64] Pontsho: Yes. They must be able to analyse the data they come across.

[65] Researcher: So every time you have to, (inaudible) you use a textbook but then you have your own (inaudible)?

[66] Pontsho: Yes will (inaudible) encourage them to think in a broad sense saying that even if, wherever I go I must be able to read and interpret what the data is all about.

[67] Researcher: Okay, alright….And then uhm the other thing I wanted to find out from you was uhm the examples that you choose, and the exercises, whether it's homework or classroom exercises. And how do you choose them looking at say for instance what is required maybe say in CAPS? Do you ever refer to CAPS so that you can maybe say (inaudible) examples and then exercises or do you just look at the concept and then …

[68] Pontsho: Because I know or understand what is CAPS all about, when I choose the exercise for the learners I choose this exercise based on blooms' taxonomy because they are not of the same mentality. I choose the exercise based on knowledge and analysis. Whatever they know will they be able to analyse, interpret according to the blooms taxonomy. Will it be possible for them? If it is not possible, if

they are much in knowledge than in analysis it means I have to go back and find out more activities, more lessons based on the interpretation on this one.

[69] Researcher: Uhm, and then, then your lessons. I mean your learners, you said that they all have textbooks?

[70] Pontsho: Yes. They do have because as a school we force them to have textbooks as the only means now that we can use in class rather than some using laptops and some using (inaudible). We want to have a uniform thing.

[71] Researcher: Okay, alright. Then how does it affect your teaching if they all have textbooks. Does it make it easy or …

[72] Pontsho: I think it makes my teaching very easy because this helps me to check every learner. Which learner has a reading problem, a language problem as far as, because the language of teaching is English and that's not their mother tongue. So it helps me a lot again to give them lot of activities and it saves time rather than writing on the board for activities and (inaudible).

[73] Researcher: Okay. And then when you design uhm, let me say an assessment activity or task, then how do your examples and exercises help you? Is there any relationship between the questions in your tasks and the ones in your examples and exercises?

[74] Pontsho: Yes. They are there. There is a great relationship or similarity. The only difference is wording but this again I've, as I said it helps the learner to think in a constructive way. Not just to be biased or just to cram (memorise), these are the kind of questions that (inaudible) ask

[75] Researcher: Okay. When you look at the (inaudible) exercises and examples in the textbook that you using, like you said you using Spot On, and then the exercises and examples, are they enough to prepare learners for maybe mastering of concepts?

[76] Pontsho: Not exactly. As I have said, I'm using other textbooks. Yes. And sometimes I just google. When I deal with data handling I may google any question based on data handling. Different (inaudible) different (inaudible) of questions etc. Then I just give them sometimes, don't check in your textbooks, do this one. I just give them some hand-outs.

[77] Researcher: Okay. I think mam. Up to so far I'm satisfied and then, then I can see that a textbook is playing a major role because like you said …

[78] Pontsho: Cause it's affordable the other way very much as to the this electronic devices.

[79] Researcher: Thank very much mam.

Mohau's Interview

[1] Researcher: You said you were (unavailable) this, morning?

[2] Mohau: Yes

[3] Researcher: We need to check a few things, it's not much neh

[4] Mohau: Okay

[5] Researcher: It's just a few questions

[6] Mohau: Yes

[7] Researcher: And based on the two lessons I observed

[8] Mohau: Okay

[9] Researcher: But I will start first with a bit of history in terms of your, I mean teaching in

general; not necessarily maths

[10] Mohau: Yes?

[11] Researcher: And maybe, eh how many years have you been teaching now? Not necessarily maths, just teaching?

[12] Mohau: Its twenty three (23) years

[13] Researcher: Twenty three (23)?

[14] Mohau: Yes

[15] Researcher: (Laughing) it's a lot of experience

[16] Mohau: Yeah

[17] Researcher: Yeah all right and then maths grade nine (9)? How many years teaching grade nine (9) maths?

[18] Mohau: Eh... I would say I did go home and teach for some time, back right I was doing grade nine (9) wabona, five or so years

[19] Researcher: Yeah, Five more years?

[20] Mohau: Yes teaching there grade nine (9) wabona (you see)?

[21] Researcher: So it's ±10 years?

[22] Mohau: Yes.

[23] Researcher: And other grades mathematics

[24] Mohau: Oh just the same, been having say this year may be teaching this grade and the other year maybe teaching that grade, it's been about the same years

[25] Researcher: Oh different grades from grade eight (8) to?

[26] Mohau: To grade twelve (12)

[27] Researcher: Up to twelve (12)?

[28] Mohau: Yes

[29] Researcher: All right. And then is your teaching neh

[30] Mohau: Yes

[31] Researcher: Since you started teaching, when do use a textbook?

[32] Mohau: Uh… I would say at any given available opportunity I would use a textbook

[33] Researcher: Yeah

[34] Mohau: With the lesson

[35] Researcher: Yeah

[36] Mohau: Because it becomes easier for them to follow especially taking to account that maths textbook comprises of, … it's a different textbook from all textbooks because it comprises mainly of exercises, exercises of which its basically what we want to do in mathematics, practice, practice

[37] Researcher: Okay

[38] Mohau: Uhm no I can't say, I always use a textbook

[39] Researcher: Okay

[40] Mohau: Different types of textbooks

[41] Researcher: Oh different types of textbooks?

[42] Mohau: Yes

[43] Researcher: Okay. Say uhm in your planning of any lesson

[44] Mohau: Yes

[45] Researcher: Including the ones we observed

[46] Mohau: Yes

[47] Researcher: To what extend do you use a textbook?

[48] Mohau: Uhm in my planning I did go and consult about three textbooks

[49] Researcher: Okay

[50] Mohau: To plan a lesson you have to see various types of exercises from about three types of textbooks

[51] Researcher: Uhm

[52] Mohau: In this instance I took into account that GET textbook which is for free

[53] Researcher: Yes

[54] Mohau: Which is normally given to kids

[55] Researcher: Uhm

[56] Mohau: I used Classroom Mathematics for previous years and then Platinum to compare the exercises, and then maybe with that one that the GET had, to some extend the exercises were not really

[57] Researcher: Okay

[58] Mohau: Yeah, up to scratch in that regard
[59] Researcher: Okay
[60] Mohau: Yeah. They require high grade exercises then
[61] Researcher: Okay
[62] Mohau: Yeah
[63] Researcher: Do you have any specific one, specific textbook that you using at the moment?
[64] Mohau: Yeah at the moment we are using Platinum mathematics
[65] Researcher: Okay why use that?
[66] Mohau: Uhm I think this textbook is good for the learners
[67] Researcher: Okay
[68] Mohau: Yeah. Although as a teacher you go to Classroom Maths
[69] Researcher: Okay
[70] Mohau: You can consult classroom maths and any other textbook that you have
[71] Researcher: Okay but when you look at the one you use and the one that the school decided or whoever decided that on.
[72] Mohau: Yes
[73] Researcher: According to what you get it
[74] Mohau: Yes
[75] Researcher: Does it address what you want in terms of maybe the teaching of concepts as required by the syllabus
[76] Mohau: Yes, it does, it does to some extend although I feel like in some instances there're few exercises where kids are supposed to practice
[77] Researcher: To practice
[78] Mohau: There are fewer exercises
[79] Researcher: Uhm
[80] Mohau: It sort of a rush in some topics where you find there are only one or two exercises and then
[81] Researcher: Okay from there?
[82] Mohau: Then it says move on
[83] Researcher: Alright
[84] Mohau: That's when you make some worksheets for the kids from other textbooks
[85] Researcher: Okay
[86] Mohau: So that they have more practice and exercises
[87] Researcher: Okay. And then uhm this one you using because it's available
[88] Mohau: Yeah that's the textbook available for learners to (unavailable)
[89] Researcher: In terms of say the, the syllabus as outlined in the CAPS
[90] Mohau: Uhm …
[91] Researcher: Yes. Do you find it uhm covers what needs to be covered?
[92] Mohau: Yes. It really does
[93] Researcher: It does cover
[94] Mohau: It does cover what we are required to do
[95] Researcher: To do.
[96] Researcher:: And then any other resources besides classroom maths and other textbooks. Is there any other resource that you use?
[97] Mohau: Yes. Normally we just go to the internet
[98] Researcher: Okay
[99] Mohau: I'm dealing with a topic GET that's what they rather quite a number of websites
[100] Researcher: Okay
[101] Mohau: Where we always go and get part of exam papers or questions depending on the topic there are quite a number of websites on the computers at our school
[102] Researcher: Okay. And then for the two lesson we've observed, neh
[103] Mohau: Okay
[104] Researcher: Did you prepare and if you did which resources did you use?
[105] Mohau: Uhm…
[106] Researcher: You still remember on that day you were doing statistics
[107] Mohau: Oh statistics
[108] Researcher: Data handling, you still remember your two lesson were based on

[109] Mohau: Okay
[100] Mohau: (Paging through the notebook) unavailable
[101] Researcher:: Measures of central tendency. Yeah that was the first one I think and then the second one you were just continuing dealing with the graphs, the graphs that learners had to do to represent data and staff
[102] Mohau: Yeah
[103] Researcher: So which textbook did you use or if not any other resource?
[104] Mohau: This study, this teacher guide, that the platinum teachers guide and then in a view of our syllabus if you look at it, I also teach grade ten (10) and also grade twelve's (12's) and eleven's (11's) so there is also when dealing with that content, there are quite a number of textbooks that deal with that content. What you need to do is water down this staff so that it comes to a grade nine (9) level. Otherwise there is quite a number of textbooks that we use grade ten (10) and grade eleven (11) just trying to (unavailable) based on grade nine (9)
[105] Researcher: All right, and then again in your two lessons what I discovered is that for definitions and for activates you were using a textbook.
[106] Mohau: Yeah
[107] Researcher: Yes?
[108] Mohau: So yeah, … just to …
[109] Mohau: In this case mine, not the example given by the textbook
[110] Researcher: Okay
[111] Mohau: But I went to take on exercise and started with the exercise that's when we come with the example, which in one equation in the textbook and then from there and refer the kids to go and see the exam worked in the textbook and compare with what we have done and give them an exercise
[112] Researcher: Okay
[113] Mohau: That's what is done
[114] Researcher: Okay, so you prefer definitions from the textbook?
[115] Mohau: Yeah, for, for this, in this case the platinum was,uhm… I think it was uhm…
[116] Researcher: More clearer?
[117] Mohau: More clearer than other textbook that we using
[118] Researcher: Yeah
[119] Mohau: That's where I chose the ones
[120] Researcher: Okay, with other lessons?
[121] Mohau: With other lessons, with other lessons, I, I, I go on and look for other definitions from different textbooks and come up with what I think is really good idea, this is what they could understand
[122] Researcher: Okay
[123] Mohau: Cause it depends on the level again
[124] Researcher: Okay
[125] Mohau: Even at grade eight (8), eh, eh… there is a difference
[126] Researcher: Much
[127] Mohau: That way you do the weighting
[128] Researcher: Yeah
[129] Mohau: So that the kids try to understand what you're saying so how if you are in grade ten (10) again using your textbook there are sigma notations of which the kid in grade eight (8), now what does it to that kid
[130] Researcher: Okay
[131] Mohau: So at least in that case it was specified
[132] Researcher: Okay, so in this case it's because the textbook was clearer
[133] Mohau: From the textbook yeah
[134] Researcher: Okay, alright…
[135] Mohau: And then when you do you eh say when for instance preparation or when you teach and all that
[136] Researcher: How do you choose your examples and exercises?
[137] Mohau: Uhm… we normally try and start from what they know and to the and we always trying to from simple to difficult as we go
[138] Researcher: Uhm …
[139] Mohau: That's how we choose our exercises

[140] Researcher: Uhm
[141] Mohau: Find that at times in the textbook they register question 1(a). EL 1 part A (b) ;(c) ;(d) quite simpler then they put something quite difficult
[142] Researcher: Uhm
[143] Mohau: So you find that at times that concept it won't really need to follow what they are saying
[144] Researcher: Okay
[145] Mohau: Choose maybe there we dealing with maybe removing the brackets or factorization
[146] Researcher: Uhm
[147] Mohau: Different types of questions, you go on and choose from so that it suits what you are going or that particular (inaudible)
[148] Researcher: Okay
[149] Mohau: That's what we do then
[150] Researcher: Okay, and then in terms of the levels, you when you I'm thinking, say you give examples then obviously you shall have prepared, and you have to give them some exercises to do, when you do then with them or you let them do it on their own, then you consider some, different levels?
[151] Mohau: Yes we, I've to take that into account, you find that there are some fast learners, and at the end that's where you end up giving them difficult and at the same time taking into account that there are some slow learners, hence we go back. So there worksheets in the Platinum we got, we got some worksheets in the textbook which they are… worksheet A is for the good ones and worksheet B gives us basic for (inaudible)
[152] Researcher: Okay. So you are able to… if you look at the textbook you know eh, then to… to prepare in such a way that I maybe all the (unavailable) learner in your class yeah, yeah
[153] Mohau: Exactly
[154] Researcher: Considering that there their own different ways of learning and all that
[155] Mohau: You have find ever there still or a way of intervention in a textbook
[156] Researcher: Uhm
[157] Mohau: So after every topic, so…so it's nice to give them something, something about that topic
[158] Researcher: The other thing is that when you set a …
[159] Mohau: Uhm
[160] Researcher: Whatever … task, whether it's on this a topic or any other topic and then how do questions in the, … relate to the questions or the example and the questions that you are in the classroom
[161] Mohau: Uhm… you have to take into account that Bloom's taxonomy whereby now you are creating your questions. You find it that there might be there in the textbook but then when you need to is there and there whatever it is taking into account how that this is a task or all say let's make this simple so that they all pass. Yeah the difficult questions 9 and10 (*inaudible*)
[162] Mohau: You have to take into account
[163] Researcher: But when you teach what's the difference, the examples and the exercises that you choose …
[164] Mohau: Yes
[165] Researcher: And then with relation to when you have to set a task …
[166] Mohau: Because it really needs to become and for at all the time. But then you remember we talking into account the, …the capabilities of the children or your teaching became our subject on its own is rather its difficultly for them
[167] Researcher: Uhm
[168] Mohau: So at all times we always try to motivate taking into account questions to appreciate how simple it is and then now the difficultly as you go
[169] Researcher: Uhm
[170] Mohau: So that they understand what you're saying
[171] Researcher: All right. And then the other thing is if you look at the textbook you're using Platinum for and other… the examples that are in the textbook and the exercises, according to you when you look at then do they prepare learners adequately for of concepts as required and therefore maybe prepare them

maybe achieve in the tasks that you give them?

[172] Mohau: Yeah, they really do is just do to add as you go on. These are quite a number of resources which there'll that ANA exemplar taking into account that I'm done with this topic taking one or two and them (unavailable) a question paper give one or two so that they got a of what's going to happen at the end when they are writing a test

[173] Researcher: So your (unavailable) is to expose then to

[174] Mohau: Yes

[175] Researcher: To different question?

[176] Mohau: Yeah

[177] Researcher: What happens if you don't use that (unavailable) just use the textbook?

[178] Mohau: Uhm…what I noticed is that these kids they tend to be… the way of question tend to, to be (unavailable) as if this is the only way of that is going to be questioned. They are not surprised to this type of questioning they do the writing that's (unavailable) for them to do

[179] Researcher: Uhm… so which might mean that this textbook has its own way of uhm… asking questions in examples and all that, which might not necessarily be uhm maybe, which might not necessarily address what the might look like maybe in terms of the questions

[180] Mohau: It's not really much difference

[181] Researcher: Uhm

[182] Mohau: It's just the wording, we should just need to explore to that thing, the examiner, might asked this question and say or this is, what but it all means the same this so it means explaining to the kids really what the examiner wants because what the textbook and what the examiner also is really one and the same thing is the wording. So it's a matter of exploring then on how…

[183] Researcher: Questions might be

[184] Mohau: Yeah

[185] Researcher: Okay. Alright. Which means therefore according to you maybe it might be that the examiner has their own way of doing or questions which might not necessarily be in the textbook?

[186] Mohau: Uhm

[187] Researcher: And then in that case, if you think of it what might be their source, I mean if a textbook might be this source that us to use. Because I that if there's a textbook say presented or something therefore whoever to ask or set a an examination somehow they might or they should be alright themselves with the way questions are or learners are taught in the classroom

[188] Mohau: Yeah…yeah…exactly (inaudible)

[189] Researcher: So you think there are other sources?

[190] Mohau: Uh…

[191] Researcher: Or maybe it's…

[192] Mohau: It's a matter of personal words (unavailable) because instead of saying simply given a algebraic expression someone might say remove the brackets and simplify

ANNEXURE G: A sample of questions and answers during the teachers' interviews

Research question 1

RQ1SQ1 **How many years have you been teaching?**

Teacher 1 05 Years.

Teacher 2	16 Years
Teacher 3	23 Years
Teacher 4	19 Years
RQ1SQ2	**How many years have you been teaching mathematics in grade 9?**
Teacher 1	05 Years.
Teacher 2	10 Years
Teacher 3	10 Years
Teacher 4	19 Years.
RQ1SQ3	**In your teaching when did you start using a textbook as a teacher?**
Teacher 1	When I started working
Teacher 2	For all the time that I've been teaching, I've always been using a textbook, yeah, for me as a teacher I've always used a textbook
Teacher 3	Uh… I would say at any given available opportunity I would use a textbook …Because it becomes easier for them to follow especially taking to account that maths textbook comprises of, … it's a different textbook from all textbooks because it comprises mainly of exercises, exercises of which its basically what we want to do in mathematics, practice, practice
Teacher 4	Since I started teaching, 1995.
RQ1SQ4	**To what extent do you use a textbook to prepare a mathematics lesson?**
Teacher 1	Uhm I do use a textbook when I, especially when it comes to … cause with the, with the, with the CAPS that we having now I can't plan my lessons as I used to because some things have changed. So I have to. I look at the textbook I see that if the textbook go hand in hand with the CAPS document
Teacher 2	Uhm… Normally I make particular reference to the work schedule and then I normally refer to the textbook when I'm checking some examples that are appearing in the textbooks …
Teacher 3	Uhm in my planning I did go and consult about three textbook. […]. To plan a lesson you have to see various types of exercises from about three types of textbooks. … In this instance I took into account GET textbook which is for free. … I used Classroom Mathematics for previous years and then Platinum to

compare the exercises, …

Teacher 4 I can say 95% of my preparation is based on the textbook.

RQ1SQ5 To what extent do you use a textbook to teach a mathematics lesson?

Teacher 1 When you teaching maths I don't like having my textbook as if I'm teaching history. So I want the learners to hear what I'm saying because usually when you refer every time you refer then to a textbook they don't even get what you saying but it's just written there. I use the [textbook] with topics that I see that there's … there are more exercises and that the exercises are in line with how I'm teaching.

Teacher 2 … if that textbook is the same textbook the learners have it becomes easy because they will first of all refer to an example and from the example normally the textbook will give questions that are relevant to the example that would have been given, so that will enhance their understanding. Depending on the lessons, I will just use other methods but the textbook is always been there when I teach maths.

Teacher 3 In this instance I took into account that GET textbook which is for free. I used Classroom Mathematics for previous years and then Platinum to compare the exercises,

Teacher 4 I think especially with the explanation of the resources. I mean the explanation of the concepts and again the other alternative methods because we rely much on the methods that are there on the textbooks. Few that we can take from outside. Maybe those that I think that can access maybe from textbook A and textbook B

RQ1SQ6 To what extent do you use a textbook for mathematics homework?

Teacher 1 You know in mathematics you have to give them homework everyday so you can't say they should do your homework in a textbook because lots of them do not have them

Teacher 2 I normally refer to the textbook when I'm checking some examples that are appearing in the textbooks and then also giving extra work to the learners especially homework in cases where learners also have textbooks

Teacher 3 … at the moment we are using Platinum mathematics. Although as a teacher you go to Classroom Maths

Teacher 4 I'm using Spot On for grade 9. This is the textbook they're using

RQ1SQ7	**To what extent do you use a textbook to assess learners?**
Teacher 1	We do … when I'm setting my task usually I look at the examples that we have done. Then I also look at some … I also look at different textbooks. And I also look at questions from my other friend who is a teacher too. Like we usually exchange questions.
Teacher 2	Normally in task, uhm we… it's usually given when you are actually integrating there may be three or four aspects that you taught in class. So we give an uhm,… uhm a task on uhm combining those examples and activities that we would have given, …
Teacher 3	Uhm… you have to take into account that Bloom's taxonomy whereby now you are creating your questions. You find it that there might be there in the textbook but then when you need to do is to take there and there whatever it is taking into account how that this is a task or all say let's make this simple so that they all pass.
Teacher 4	There is a great relationship or similarity. The only difference is wording but this again I've, as I said it helps the learner to think in a constructive way. … As I have said, I'm using other textbooks. And sometimes I just google. When I deal with data handling I may google any question based on data handling. … I just give them some hand-outs.
RQ1SQ8	**Did you use a textbook to prepare, teach and for homework in the observed lessons?**
Teacher 1	For rotation I looked at Platinum and I also looked at the notes that we have yeah … the notes that we have when we were doing this uhm broadcast lessons. [For data handling] I used uhm … there's another textbook that uhm … I used Platinum for some of the questions and I used another textbook … I forgot the name of the textbook
Teacher 2	Sometimes you teach in the situation where learners do not have textbooks. …if the textbook is not available then I will just use other methods but the textbook is always been there when I teach maths
Teacher 3	This study, this teacher guide, that the platinum teachers guide and then in a view of our syllabus if you look at it, I also teach grade 10 and also grade 12 and 11's. So there is also when dealing with that content, there are quite a number of textbooks that deal with that content. What you need to do is water down this staff so that it comes to a grade 9 level.

Teacher 4 I'm using Spot On for grade 9. This is the textbook they're using. I use Classroom Maths. … I let them go watch TV normally when we watch the news during … between 7:00 and 7:30. The time when they are supposed to or maybe when they are talking about weather, three days weather, where they are going to use a double pie chart

RQ1SQ9 Do you have any specific textbook that you using at the moment?

Teacher 1 For rotation I looked at Platinum and I also looked at the notes that we have yeah … the notes that we have when we were doing this uhm broadcast lessons. [For data handling] I used uhm … there's another textbook that uhm … I used Platinum for some of the questions and I used another textbook … I forgot the name of the textbook

Teacher 2 For grade nine (9) I normally, in (inaudible) I use Platinum. […] Yes, I use Platinum. I find it in, in line with the work schedule

Teacher 3 Yeah at the moment we are using Platinum mathematics. Uhm I think this textbook is good for the learners. Yeah. Although as a teacher you go to Classroom Maths. You can consult classroom maths and any other textbook that you have.

Teacher 4 Yes. I'm using Spot On for grade 9. This is the textbook they're using. Then for my … for me, I can go an extra mile. I use Classroom Maths. This revised one and the old Classroom Maths because you might find that sometimes they explain the concept in different ways. They …, the way they use their calculations at least like the olden one it has, … the calculations are in detail, like the revised one

RQ1SQ10 Do you use any other resources besides your specific textbook(s) and other textbooks?

Teacher 1 … yeah and other resources will be my own resources. From the notes that I have from university some of the notes from the internet sometimes

Teacher 2 Yes, I normally use the internet. Uhm some of the information we google, through the internet I can just uhm identify the topic that I'm going to deal with and I can just, from the internet I can source more of the information

Teacher 3 Yes. Normally we just go to the internet. … I'm dealing with a topic GET that's what they rather quite a number of websites. … Where we always go and get part of exam papers or questions depending on the topic there are quite a number of websites on the computers at our school

Teacher 4 I can google. Especially with the explanation of the concepts because I've

realized that if learners don't understand the concepts, the whole lesson will be (inaudible)

Research question 2

RQ2SQ1	**How do you choose examples, exercises, homework activities and tasks?**
Teacher 1	We try to make it at least … I .. I still use Bloom's Taxonomy. So maybe you'll find if the test is out of 50 you make maybe the first question not be difficult, the second question to be in the middle there and the last .. that's the sub-questions, that's what I do. … And I also refer obviously referring to the CAPS document. So the tasks are not the same but they are similar there and there adding some difficult a bit so that we so that is not obvious for them
Teacher 2	Uh, I'm guided by the schedule … Yes, I focus on the objectives; I focus on the content that they must cover. Then when I … then, I'm, ..what is expected of them at the end of the year. … I will look at the CAPS document neh …
Teacher 3	Eh… you have to take into account that Bloom's Taxonomy whereby now you are creating your questions. You find it that there might be there in the textbook but then when you need to it there and there whatever it is taking into account how that this is a task or all say let's make this simple so that they all pass.
Teacher 4	Because I know or understand what is CAPS all about, when I choose the exercise for the learners I choose this exercise based on Blooms' Taxonomy because they are not of the same mentality. I choose the exercise based on knowledge and analysis. Whatever they know will they be able to analyse, interpret according to the blooms taxonomy. Will it be possible for them?
RQ2SQ2	**When you design your assessment tasks how do the questions in the tasks relate to your examples and exercises that you give during your lessons?**
Teacher 1	We do … when I'm setting my task usually I look at the examples that we have done. Then I won't set exactly what we did in class I look at similar examples changing it there and there
Teacher 2	Normally in task, uh we… it's usually given when you are actually integrating, … there may be three or four aspects that you taught in class. So we give an uhm, uhm an task on uhm combining those examples and activities that we would have given, uh given before so that you check the understanding of the

learners…, are they able to relate this output to this one and to this other one

Teacher 3 Eh… you have to take into account that Bloom's whereby now you are creating your questions. You find it that there might be there in the textbook but then when you need to it there and there whatever it is taking into account how that this is a task or all say let's make this simple so that they all pass.

Teacher 4 Yes. They are there. There is a great relationship or similarity. The only difference is wording but this again I've, as I said it helps the learner to think in a constructive way. Not just to be biased or just to cram (memorise), these are the kind of questions that (inaudible) ask

RQ2SQ3 Are examples and exercises that you give in the classroom on the same cognitive level with the questions asked in assessment tasks?

Teacher 1 Yes … but some with a task you don't want learners to be … to get to get used to getting things easy. So the tasks are not the same but they are similar there and there adding some difficult a bit so that we so that is not obvious for them. So it's not exactly but it's similar and adding some more difficult questions. We try to make it at least … I … I still use bloom's taxonomy.

Teacher 2 I have a problem with their examples because normally they given level two (2) or level uhm, lower level examples. The exercises are also of low levels but there some exercises there the levels is high yet the example of the low level.

That's when we make use of the internet, we make use of the past papers to say ok this is the topic I've done and this topic let me now all the past papers, let me revise all the questions from the past papers that are particular to that topic, is then that the learners get to know what to expect in the examination about that particular topic

Teacher 3 It's not really much difference. It's just the wording, we should just need to explore to that thing, the examiner, might asked this question and say or this is, what but it all means the same this so it means explaining to the kids really what the examiner wants because what the textbook and what the examiner also is really one and the same thing is the wording. So it's a matter of exploring then on how…

Teacher 4 Because I know or understand what is CAPS all about, when I choose the exercise for the learners I choose this exercise based on blooms' taxonomy because they are not of the same mentality. Whatever they know will they be able to analyse, interpret according to the blooms taxonomy. Will it be possible for them? If it is not possible, if they are much in knowledge than in analysis it

	means I have to go back and find out more activities, more lessons based on the interpretation on this one
RQ2SQ4	**Do examples and exercises in the textbooks you are using textbooks prepare learners adequately for assessment?**
Teacher 1	To be honest the DBE books they are … they do not have challenging questions. With Platinum some questions there and there but both of them combined. I wouldn't say they are hundred percent accu … uhm maybe … To prepare learners no, they're not. That's why I use I also use some of the old textbooks as long as they are in line with CAPS
Teacher 2	Yeah yeah, uhm, their examples, I have a problem with their examples because normally they given level two (2) or level uhm, lower level examples. I think they should also include examples that are of high level. […], the questions that they have in their textbooks are only meant to, to check the undertaking not the application
Teacher 3	Yeah, they really do is just do to add as you go on. These are quite a number of resources which there'll that ANA exemplar taking into account that I'm done with this topic taking one or two and them (unavailable) a question paper give one or two so that they got a of what's going to happen at the end when they are writing a test
Teacher 4	Not exactly. As I have said, I'm using other textbooks. Yes. And sometimes I just google. When I deal with data handling I may google any question based on data handling. Different (*inaudible*) different (inaudible) of questions etc. Then I just give them sometimes, don't check in your textbooks, and do this one. I just give them some hand-outs

ANNEXURE H: Letter to Lesson Observations Participants

Teachers' use of mathematics textbooks

INFORMATION SHEET: PRINCIPAL

DATE: 18 May 2014

Dear Principal

My name is Charles Ramoshebi and I am a Masters student in the School of Education at the University of the Witwatersrand.
I am conducting research on teachers' use of mathematics textbooks in their teaching of mathematics. The aim is to determine ways and the extent to which Grade 9 mathematics teachers in particular, use prescribed mathematics textbooks in their day to day teaching of mathematics. I hereby request your permission to work with one of your Grade 9 teachers in this study.
The study involves observing the teacher's lessons and engaging him/her in conversations on critical incidents about the observed lessons. The teacher's lessons and his/her conversations with me will be audio-taped. My research will not disrupt any school activity. Two lessons will be observed at normal times and your Annual Teaching Plan will not be tempered with in any way. The reason I chose your school is your interest in the ANA as evident from your 2012 and 2013 participation. I am assuring you that your name and identity and the school's name and identity will be kept confidential at all times and in all academic writing about the study pseudonyms will be used. All research data will be securely stored and will be destroyed between 3-5 years after completion of the research.
This will be a learning experience for all of us as co-teachers in this study. Your school's participation is voluntary, so you are free to withdraw your participation at any time without any prejudice and/or penalty. Please also note that there are no financial rewards for your school's participation in this study.
Please let me know if you require any further information.
Thank you very much for your help.

Yours sincerely,

_____
SIGNATURE

NAME: Charles Ramoshebi

EMAIL : charles.ramoshebi@gauteng.gov.za or ramoshebicharles@gmail.com

TEL NUMBER: 011-6669106 (work) or 0748428574 (cell)

Teachers' use of mathematics textbooks

INFORMATION LETTER: PARENT

DATE: 07 May 2014

Dear Parents/Guardian

My name is Charles Ramoshebi and I am a Masters student in the School of Education at the University of the Witwatersrand.
I am conducting research on teachers' use of mathematics textbooks in their teaching of mathematics. The aim is to determine ways and the extent to which Grade 9 mathematics teachers in particular, use prescribed mathematics textbooks in their day to day teaching of mathematics.
I write to ask you to consider giving your consent for me to collect data on learner involvement in the mathematics classroom activities. Learners' engagement with mathematics activities as presented by the teacher in two selected mathematics lessons will be observed and audio-recorded.
I envisage that all these activities as outlined above will take place during the third term of the current year. The participation of learners in this study will have no bearing whatsoever on your child's or ward's day to day learning and performance.
Kindly note that if you or your child/ward decides at any time that s/he prefers not to be part of this project, s/he will be placed far away from the audiotape and special care will be taken not to record his/her voice and not to observe him/her during the lessons. Your child will be reassured that s/he can withdraw her/his permission at any time during the project without any penalty. There are no foreseeable risks in participating and your child will not be paid for this study.
I also undertake to maintain anonymity and confidentiality of all teachers and schools in my reporting of this work. Moreover, all data collected will be stored safely and destroyed after 5 years of completion of this research.
Please return the signed slip indicating your consent for your child/ward's participation in the study.
I trust that you will find the above in order and I look forward to working with you.
Please feel free to contact me if you have any questions.

Thank you.

_____

SIGNATURE

NAME: Charles Ramoshebi

EMAIL: charles.ramoshebi@gauteng.gov.za or ramoshebicharles@gmail.com

TEL NUMBER: 011-6669106 (work) or 0748428574 (cell)

Teachers' use of mathematics textbooks

INFORMATION LETTER: LEARNER

DATE: 18 May 2014

Dear Learner

My name is Charles Ramoshebi and I am a Masters student in the School of Education at the University of the Witwatersrand.
I am conducting research on teachers' use of mathematics textbooks in their teaching of mathematics.
I write to ask you to consider giving your consent for me to collect data on your involvement in the mathematics classroom activities. Your engagement with mathematics activities as presented by the teacher in two selected mathematics lessons will be observed and audio-recorded.
I envisage that all these activities as outlined above will take place during the third term of the current year. Your participation in this study will have no bearing whatsoever on your day to day learning and performance.
Remember, your participation in this study is voluntary, which means that you don't have to participate. If you decide that you prefer not to be part of the project, this is completely your choice and will not affect you negatively in any way. If you do not wish to participate in this study or if you decide at any time that you prefer not to be part of the project, I will make sure not to observe you or to audiotape your voice. Accordingly you will be placed far away from the audiotape and special care will be taken not to record your voice.
All information about you and your school will be kept confidential in all my writing about the study. I will us the pseudonyms for all names and the name of your school. Also, all collected information will be stored safely and destroyed between 3 – 5 years after I have completed my project.
Your parents have also been given an information sheet and consent form, but at the end of the day it is your decision to join us in the study.
Please return the signed slip indicating your consent for participation in the study.
Please feel free to contact me if you have any questions.

Thank you

_____
SIGNATURE

NAME: Charles Ramoshebi

EMAIL : charles.ramoshebi@gauteng.gov.za or ramoshebicharles@gmail.com

TEL NUMBER: 011-6669106 (work) or 0748428574 (cell)

Teachers' use of mathematics textbooks

INFORMATION LETTER: TEACHERS

DATE: 18 May 2014

Dear Mr/ Ms _____

My name is Charles Ramoshebi and I am a Masters student in the School of Education at the University of the Witwatersrand.
I am conducting a research on teachers' use of mathematics textbooks in their teaching of mathematics. The aim is to determine ways and the extent to which Grade 9 mathematics teachers in particular, use prescribed mathematics textbooks in their day to day teaching of mathematics.
The study involves observing your lessons and interviewing you about critical incidents in each observed lesson. Two lessons will be observed and thus there will be two interviews. Each interview will be about at most one hour long and will take place after school. Both your lessons and the interview will be audio-taped. My research will not disrupt any school activity. The two selected lessons will be observed at normal times and your Annual Teaching Plan will not be tempered with in any way. The reason I chose your school is your interest in the ANA as evident from your 2012 and 2013 participation. I am assuring you that your name and identity and the school's name and identity will be kept confidential at all times and in all academic writing about the study pseudonyms will be used. All research data will be securely stored and will be destroyed between 3-5 years after completion of the research.
This will be a learning experience for both of us as co-teachers in this study. Your participation is voluntary, so you are free to withdraw your participation at any time without any prejudice and/or penalty. Please also note that there are no financial rewards for your participation in this study.
Please let me know if you require any further information.
Thank you very much for your help.

Yours sincerely,

_____
SIGNATURE

NAME: Charles Ramoshebi

EMAIL: charles.ramoshebi@gauteng.gov.za or ramoshebicharles@gmail.com

TEL NUMBER: 011-6669106 (work) or 0748428574 (cell)

ANNEXURE I: GDE Research Approval Letter

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no: D2015 / 148

GDE RESEARCH APPROVAL LETTER

Date:	**11 July 2014**
Validity of Research Approval:	**11 July 2014 to 3 October 2014**
Name of Researcher:	**Ramoshebi C.S.**
Address of Researcher:	**12 Kruger Avenue**
	Discovery
	1709
Telephone Number:	**011 666 9106; 074 842 8574**
Email address:	**ramoshebicharles@gmail.com**
Research Topic:	**Teachers' use of CAPS aligned and DoBE approved Mathematics textbooks and Teacher Guides in their teaching of Mathematics**
Number and type of schools:	**THIRTY Secondary Schools**
District/s/HO	**Johannesburg East**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Makhado
2014/07/14

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