

**The beliefs of educators about effective mathematics classroom
practice in Grade 6**

by

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DECLARATION

I declare that **The beliefs of educators about effective mathematics classroom practice in Grade 6** is my own work and that all sources that I have used in this work have been acknowledged by quoting and using references.

Rosina Nkadi Ngoako

Signature_____

Date: 08 January 2018

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- Dr Tlale for editing my dissertation to ensure that my work is of the correct language standard.
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DEDICATION

This study is dedicated to my family for their support when I took away their time and made this study a priority. I dedicate this study to my husband, Molefe, my daughter Katlego, my sons Tumisang, Mothusi, Omphile and my grandson Mohau.

I praise the Lord who was and is still there for me when I needed Him most, Ps 67:5, “May the peoples praise you, O God; may all the peoples praise you!”

ABSTRACT

In this study, the researcher investigates educators' beliefs in Grade 6, along with their effect on educators' classroom practice and the possibility of changing such beliefs towards effective classroom practice. Four Grade 6 mathematics educators were sampled from the four selected rural primary schools in Moretele area (Bojanala district in the North West Province). Data was collected, at the four schools through educators' interviews, lesson observations, and mark sheets (indicating learner performance). A qualitative approach was used according to which interviews held were transcribed and coded; lessons observed using observation schedule were coded and analysed; the mark sheets collected were also analysed.

Based on the data collected from interviews, it appeared that the beliefs that educators have, emanated from different factors and experiences. The most contributing factor is the educators' subject content knowledge (SCK). It was clear that there are differing beliefs that mathematics educators have about mathematics, mathematics teaching and also about the learners who do mathematics. Beliefs that educators have can be strongly held, which makes them difficult to change or less strongly held which makes them easy to change.

Educators in this study displayed a contradiction in their beliefs. Some beliefs that are held by educators are not manifested in their classrooms. Strongly held beliefs are difficult but not impossible to be changed, and less strongly held beliefs can be changed through a process that can be undertaken in steps. This study also revealed that educators' beliefs affect their classroom practice and if the effect is negative, and the beliefs that cause that negative effect are not changed, they will continue to have a negative impact on learners' performance in mathematics. Educators can decide which beliefs they want to change, depending on the reasons why such beliefs are held and how the educators benefit from holding such beliefs.

The analysis of mark sheets reveals that learners' performance in mathematics is poor, especially in the half-yearly examination paper which is prepared by the provincial assessment section also called the North West Provincial Assessment.

In overall, it was revealed that educators do not necessarily practice what they believe in hence there is a contradiction in educators' beliefs. It was also revealed that changing educators' beliefs can be a life-long process.

ACRONYMS

BA – Bachelor of Arts

B Tech – Bachelor of Technology

CAPS (Curriculum and Assessment Policy Statement) – A new approach issued by the department of Education used to assess topics in the new curriculum.

DBE – Department of Basic Education

DIKW model – Data, Information, Knowledge, Wisdom model used by Dennis Barbara

GET – General Education and Training

FET – Further Education and Training

HOD – Head of Department, educator on post level two in a public school.

NPPPPR – National Policy Pertaining to Promotion and Progression Requirements, a policy document issued by the department of education in order to determine promotion of learners from one grade to the next.

NWED – North West Education Department

NWPA – North West Provincial Assessment

PCK – Pedagogic Content Knowledge

PPM (Post Provisioning Model) – model or policy for determining number of educators to be allocated to schools

PSF – Professional Support Forum

PTD – Primary Teacher's Diploma

SBA – School Based Assessment

SCK – Subject Content Knowledge

SES – Subject Education Specialist

SMT (School Management Team) – educators who are in senior posts from post level two to post level four.

UDE – University Diploma in Education

DEFINITION OF TERMS

Educator — is any person employed by the state and given the responsibility to teach children in a public school.

Beliefs — anything that an individual thinks is true, based or not based on any evidence.

Classroom practice — the daily activities that educators engage in with their learners

Learner — is any minor person who attends school at primary level.

Promotion — is when the learner is moved to the next grade after having met the pass requirements for a particular grade.

Progression — When the learner is moved to the next grade due to other reasons even if the pass requirements for the grade have not been met.

Mark sheet — Recorded marks for tests, assignments, June examination, projects and final examination (November examination).

Trapped schools — schools that got an average that is below 50% in mathematics in the final examinations set by the North West Provincial Assessment.

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CHAPTER 1: CONCEPTUALISATION OF THE STUDY

1.1. Introduction

This study deals with how beliefs of educators in Grade 6 affect their classroom practice and the possibility of changing such beliefs if they affect educators' classroom practice to the extent that they yield poor learner performance in mathematics. In the literature used for this study, beliefs are linked to subject content knowledge of educators. Mathematics educators require subject content knowledge (SCK) as a basis for their confidence when teaching in class. In other words, it is not easy for educators to teach a subject which they do not have any knowledge about. If educators do not have the necessary subject content knowledge of mathematics, they will lack confidence in teaching the subject and consequently develop a negative attitude in the subject, which will consequently develop into negative beliefs about mathematics as a subject and also mathematics teaching. This will subsequently have an adverse effect on the performance of learners. It is therefore essential for educators to be adequately knowledgeable in the subject they teach. In that way they will only have to deal with teaching methods and strategies appropriate for delivering the subject content to learners, which is pedagogic content knowledge (PCK). This statement is supported by Shulman (1986) when he refers to what teachers do, which is:

Teachers must not only be capable of defining for students the accepted truths in the domain. They must also be able to explain why a particular proposition is deemed warranted, why it is worth knowing, and how it related to other propositions,...(Shulman1986, p. 9).

After an extensive education reform from the previous Bantu education system, to the outcome based education (OBE) in 1997, and then the National curriculum statement (NCS) in 2005, the Curriculum and Assessment Policy Statement (CAPS) in 2011 was finally introduced. All this transformations in education came along with the introduction and withdrawal of other topics in mathematics. For example, in primary schools in Grade 6, the sections of Geometry and Probability were added in the syllabus when CAPS was introduced in 2011. Based on the experience of the researcher as an HOD, educators find these sections challenging.

In addition to this challenge, the subject allocation that changes from time to time in primary schools is another problem. Educators are sometimes allocated subjects they have never taught, due to rationalisation of educators as a result of the resolution 2 of 2003 regarding the redeployment of educators who are in excess, and recently educators who are resigning. These challenges may cause unwillingness on the part of educators to teach mathematics,

perceiving it as a difficult subject; in addition they may not even have been trained for the teaching of CAPS. Even if educators may have undergone CAPS training, it might not have adequately equipped them with the necessary subject content knowledge required to teach these topics. Based on the experience of the researcher, the educators finding themselves in the similar situation would then be required to learn the new topics on their own as they teach learners. Learning sections with learners might not be easy because the educator may not cope with the pace of the pace setter and may not be able to complete the syllabus. As a result the educator may decide to skip some topics he or she finds challenging which will create content gaps in learners' knowledge as well.

According to Philipp (2010), beliefs might be thought of as lenses which human beings use when interpreting the world. These beliefs are cognitive, which means that they are associated with how educators think and are therefore hard to be changed. Research on mathematics educators' beliefs and conceptions cannot be isolated from research on mathematics' knowledge because it will necessarily result in an incomplete picture. There are beliefs that serve as foundation for other beliefs, which are usually called primary beliefs (Philipp2010). Primary beliefs are beliefs which educators first develop; it could either be about mathematics, the teaching of mathematics or the learning of mathematics. There are also some beliefs that are regarded as derivative beliefs because they emanate from primary beliefs, in other words they are linked to primary beliefs, but are less important as compared to primary beliefs and they are built onto primary beliefs.

Furthermore, Philipp (2010) continues to point out that primary beliefs can be central, which makes them to be strongly held and hard to change, and others can be peripheral, which means they are less strongly held and can change easily. This study focuses on beliefs about self, beliefs about mathematics and beliefs about mathematics teaching. The study is envisioned for Grade 6 primary education mathematics teachers, in the rural areas of the North West province of South Africa. Detailed discussion of sampling and research methodologies is discussed in Chapter 3. In this study, mathematics educators' beliefs were investigated with reference to the following characteristics:

- Beliefs held by mathematics educators
- The effect of beliefs on educators' classroom practice
- The possibility of changing educators' beliefs
- The extent to which such beliefs can be changed

1.2. Context of the study

South Africa is a diverse country, which is made up of nine provinces, which are vastly different with regard to infrastructure, population and economic status. Each of the nine provinces has its own department of education which is run differently from others. For example, in Gauteng Province, there are assistant educators who assist learners with homework before they go home. In the North West Province, there are no assistant educators employed for assisting learners with homework. The difference in education departments was evident in the manner in which provinces conduct their examinations, especially in Grade 12 final examination question papers. The difference in the education system in provinces has been recently addressed through the introduction of CAPS. Since CAPS was introduced there is uniformity in examinations, however, the implementation of the CAPS is still a problem.

Differences are noticeable in the ways educators teach and assess learners informally, because CAPS only outlines the topics to be assessed, but suggestions as to how these topics should be taught are not enforced. Differences in classroom practice are influenced by a number of reasons, for example, the historical background of the school, availability of resources, the socio-economic status of the community in which the school is situated, the level of training educators received, knowledge of the subject, the level of professional support educators receive, beliefs and attitudes of educators. All these factors have a unique impact on the educators' performance in the classroom and consequently the performance of learners in the subject. In this study, beliefs of mathematics educators will be the central focus.

In South Africa, schools are divided into 4 different phases. Grade R to Grade 3 is called the foundation phase which takes four years to complete; Grade 4-6 is the intermediate phase and also takes four years to complete; Grade 7-9 is the senior phase, and takes four years to complete, and Grade 10-12 is the Further Education and Training band (FET). Grades R-9 is then classified as the General Education and Training band (GET). The focus of this study is on Grade 6 mathematics educators, which is the intermediate phase. In all the phases, learners are allowed to fail only once. The learner who fails to meet the pass requirements after failing once in a certain phase is progressed to the next grade.

1.3. The status of mathematics performance in South Africa

Venkat (2013) asserts that "poor learner performance in mathematics continues to exist at all levels of the system in South Africa" (p4). This has also been highlighted by the minister of basic education when announcing the Grade 12 results for 2016. This poor performance

might suggest that there may be some contributing factors not yet identified by the education system. The researcher is currently teaching mathematics in primary school, and has noted that most of the primary schools in the area she is working have performed poorly in mathematics. The circular she used in sampling trapped schools indicates that out of 58 schools in Moretele area, 23 schools did not obtain 50% pass mark in mathematics. Such schools are called “trapped schools”. This implies that such schools have not met the fifty percent pass percentage (50%) target set by the area office in mathematics. This target of 50% is not a national norm, but it is determined by the area office for the schools falling under the particular area office. As a result they are called trapped because they did not meet this target for November/December examinations for 2015.

In primary schools, all the learners do mathematics together with other subjects. This implies that all learners in Grade 6 do the same subjects. Learners are allowed to proceed to the next grade if they achieve a minimum of 40% in mathematics.

Based on the researcher’s experience since she started teaching in primary school in 2013, the emphasis that is placed on learner achievement in secondary schools is non-existent in primary schools. This is influenced by the fact that the National Policy Pertaining to Progression and Promotion Requirements (NPPPR) stipulates that learners are not allowed to remain in the intermediate phase for more than four years. In other words, learners can only fail once in each phase. Once they repeat a grade, they will not be retained in any grade in the intermediate phase even if they do not meet the promotion requirements for that grade. So they will be progressed due to age cohort, which means that they should be placed in a grade which is suitable to their age and peers, which implies that once the learner is older in age, she or he can be progressed without meeting the necessary promotion requirements. This may have adverse effect on learner performance in the grade in which such a learner is placed, especially in mathematics.

The department of education has started holding accountability sessions in primary schools for schools that performed poorly in mathematics, which are trapped schools. Accountability sessions are conducted by the Area office (office where schools report). The aim of these sessions is to find out if there are problems being faced by the school, or strategies used by the school to solve these problems are effective, as well as how the area office can help the school. Officials called to these accountability sessions are usually the principal and the HOD or school management team (SMT) member.

The department makes efforts to ensure that mathematics results improve, by calling educators to content training workshops (developmental workshops), professional support forums and subject meetings. This has been happening for a number of years for educators teaching mathematics. In spite of all these efforts, schools continue to perform poorly in mathematics. It is against this background that this study took place, it investigated the beliefs held by mathematics educators in primary schools, particularly in Grade 6 and how these beliefs affect the educators' classroom practice.

1.4. Problem statement

Educators' actions in their classrooms are to a greater extent influenced by the beliefs they have, and their actions affect learners' performance. According to Beswick (2008), beliefs can either be positive or negative, and are seen as determinants of what educators do in the classroom, it can be deduced that positive beliefs influence classroom performance in a positive manner, whereas negative beliefs have an adverse influence on classroom practice. Therefore, educators need to have positive beliefs about mathematics and mathematics teaching if learner performance in mathematics is to improve.

According to Beswick (2008), the relationship between educator beliefs and classroom practice is complex and needs to be addressed by professional learning programmes. In other words, beliefs of mathematics educators in primary schools in the rural areas of North West province whether negative or positive, affect learner performance. In order for learners to perform well, teachers' negative beliefs need to be changed if possible.

According to Venkat (2013), syntactic knowledge relates to the nature of inquiry and the ways in which new knowledge comes to be established. This assertion explains the importance of language, particularly mathematical language in teaching concepts for learners to understand and build their own mathematical vocabulary for use in the next grades. This can be achieved if educators have the necessary PCK in Mathematics.

This study focuses on the ways in which educators view mathematics, how they know it and how they teach it. All these are crucial determinants of learner performance and achievement. The participants in this study are experienced educators of mathematics in Grade 6 (intermediate phase) in rural primary schools of the North-West province in the Republic of South Africa. By experienced, the researcher means that educators participating in this study are sampled based on the number of years they have in teaching mathematics in Grade 6. The researcher's interest is in exploring the nature of intermediate phase educators' beliefs in

mathematics and mathematics teaching and to compare it with their level of content knowledge.

The problem is that learners do not perform well in mathematics in spite of the training (development) that the Department of Education offers to educators. The department of education offers training in the form of workshops which last for three to five days, usually on an annual basis. These workshops are facilitated by subject advisors in the form of Professional Support Forums (PSF's) to capacitate mathematics educators with content they have to teach in class so that learner performance is improved. Recently, the subject advisors realised that some educators understand topics but they find it difficult to teach them. They then decided to include methods and teaching strategies, where educators are asked to explain how they would go about teaching a particular topic. The question is, if educators receive training on mathematics content and pedagogic content knowledge, what then causes learners to continue underperforming? It becomes evident that there could be other factors that contribute to the poor learner performance that are not addressed. It is on the basis of this fact that this research investigated beliefs of teachers about mathematics and mathematics teaching.

The problem as identified by the researcher is that in spite of all the endeavours of the Department of Education to offer training and development to educators, learners still perform poorly in mathematics. The researcher's assumption is that the cause of this poor performance might be the beliefs of educators about mathematics and the teaching of mathematics. In this study, other factors that might contribute to poor learner performance are disregarded and only beliefs of educators were investigated.

Beliefs are described as anything that an individual can regard as true, and may or may not be held on the basis of evidence (Kalckman 2011). In the teaching of mathematics, beliefs can be described as the force that propels educators to act or behave in a certain way, to have certain preferences on the way they teach and handles the teaching content, and why they would do things in one way and not the other. Educators have an in-born sense of preferences that might have been tested during their time as educators. This in-born sense of preference or propelling force is what the researcher identifies as educator beliefs.

Educator beliefs can be identified through the manner in which educators teach mathematical content, the way they assess learners, as well as the way they react to learners' responses

during their interactions. For example, the educator who believes that mathematics is a set of algorithms will teach mathematics step-by-step and not use group work, as Handal (2003) states that beliefs of educators about mathematics help them shape their instructional practice.

White, Way, Perry and Southwell (2006) argue that educators bring with them beliefs that they developed when they were in high school or tertiary institutions. This implies that beliefs develop through interactions with fellow human beings. Learners develop beliefs about mathematics when they see their educator behaving or teaching in a certain way. Beliefs developed can either impede or facilitate learning. For example, if the educator always tells learners how difficult mathematics is every time she/he teaches, then learners will develop this belief and they will hold strongly onto it that it would be difficult to prove them otherwise even when they have grown.

The influence of beliefs on classroom practice is discussed in detail in section 2.4. However, it can be stated that beliefs have a decisive role to play in the manner in which educators execute their daily activities in classrooms (Handal 2003), such as the choice of teaching methods and how they teach mathematical content to learners. This implies that beliefs influence the actions of educators in teaching. At the same time, how the educator conducts her/his lesson has a direct influence on learners' performance. Therefore, beliefs have an indirect influence of learner performance in mathematics.

1.5. Rationale

The researcher has first-hand experience of having been required to teach mathematics in secondary classes without being adequately trained in the subject. She felt that it was a burden for her since she was not trained for this purpose. Her belief at that stage was that in order for her to be successful in teaching mathematics and get good results, she should have adequate mathematical knowledge appropriate for the grade she was teaching. She therefore felt the need to further her studies in mathematics teaching in order for her to be confident in teaching the subject, and more importantly to be able to deliver the subject matter as required of any mathematics educator. This made her think that there could be some beliefs that arise as a result of similar experiences in which other educators find themselves.

Beliefs that this study focused on are as follows, as highlighted by Beswick (2008):

- All learners can acquire mathematical skills necessary for life in the modern society

- Some people have a mathematical mind and others do not
- Mathematics requires a good memory
- Mathematicians do problems quickly in their heads
- Mathematics requires logic not intuition

The aim of this study is three-fold: firstly, it will provide an overview of beliefs held by mathematics educators and how educators' beliefs influence their behaviour in classrooms in primary school mathematics teaching, with special attention to learner performance as a result of these beliefs. Secondly, it will explore the possibility of changing these beliefs if possible. Thirdly, it will account for programmes that can be utilised to ensure sustainability of the changed beliefs. The focus of this research is therefore based on the following research questions:

1.6. Research questions

The aim of this study was to explore the beliefs of mathematics educators in primary schools, particularly in Grade 6 and how they influence educators' behaviour in their classrooms. The following research questions are being addressed in this study.

1. Which beliefs are held by mathematics educators in primary schools in Grade 6?
2. How do beliefs of mathematics educators in primary schools in Grade 6 influence their classroom practice?

1.7. Significance of the study

Primary school is the institution in which learners should receive foundation of education in all the subjects, especially in mathematics. The reason for this is that in mathematics the learning outcomes do not change, but only increase in difficulty. For example, learners are taught patterns from Grade 1 until they reach Grade 12. This study of educator beliefs is of great significance for a number of reasons, bearing in mind that the performance of mathematics in primary schools is not satisfactory. The other reason is that primary schools are the feeder schools for secondary schools. When the problems leading to poor performance in primary school mathematics are not addressed early, but are left to persist until learners proceed to high school, they will affect the performance of secondary schools in mathematics. In other words, if learners will progress to secondary schools having failed mathematics then it will be difficult for them to cope if they choose mathematics as one of their Grade 12 subject, and this will increase the failure rate in mathematics.

1.7.1. Practice

This study is important in the fact that curriculum practitioners at the lower level (educators and subject advisors) can use the results of this study to improve their practice. Subject advisors can intensify monitoring at schools and provide more support to educators. If beliefs of educators are seen as hampering learner performance in mathematics, then there should be ways and strategies that can be used to change such beliefs.

1.7.2. Policy significance

This study may be of great significance to policy makers in the sense that if issues raised by educators can be taken into consideration, policies may be amended in favour of educators. The department of education can also use the results of this study as a basis for conducting a survey or another research to verify the results of this study before amending the existing policies.

1.7.3. Scholarly research

This study is also significant in the fact that it will add to the existing literature about educator beliefs, and may also serve as reference material and point of departure to scholars who wish to research further about this topic, by considering the limitations of the study as a guideline.

1.8. Defining the concept beliefs

The concept of beliefs has many definitions. A few definitions by different authors is presented. According to Smith (2014), beliefs are understandings or propositions that people have about their world, which they think are true. On the other hand, Beswick (2008) and Kalckman (2011), explain beliefs as anything that an individual can regard as true, and may or may not be held on the basis of evidence. Kalckman (2011) further asserts that these beliefs are convictions that resist change. The researcher aligns herself with the definition of Beswick (2008) and Kalckman (2011).

1.9. The structure of the dissertation

This dissertation begins with Chapter 1, which gives an overview of the study as a whole, starting with the conceptualisation of the study, the context on which the study is based, the rationale for embarking on the study, the problem statement and the research questions that guide the study.

Chapter 2 outlines the views of different authors in literature used, in relation to the topic of the study, which is, beliefs about mathematics educators in Grade 6. Literature used includes national as well as international studies done on the same topic of beliefs. Literature review in this study provides detailed educator beliefs, starting with the definition of concept of beliefs, followed by categories of beliefs held by mathematics educators, the nature and effect of these beliefs on educators' classroom practice and how these beliefs can be changed if possible.

Chapter 3 is a discussion of the conceptual framework, showing the relationship between educator beliefs, educator subject content knowledge, educator pedagogic content knowledge and learner performance.

Chapter 4 discusses the research design of the study, methodologies used for data collection, rationale for choosing the research design, methods for data analysis, and methodological norms related to the research design.

Chapter 5 gives a detailed presentation and interpretation of data collected, starting with interviews, followed by lesson observations and then analysis of mark sheets, collected from schools.

Chapter 6 is a general discussion of the findings from data interpreted.

Chapter 7 draws conclusions, showing reflections on the conceptual framework and the research methodologies as well as recommendations. At the end is a list of references used in the entire research report, followed by appendices.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter presents a discussion about the views of different researchers concerning the topic of beliefs of mathematics educators. It begins with outlining the details of the types of beliefs that educators of mathematics have and the influence these beliefs might have on educators' classroom practice. The main aim of this chapter is to provide an insight and share with the reader the views of different researchers on the topic of beliefs. This chapter is essential in a sense that it provides a framework on to which the importance of the study is based, as investigated by different researchers.

2.2. Types of beliefs

There are two types of beliefs that some mathematics educators hold about mathematics and mathematics teaching, namely, positive beliefs and negative beliefs (Philipp 2010 & Beswick 2008). Positive beliefs are beliefs which teachers are in agreement with, for example, the belief that every learner can acquire mathematical skills that are necessary for life. If educators are against this and believe that not all learners can acquire mathematical skills, then it becomes a negative belief. In other words, a belief can be positive to one educator and negative to the other, depending on their views. For example, one educator can regard mathematics as a difficult subject and every time when teaching she/he would remind learners how difficult mathematics is. The educator who says so holds a negative belief about mathematics. On the other hand, the educator who always encourages learners to do their work and tell them that they can do mathematical problems holds a positive belief about mathematics. Positive beliefs need not be changed, by virtue of their nature, but can only be modified. Beliefs that should change are those that are negative, because they impact negatively on learner performance since learners are not yet intellectually independent and still require a lot of guidance from their educators. In this study, the focus is mainly on negative beliefs that educators have about mathematics and mathematics teaching. Educators who have positive beliefs and those who do not have any beliefs concerning mathematics will not be investigated in this study.

2.3. Nature and effect of beliefs

Research study by Ertmer (2005) has shown that beliefs play a decisive role in how educators perceive and judge the manner in which they teach mathematics, which consequently

influence their behaviour in the classroom. Liljedahl (2007) also sees beliefs as the primary regulators for mathematics educators in the classrooms. Schlöglmann and Moab (2009) also contend that the behaviour of people can be predicted better from what they believe in as compared to their actions. Handal (2003) also argues that educators hold beliefs about mathematics which they use to shape their instructional practices in classrooms. Adam (2012) also agrees that beliefs influence educators' instructional practices; however, there is no linear relationship between educators' beliefs and their practice. This implies that there are inconsistencies in educators' beliefs, which cause a contrast between some of their beliefs. The researcher tends to agree with all these views and can therefore add that such beliefs can cause educators to be bias towards their own judgements when they reflect on their teaching performance.

According to Schlöglmann and Moab (2009), beliefs enlighten the way for an individual and form a basis for understanding one's actions, and furthermore, beliefs can function to facilitate or impede mathematical learning, depending on the nature of the belief. When individuals interact with the context of the world they live in, their beliefs help them shape information and prioritise goals. In other words, people implement knowledge that is consistent with their belief systems. It can therefore be deduced that goals and beliefs are mutually dependent variables or factors, which implies that for goals to be set, one needs a strong inherent belief system. Educators need to set goals every time when they plan their lessons. These goals are influenced by the way educators perceive mathematics, the teaching of mathematics and the learners they teach.

Zakaria and Maat (2012), assert that beliefs of educators are critical when it comes to the implementation of their teaching and learning in the classroom. This assertion supports that of Schlöglmann and Moab (2009) that beliefs influence educators' goal setting. Smith (2014) also agrees with the above views when he states that the manner in which educators are orientated towards a particular curriculum, affects how that curriculum is used. The researcher aligns herself with these views. For example, if the educator sees mathematics as a difficult subject, then she or he will teach the content in a very simplified way to make learners understand (or just teach content because she or he has to teach it anyway). As Polly, McGee, Wang, Lambert, Pugalee and Johnson (2013) put it, "educators' beliefs towards mathematics and their impressions of effective mathematics teaching are associated with the way they teach, their use of curriculum and their willingness to use learner-centred approaches" (p3).

The findings of research done by different researchers for example, Liljedahl (2007), White, Way, Perry and Southwell, (2006), Kalckman (2011), Handal (2003) and Adam (2012) indicate that educators' beliefs do not emanate from their teaching practice, but educators enter the teaching fraternity with already developed beliefs about mathematics, the teaching of mathematics and the learning of mathematics, originating from their traditional learning experiences, which are linked with each other in structured systems. Educators then use these beliefs as a foundation or guideline onto which their teaching practice is built. The researcher disagrees with the view that beliefs of educators do not emanate from their teaching practice, but were developed as educators entered the teaching fraternity. The researcher contends that educators can also develop new beliefs which may be influenced by their encounter with different learners and interaction with colleagues or they can even modify their existing beliefs. This can take place when these educators do not produce good results and compare their performance with that of their colleagues who do well. The researcher's idea is that beliefs do not cease to develop and the development of beliefs is an on-going process which includes modification of existing beliefs. Furthermore, White et al (2006) contend that negative beliefs may contribute to negative classroom practice or teaching strategies. The negative classroom practice may in turn contribute to negative learner beliefs and performance outcomes. If these learners with negative beliefs can also become educators, then a cycle of negativity may be created and this may have a very detrimental effect on the nation unless an appropriate intervention is done to break the cycle.

Schlöglmann and Moab (2009), see beliefs as being linked to the self-concept of the one holding such beliefs, in that "these beliefs function to serve a kind of self-assertion which protects the bearer against uncomfortable ideas" (p22). This implies that beliefs make the individual, affects the individual's decision-making and are based on the individual's previous experiences. Educators may then use these beliefs as a stronghold to argue in favour of their teaching practices based on their previous experiences.

2.4. The influence of beliefs on educators' classroom practice

Educators of mathematics believe that for them to be able to teach the subject effectively, they should have adequate SCK and PCK, which will help them to believe in themselves, building in them professional self-esteem and confidence (Beswick, 2008). This belief coincides with that of Blömeke and Kaiser (2011) when they contend that efforts that are made to enhance the mathematical knowledge of US primary educators seem to be

meaningful. They also see mathematical content knowledge as an important precondition for applying mathematical pedagogic knowledge successfully in the classroom.

Taylor (2008) indicates that subject knowledge of many educators does not meet the curriculum standards set for the children they are teaching, and further states that it is just not possible for any programme to train educators on every aspect of the curriculum they are responsible for, so educators as well must be responsible for their own development. Kalckman (2011) also sees the quality of an educator as the most direct measure of learners' academic achievement and success. Educator quality entails educator's qualification in the subject, which implies SCK, and the way in which content is delivered in instructional practices, which is PCK. The researcher aligns herself with this view and can also add that if educators can be responsible for their own development, they will be committed to it and ensure that they use what they learned effectively.

Bush (2010) sees educators' ineffective teaching methods (PCK) and insufficient SCK as contributing factors to crisis in primary education. The researcher aligns herself with this view, and the Department of Education, particularly the district in which she is teaching, has undertaken to conduct content and pedagogic training workshops for educators. Venkat (2013) also highlights the view raised by Blömeke and Kaiser (2011) and Beswick (2008) by alluding to the fact that significant gaps in educators' content knowledge and pedagogic knowledge have been identified and continue to be noted as prevalent on the ground in research studies and in public arena. Furthermore these gaps continue to be prevalent despite the department's effort to up skill educators in programmes such as Advanced Certificate in Education (ACE). Christiansen and Aungamuthu (2012), also acknowledge that educator knowledge, both SCK and PCK continue to be an issue of concern. This is a clear indication that educators need professional development, which will help them to have confidence in themselves, and also bearing in mind several transformations that the education system of South Africa has undergone, that is, from old curriculum (Bantu education system) to Outcome Based Education (OBE) in 1997, later the National Curriculum Statement (NCS) in 2005 and recently the Curriculum and Assessment Policy Standards (CAPS) in 2011.

The researcher aligns herself with these views and further added that the problem of educators' insufficient SCK and PCK can be addressed by continued training since educators are allocated different subjects to teach from time to time.

South African schools continue to perform poorly at primary level in mathematics and reading, and at secondary level in mathematics and Science (Taylor, 2008). Some of the factors contributing to low standards in mathematics include shortage of qualified educators, weak foundation in earlier grades, alleged poor learner attitudes to the subject, poor quality of classroom practice and lack of support and leadership from the Heads of Department (HOD^s), (Bush, 2010). The researcher finds all these factors to be inter-related and one leads to another. For instance, it would be unfair to expect the under qualified educator of mathematics to instil positive attitude about learning mathematics in learners while the very same educator lacks confidence in teaching the subject. The same applies with the incompetent HOD who is expected to support and guide educators in their department to improve their classroom practice. HOD can assist by working together with the district to organise workshops to develop educators.

There is a link between beliefs and successful implementation, positive beliefs that educators have about mathematics become their source of inspiration, encouraging them to be zealous about their teaching, which ultimately impact positively on learner performance. For example, if educators believe that the use of teaching aids and technology is essential in delivering instruction to learners, they can do their best to use any available resources in the school, and can also learn to use technology in their classrooms.

Türel and Johnson (2012), assert that successful instruction may be a result of using interactive white boards together with sound instructional strategies. Interactive white boards are technology devices that can be used with a projector. These strategies require the school to have such facilities and the educator to be technology orientated, for example, to be able to capture screenshots from web pages and project them on the interactive white board for learners to see them. This can be very accommodating to all types of learners for example, if learners have behavioural problems, this can help to sustain their interest in the lesson, for those who are visually impaired the educator can zoom the features for them to see clearly.

Learners also can achieve better if their educators believe in them as they teach (Sidiropoulos 2008). Venkat (2013) supports this belief by saying that attention needs to be paid to the ways in which educators view mathematics rather than to what mathematical content knowledge they hold. This implies that beliefs play a vital role in teaching, and that if educators have sufficient SCK with negative beliefs, they will still have poor performance in mathematics.

Barge (2013) posited that educators' daily practice has its foundations embedded in their beliefs, values and attitudes towards the profession, the learners, the school and themselves. When learners perceive that their educators care about them as they are being taught, they respond by optimising their commitment to learning. They also put forth greater efforts to reach their potential and consequently exert higher level of motivation, social responsibility and affective learning. The researcher aligns herself with these views because if the educators' beliefs about learning mathematics do not change, even their habits of how they enact mathematical modes of enquiry will still be the same after having undergone training and development.

In his study, Spaul (2012) also finds educator education and training to be positively associated with learners' mathematical performance. This implies that educators who are qualified stand a good chance of having more learners doing well in mathematics than those who are not qualified. Training of educators in the form of developmental workshops increases educators' SCK as well as PCK in the subject even if they are not qualified. As Venkat (2013) puts it, no curriculum teaches itself, and standards do not operate independently of professionals' use of them. This supports the fact that once educators get into the class, they should be in a position to teach, and they can only do this if they have adequate content knowledge of mathematics.

Furthermore, Venkat (2013) suggests that continued training be offered to educators. This implies that educator beliefs are highly unlikely to be affected by once off models of training. This also indicates that it is important to extend opportunities in programmes that build substantive and syntactical knowledge over time in order for educator development to be successful. Barge (2013) further asserts that evidence indicates that educators who receive substantial professional development can help learners achieve more.

Taylor (2008) posits that educators need to demonstrate a high level of internalised professionalism by accepting the responsibility for implementing reform themselves and prescribed curriculum needs to be covered to enable learners to sit for the examination/assessment about work already done. This implies that educators should take the responsibility of ensuring that they teach all the prescribed content they are supposed to cover in a year or semester. Not only to teach prescribed content, but also to initiate the change of beliefs they have and take responsibility for the knowledge gaps they have in mathematics. The researcher also aligns herself with this view, since training can make educators to be

highly effective and they will continuously practice self- reflection, self- evaluation and self- critique, examine and re-examine the content and context of their own behaviour in the classroom, and they are likely to refine and alter what they do and how they do it.

2.5. Categories of beliefs

Polly, McGee, Wang, Lambert, Pugalee and Johnson (2013), Handal (2003) and Adam (2012) identify the three categories, in which beliefs can be divided, namely,

- The educators' beliefs of mathematics as a subject
- The educators' ideas of the nature of mathematics teaching, and
- The educators' ideas of the learning of mathematics

2.6. Beliefs held by Grade 6 mathematics educators in primary schools.

This section deals with discussion of literature that is related to the beliefs which are held by mathematics educators.

2.6.1. Beliefs held by mathematics educators

Mathematics educators believe that the problem of learners not doing well in mathematics lies with the curriculum and curriculum designers. This demonstrates that educators do not reflect on themselves and their implementation (Sidiropoulos 2008). This belief indicates that educators do not in any way hold themselves responsible for the performance of their learners and the blame is always shifted to curriculum designers and policy makers and sometimes to learners' indiscipline or to lack of parental support. The researcher does not support this behaviour by educators for not holding themselves responsible for poor learner performance. She supports the importance of authentic teaching, self-reflection (continual evaluation of their teaching) and continued support for educators and teacher development. While doing self-reflection, educators can at the same time engage with the district officials for matters affecting curriculum and curriculum designers, since these are policy related matters and make take time to effect changes in them.

Madongo (2010) also highlights this view when he says that it is difficult to understand how learners would be able to understand the mathematical structure embedded in the very contextual problem they are to solve without some basic mathematical knowledge, which is the SCK. All that is required is for the department to offer proper training for educators so as to improve their MCK and PCK. This can be done by subject advisors or independent

specialists in the subject, quarterly at the beginning of every term to equip and remind educators of how to tackle content in their classrooms.

2.6.2. Educators' beliefs of mathematics as a subject

Educators of mathematics also believe that mathematics is a collection of skills and algorithms (Zakaria and Musiran 2010). Educators need to provide instruction on using effective approaches to learning that are appropriate for problem-solving. They should also support the use of multiple ways to solve problems and then model to learners how to monitor and reflect on the problem solving process. This is essential in promoting understanding of mathematical ideas that serve as a pre-requisite for mathematical reasoning (Jitendra, Star, Rodriguez, Lindell & Somëki 2011). This implies that educators need to optimise learning opportunities to help learners transfer and progress from one concept to another as well as helping them to integrate concepts as they progress. This view is similar to that of Star and Haser (2011) when they contend that mathematical understanding is a multi-dimensional construct which involves procedural knowledge. Liljedahl (2007) also supports this view, by alluding to the fact that mathematics is considered as a constructive process, involving creative steps such as generating rules and formulae. All these views call on for educators' specialised pedagogic content knowledge in teaching mathematical skills involving step-by-step processes to help learners understand. If educators do not have the necessary content knowledge in mathematics, they will lack confidence in teaching the subject and this will cause them to have negative beliefs, since beliefs and knowledge are related.

According to Star and Haser (2011) educators often think that learners need to master these algorithms first and then problem-solving follows later, without it being integrated with the algorithms in teaching, and as a result learners see algorithms as separate entities from problem-solving. This view demonstrates a strong link between educator dispositions and beliefs on one hand, and learner achievement on the other, which can adversely influence cognitive and affective learning.

Sidiropoulos (2008) contends that educators of mathematics often believe that mathematics is for certain learners who can do this subject, whereas others cannot and should not do it. This argument is also highlighted by Madongo (2010), who thinks that all learners can become mathematically literate, not just those who have traditionally performed well in mathematics classes. The researcher also aligns herself with this view bearing in mind that the world is

developing and mathematics turns out to be the gateway subject for many career opportunities.

2.6.3. Educators' ideas or beliefs of the learning of mathematics

Beswick (2008) asserts that educators of mathematics believe that learners with mathematical learning difficulties are severe cases that cannot be included in the practices of their own classrooms. They recommend more professional learning for these learners even though the majority of children identified as having special needs require not to be taught by specialists; but require good, high quality and effective teaching. This view is in contrary to the belief held by the department of education, (DoE 2003) that all learners can acquire the mathematical skills necessary for life in modern society, and recognises that some learners require and should receive additional support to this end. The department of education went ahead to introduce mathematical literacy for learners who do not take mathematics as a core subject in high schools to ensure that all learners be exposed to some kind of mathematics and to acquire mathematical skills necessary in life.

Bush, T, Joubert, Kiggundu, and van Rooyen, (2010) assert that educators are unwilling to provide extra classes to assist learners to catch up. Whilst the department of education sees the importance of all learners doing mathematics for them to venture into the modern society, this unwillingness to offer extra support is in contradiction with this belief. However, this can be looked into as a separate research since it encompasses extra work or overtime which in itself may require extra remuneration to those who practise it, and yet there is no provision for overtime payment that the department of education has made for working extra time.

Choi, Choi, and McAninch (2012) noted that one of the reasons why high school learners do not proceed with the Science, Technology, Engineering and mathematics related career fields is that they believe that mathematics and Science are the most difficult subjects and also not as socially rewarding as other popular jobs. This view also brings to light that learners as well hold certain beliefs and attitudes about mathematics which consequently affect their self-confidence in the subject. This also suggests that educators have the responsibility to instil positive attitude about mathematics, and also make attempts to change learners' negative beliefs and attitudes that hinder performance in the subject at a very early age when they are still in primary school. This indicates that educators have a huge responsibility in their classrooms. They should strive for a change of attitude from one which blames their situation on forces outside themselves to one in which they feel they can improve their own situation. This can be done by exercising enterprise and energy by continued self-reflection. However,

the researcher's study at this stage focuses on teacher beliefs and content knowledge, and learner beliefs and attitudes could be considered for future research.

Bush (2010) further suggests that HOD's should spend more time analysing learners' results, and jointly develop departmental improvement plans with their educators. They should also monitor educator classroom records on a regular basis, in order to establish direct observation of educator teaching and setting improvement targets with educators. The researcher finds this view to be in juxtaposition with Beswick's (2008) assertion that beliefs are wide-ranging, and to be able to understand educators' beliefs of mathematics and mathematical instruction, educators' classroom practice needs to be monitored. If HODs can monitor educator classroom practice, they will be able to identify beliefs held by their educators and act accordingly to remedy the situation at an elementary level and seek appropriate intervention from district level if such beliefs hamper learner progress in the subject.

2.7. How beliefs of educators can be changed

This section deals with what previous studies say about the possibility of changing beliefs that educators hold about mathematics, mathematics learning or learners who do mathematics.

2.7.1. Changing educators' beliefs

According to Schlöglmann and Moab (2009), Adam (2012) and Trygve, Barbro and Kislenko (n.d.), beliefs are clustered and not held in isolation, in other words similar or related beliefs are linked together or interwoven and held cognitively as a single entity. The clustering of beliefs makes educators to have inconsistent beliefs without knowing it. This implies that educators can have a belief that is contradictory to another belief that is held. As long as beliefs are organised mentally in this way, it is difficult to change them, because they do not appear as a single belief, and once an individual attempts to change a belief it would imply that change should be effected to the whole belief system.

Numerous authors, Schlöglmann and Moab (2009), Liljedahl (2007), Adam (2012) and Kalckman (2011) regard beliefs as convictions that are stable and resistant to change. However, Handal (2003) contends that the fact that it is difficult to change beliefs does not necessarily mean that beliefs are impossible to change. The researcher aligns herself with Handal (2003) and further asserts that people choose to change or not change their beliefs, depending on how they derive benefit from holding these beliefs. Trygve, Barbro and Kislenko (n.d.) support Schlöglmann and Moab (2009) by asserting that beliefs are not

independent from each other. Similar beliefs are organised together in mental states and held as a group. These clusters of beliefs are either in a weak relationship or not connected at all. As a result of lack of connection educators sometimes hold beliefs that contradict one another. For example, an educator may have a belief that Mathematics is a difficult subject, but instead of teaching it in a manner that it becomes fun to learners, uses textbook method all the time.

Schlöglmann and Moab (2009) further state that such beliefs can only be extended without changing them in their core. On the other hand, Smith (2014), asserts that whether beliefs can change or not, depends on whether educators reflect on their own instructional practices. If they do so, they can learn new ways of making sense of their own actions and observations. In other words, Smith (2014) sees a possibility that beliefs can change, and that educators are the ones who can make the change possible.

According to Liljedahl (2007), some beliefs are strongly held whereas others are less strongly held, and robust beliefs are difficult to change. The researcher disagrees with this view and asserts that even if beliefs can be strongly held, they can be modified over time when the bearer is exposed to uncomfortable circumstances such as poor results. When educators produce poor results continuously due to the beliefs they hold, they can decide to adopt certain beliefs and do away with others which are not working for them. Schlöglmann and Moab (2009), contend that beliefs may meet the emotional needs or provide the bearer with defences from pain, and when they perform such functions it may not be easy to change them. Educators, who hold beliefs based on these reasons, use such beliefs to avoid being moved from their comfort zones. Trygve, Barbro and Kislenko (n.d.), Philipp (2010) and Adam (2012) classify beliefs into peripheral and central beliefs. They see peripheral beliefs as those beliefs that are held by pre-service educators and that they are susceptible to change because they are less strongly held, while central beliefs are held by more experienced educators who have been teaching for many years, and they are difficult to change because they are deeply rooted.

Beliefs that are deeply rooted and are held by long service educators cannot be easy to change when they have been proved to be rewarding and useful. In other words, if these beliefs help the educator to achieve better results in learner performance, then the particular educator will not easily part with such beliefs even if they can be based on traditional way of teaching. Sometimes, changing beliefs may cause educators to have a feeling of distrust, discomfort

and frustration (Handal 2003), brought by other factors such as pressure of examinations as a result of content coverage, diversity of subjects that educators are allocated, especially in primary schools where educators may be allocated any subject to teach because of the circumstances caused by moving or resigning educators. The researcher agrees with this view and can further assert that pressure of covering content also brings pressure of learner performance. Educators who have pressure to cover content also develop pressure when their learners do not perform well. If beliefs they have cause poor learner performance, then they will be compelled to change their beliefs in teaching mathematics. In some instances, educators do not trust that a new belief can alleviate problems of learner behaviour, because most of the incidents that occur in classrooms require educators to react immediately, rather than reflecting on alternative responses to situations. In other words, teaching is an activity that requires educators to make decisions every now and then. All these imply that beliefs can change, depending on their nature and efficacy.

We can only attempt to change beliefs once we know which beliefs are good or positive and necessary in order to contribute positively towards learner performance in mathematics. Firstly, Liljedahl (2007) asserts that the understanding of which beliefs are essential for the teaching of mathematics is informed by the knowledge and beliefs possessed by educators who are effectively or not effectively teaching the content. In other words, positive beliefs in educators are recognised by the educators' good performance as measured by learner performance. Secondly, Liljedahl (2007) suggests that the issue of beliefs can be attended as early as when educators are still training to become educators. In this way negative beliefs can be traced as early as possible and be challenged before educators start teaching and holding them strongly in their teaching practices. Thirdly, Liljedahl (2007) suggests that beliefs of educators who are already in the teaching field should be constantly challenged by being constantly compared with their colleagues who produce good results. This can be done by holding accountability sessions at the district or any level in the department of education, in the presence of subject education specialists for schools that perform poorly in mathematics.

Schlöglmann and Moab (2009) assert that beliefs of mathematics educators can be changed through socialisation and experience. This implies that educators who possess negative beliefs should be brought together in common educational programmes with those who produce good results so that the latter can share their good classroom practices with the aim of assisting those who produce poor results. If educators become dissatisfied with the beliefs

they possess, or they are not comfortable because they do not get emotional satisfaction, then such beliefs can be replaced with new ones. White, Way, Perry and Southwell (2006) assert that pre-service educators do not always have the conceptual understanding of the mathematical content they will be expected to teach. Since beliefs (which are more affective) and knowledge (which is more cognitive) are seen as inseparable concepts and difficult to distinguish, (Trygve, Barbro & Kislenko n.d.), this implies that pre-service educators do not have adequate PCK and SCK they are supposed to have in order to teach when they exit teacher programmes. Consequently these pre-service educators bring with them negative beliefs developed at high school and teacher education institutions as well as through their previous experiences of learning and observation of teaching from their former educators, (Adam 2012). These beliefs are then shaped by their own practice and become strongly held and consequently prevent them from teaching mathematics in ways that will empower the children they teach. In order to change these beliefs, in service educators need to be taken through university academic programmes to improve their understanding and knowledge of the subject content. Adam (2012) identified five external factors which influence the beliefs of educators, namely

- Lack of resources
- Time constraints
- School culture and student behaviour
- Lack of confidence
- Class size

- Pressure to cover content

Although these factors may differ with individuals and environment, if they are not addressed they will continue to affect the way in which educators develop their beliefs. Not only will beliefs be affected, but also learner performance in mathematics. The school should try by all means to provide resources that they can afford to enable educators to do their work effectively. Education practitioners should support educators and develop them around the issue of how to handle the syllabus in order to avoid the pressure to cover prescribed content. Schools should develop a culture of work that keeps learners busy at all times to avoid having to issue disciplinary measures to learners with behavioural problems. Educators should be continually developed in subject content and pedagogic content to build in them confidence to teach mathematics. Class size should be managed according to the norms of admission and the post provisioning model in schools.

Adam (2012) suggests that in order to change their beliefs, educators should from time to time make a reflection on their beliefs and instructional practices. Educators can assess their teaching methods, strategies, assessment practices, quality of work they give to their learners and so on. This may help them to identify their weaknesses and try to rectify their mistakes. Education practitioners should also call educators to attend educator development workshops to discuss and share good practices from educators who perform well and produce good results. Adam (2012) suggests a four-step program to be used for development of educators, which is:

- Facilitate educators to identify their beliefs and practice
- Confront teaching practice that contrasted their current practice
- Encourage them to try new practices
- Encourage them to reflect on their new practice

If these steps can be followed and implemented, educators may be able to acknowledge the types of beliefs they have, which is the positive step towards change.

2.8. Conclusion

It is quite evident that beliefs of educators have a great role to play in the teaching and learning of mathematics. Beliefs, whether positive or negative, and whether strongly held or less strongly held, all of them have a significant impact on the performance of learners in mathematics. Educators also can be of significant value in the changing of the beliefs they have about mathematics, the teaching of mathematics and the learners they teach. The cohesive arguments in the discussion about beliefs above indicate that educators can and have the ability to change their own beliefs if they can continue to make an objective reflection on their teaching practices. Educators can make a reflection of their teaching on their own at their respective schools, evaluating their teaching methods and assessment practices. They can also make a reflection when they engage in dialogues with their colleagues about the strategies their colleagues use to obtain better results. It is also important for educators to be flexible and open-minded to welcome new suggestions and others' techniques and try to implement them and see if they cannot improve learner performance, because all the efforts in the education system are directed at improving the performance of learners, especially in mathematics.

CHAPTER 3: CONCEPTUAL FRAMEWORK

3.1. Introduction

Having discussed the background of the study, outlining the research questions and investigating the literature backing up my study, it is now essential that a framework for the study be established. This is done in order to put the ontological knowledge which directs the study into perspective. In order to do this, firstly, the researcher started by discussing the knowledge claim, then the assumptions of this knowledge claim, as well as the theory that is linked to the knowledge claim. She then designed her conceptual framework, guided by the theory chosen in the study, to show how this theory is applied to establish knowledge.

3.2. Paradigmatic perspectives

According to Shuttleworth (2008), “a paradigm is a framework containing all of the commonly accepted views about a subject, a structure of what direction research should take and how it should be performed”. This definition implies that a paradigm influences a research study in a sense that the research question should be linked with what is to be studied. Furthermore, the nature of the question asked directs the researcher as to which participants to look at, how to gather data as well as how the results should be interpreted. On the other hand, Creswell (2003), asserts that a research should be guided by a framework. This framework should attempt to answer or consider four questions, namely:

1. What theory of knowledge informs the research?
2. What theoretical perspective lies behind the methodology in questions?
3. What methodology governs our choice and use of methods?
4. What methods do we propose to use for data collection?

In this study, beliefs of Grade 6 mathematics educators in primary schools are the focus of the research. The approach which is used is qualitative research. Data collection methods are interviews, observations and mark sheets. The discussion below is an attempt to justify the four questions asked by Creswell (2003) above.

3.2.1 Constructivist theory

This study follows the constructivist theory, which involves how human construct knowledge. According to Creswell (2003), social constructivism is often combined with interpretivism, and explains that individuals seek to understand the world in which they live and work. In this

study, the views of the participants are important, and the meaning of their experiences was constructed from the processes that resulted from the interaction with the participants, through interviews and observations.

Educators have the responsibility to provide guidelines to learners on how to approach problems and how to solve them. They should also support learners by giving examples of problem-solving as well as to encourage them to work cooperatively in groups. Adam (2012) asserts that constructivist learning is about learners constructing knowledge by being actively involved in the learning process and not receiving it passively from educators. If educators guide learners to be involved in their own learning, by providing them with challenging activities, learners will be active in the learning environment and construction of knowledge will take place. If learners take part in their own learning by being actively involved, they will understand concepts and not forget easily what they have learned. Although there are no specific teaching strategies that relate with constructivist teaching, educators can use manipulatives to encourage learners to be involved in discussions during problem-solving, to help learners to make sense of knowledge. In this study, the research question is how beliefs of mathematics educators affect their classroom practice, and how these beliefs can be changed if possible to enhance effective classroom practice.

Constructivist theory focuses not on a phenomenon, but on how it comes to be constituted (Maree 2010). Educators need to teach learners in a way they would make meaning of concepts and ultimately understand. In other words, learners should be able to interpret concepts and derive meaning from the learning material by being mentally involved in thinking and analysing problems, and not accumulate and memorise knowledge from the educator. If educators hold negative beliefs about their own teaching and also about the learners they teach, it then becomes difficult for learners to construct meaning about phenomena, because the way educators present such phenomena would affect the learners' ability to constitute knowledge.

Adam (2012) contends that the classrooms in which learners are taught should have a culture that encourages learners to be engaged in mathematical investigation. This can also mean that classrooms should be print-rich and full of pictures and posters that trigger their thinking skills. Educators interact with learners on daily basis using visual representations, for example, charts showing 2-D figures of which learners should assimilate to foster understanding. Maree (2010) asserts that in order to understand the whole, it is important to understand the parts. It is therefore important to understand the facts behind the educators'

actions in presenting the learning material, in order to understand why they maintain such actions. Therefore the interpretivist perspective would be more suitable in an attempt to investigate educators' beliefs based on the constructivist theory. According to Adam (2012), there are no step-by-step procedures that lead to constructivist teaching. Learners should acquire knowledge and skills without emphasising procedural methods of how they arrived at the answers. In other words, the constructivist theory emphasises discovery rather than transmission of knowledge from the educator, hence repetition and drill work are not necessary because learners become passive listeners. Therefore, the constructivist theory focuses on new practices and modern ways of teaching and opposes the traditional way.

Creswell (2003) asserts that social constructivism is often combined with interpretivism. In the next subsections, the researcher presents a discussion of the assumptions of both constructivism and interpretivism, since they are related.

3.2.2. Assumptions of the constructivism

Creswell (2003) outlines the following assumptions of the constructivist theory:

Human beings construct meanings through their engagement with the world they live in. In order for the researcher to get information from participants about their meanings, open ended questions should be asked during interviews to give participants enough opportunity to express their views. Humans engage with their world and make sense of it based on their historical and social perspective. This engagement is a result of interaction between fellow human beings. The basic generation of meaning is always social, it happens as a result of an interaction between human beings.

3.2.3. Assumptions of interpretivist approach

Assumptions of the interpretivist approach according to Maree (2010) are as follows:

By merely observing respondents' actions, the researcher may come up with subjective findings. When people are consciously observed they tend to mould behaviour even when they have sworn honesty. Therefore several research techniques should be used to help the researcher to be objective as much as possible.

Qualitative research cannot be overall objective, since it involves interaction between human beings. The researcher can sometimes be biased, or the respondents can be subjective. This implies that in order to understand human perceptions concerning their own activities, and to reduce subjectivity, people should be placed in their social contexts, for example, educators

can be observed in their own schools, teaching their own learners, in their natural environment.

By observing participants in the teaching and learning environment, it is possible to develop an understanding of how learners construct meaning of phenomena, and how educators influence these learners to do so. The way learners construct meaning to phenomena is influenced by social background (Maree 2010). It is important for the educator to understand the learners' social background, so as to base teaching and learning activities around that. For example, it would be a futile exercise for the educator to teach application of parabola and eclipse by giving learners problems involving bridges when learners have never seen a bridge or a picture thereof. The researcher as well should have knowledge of the social environment in which the research is conducted, in order to have an understanding of the social background of the participants' actions. This will enable the researcher to understand issues related to the respondents, which may hinder the smooth-running of the investigation.

Sometimes researchers are compelled to adjust their research techniques or research questions because of the unwillingness of the participants to be honest when responding to questions asked by the researcher. Our knowledge and understanding are always limited to which we have already been exposed to (Maree 2010). This implies that due to the knowledge, experiences and beliefs that the researcher brings to make meaning of the phenomena under investigation, the research is obliged to be subjective.

3.2.4. Challenges of interpretivist theory

The problem with the interpretivist theory is a belief in the possibility of achieving a single correct interpretation (Maree 2010). People think differently and might come up with interpretations that might not necessarily be the same even though made on the same phenomena. Therefore, coming up with a single correct interpretation can promote great subjectivism.

Epistemologies are philosophically distinct, but in practice these distinctions are not always clear-cut and are sometimes overlapping (Maree 2010). This implies that some approaches developed as a result of others and they complement one another in one way or another. In an attempt to explain an approach, one may end up infusing points related to a different approach explained. The other challenge is that the researcher comes into the picture with a particular world-view and experiences. This world-view influences the research unconsciously, and sometimes participants are expected to respond according to the

researcher's philosophical world. This causes the qualitative research to be subjective most of the time.

3.3. The conceptual framework

3.3.1. Beliefs

The concept of beliefs has already been explained in section 1.8 as anything that an individual regards as true and may or may not be held on the basis of evidence (Kalckman 2011). Individuals are different and may have different versions of what is the truth. In this way what one individual regards as true, the other may not do so. This implies that beliefs can be subjective and depend on what individuals regard as true. Philipp (2010) argues that beliefs are held in relation to each other in clusters and no belief exists in isolation, and some beliefs are primary (first to be developed) while others are derivative, meaning that they were developed as a result of other already existing beliefs. When beliefs that are held in clusters they can result in contradictory and conflicting actions, but interrelated beliefs results in intergratedness which can be seen from the behaviour of educators when they teach. Philipp (2010) also asserts that beliefs are not held with the same degree of conviction, so some beliefs are central (strongly held) while others are peripheral (less strongly held).

3.3.2. Conceptions about mathematics

There are conceptions or beliefs that are held by educators about mathematics. Since educators' beliefs are yet to be investigated in this study, the researcher based her argument on the conceptions of mathematics described by Handal (2003) namely;

- Mathematics is a complete static body of knowledge with logic and structure.
- Mathematics is a collection of facts, rules, algorithms and skills to be mastered for utilitarian purpose.
- Mathematics is a discipline based on rules and procedures to be memorized.

Numerous authors (Handal 2003, Liljedahl 2007 and Adam 2012) indicate that beliefs have greater influence on the educators' classroom practice and the implementation of their teaching. If educators also share the conceptions of mathematics mentioned according to Handal (2003), then their teaching will be guided by and be based on these.

3.3.3. Conceptions about teaching and learning mathematics

Three conceptions about the teaching and learning of mathematics have been identified from Handal (2003), namely;

- Some people have a mathematics mind and some don't.
- Manipulatives should be used in classrooms especially for primary school mathematics.
- The use of group work in teaching

The beliefs mentioned above as referred to by Handal (2003) will be used to form the basis of this research study.

Kalckman (2011) argues that beliefs are more influential than knowledge in determining how individuals organise and define tasks and problems, and that beliefs are stronger predictors of behaviour. Educators who share the beliefs of Handal (2003) will use manipulatives or teaching aids, they will use group work more often but they will not give much of their time to struggling learners since they will regard them as not having a mathematics mind.

Educators who hold beliefs about mathematics as a set of rules and algorithms would always rehearse steps before going to class and also rehearse these steps to learners to master. Educators would do most of the talking and learners would learn by watching and listening in order to remember. In this way learners are encouraged to memorise and reproduce information without understanding. The constructivist theory would not be applied in this case, and educators' actions would be purely influenced by their beliefs.

The conceptual framework guiding this study emanates from the relationship that exists among beliefs and educator pedagogic knowledge; educator pedagogic knowledge and learner performance; educator beliefs and learner performance; educator subject content knowledge and learner performance; and subject content knowledge and educator beliefs. Beliefs of educators (about mathematics and mathematics teaching) influence the manner in which they teach mathematics (PCK). If learners receive quality teaching in which educators use available resources in the school, they will perform well in mathematics. This implies that educators' impressions of effective teaching and their willingness to use learner-centred approaches have a strong influence on the performance of learners. These impressions of effective teaching and usage of learner-centred approaches are influenced by educators' beliefs. This indicates that there are also other factors that influence educators' instructional practices, and these other factors also influence educators' beliefs. The SCK is important for

educators, without it they will be unable to teach learners mathematics and they will regard mathematics as a difficult subject (Baspinar & Peker 2016), and cause learners to regard it as difficult as well. In other words, inadequate SCK influences educators to develop negative beliefs which also affect learner performance negatively. In some instances, educators lack the SCK and the PCK because of the qualifications they hold. If educators lack one of these, it is essential that they consider development in these areas. When educators have sufficient knowledge in mathematics (both SCK and PCK), then they will find it easy to deliver the subject matter to learners. Educator development programmes will not only equip educators with the necessary knowledge to teach mathematics, but also build their confidence in teaching the subject.

The experience of educators in teaching mathematics also plays a vital role in the manner in which they teach and approach problems encountered in their classrooms. According to Burgess (2010), educators gain more mathematical knowledge as they gain experience. This can be done through personal reflection and engaging in discussion about specific topics with colleagues. There are workshops conducted by subject advisors for content training and how to teach challenging topics. Educators who attend these workshops stand a good chance of having more knowledgeable in SCK and PCK. The researcher has already highlighted the fact that knowledge and beliefs are related concepts. Knowledge helps an individual to develop beliefs based on the particular knowledge they have about phenomena, while beliefs are convictions which are based on what an individual knows.

Figure 3.1 shows how learner performance is influenced by several factors including educator beliefs, subject content knowledge, and pedagogic knowledge.

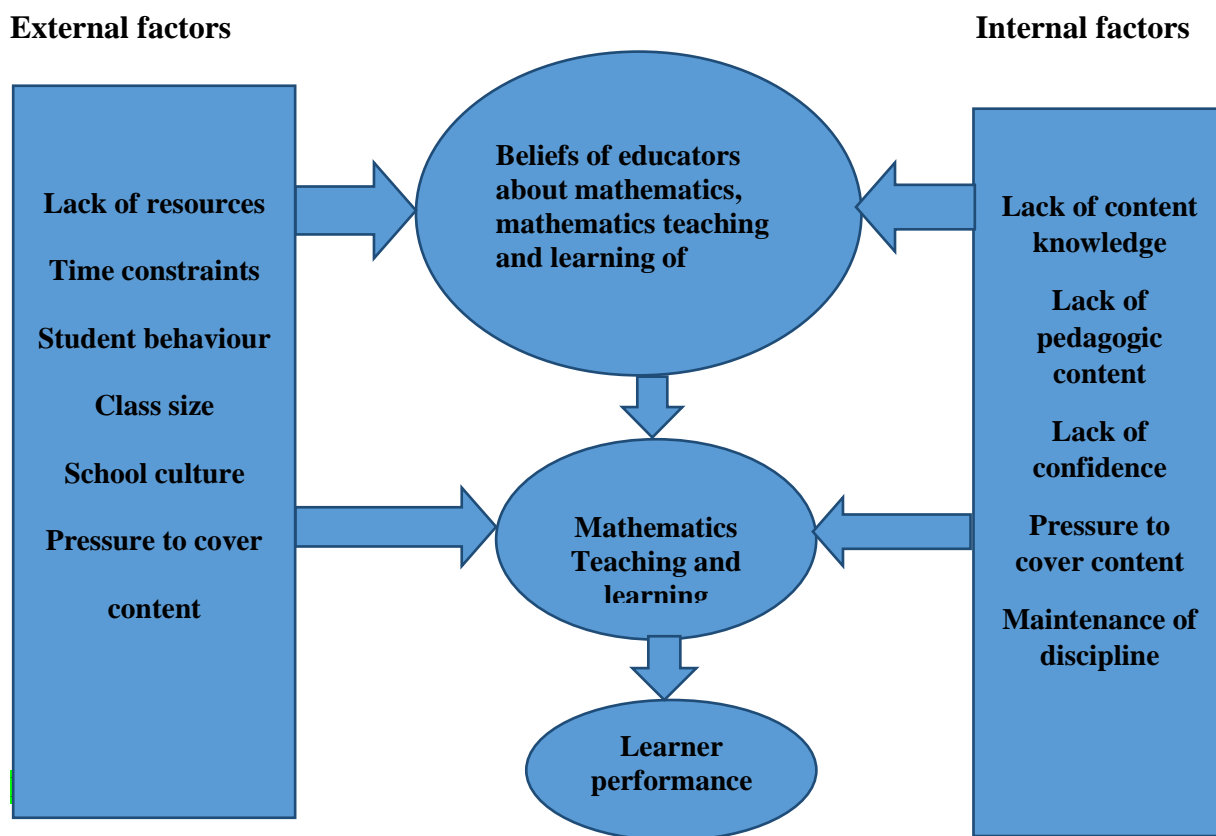


Figure 3.1: Relationship between educator beliefs, SCK, PCK and learner performance (ADAPTED from Adam 2012)

Figure 3.1 shows that beliefs of mathematics educators are influenced by factors that emanate from the educators' work environment (external factors) as well as from educators themselves (internal factors). On the one hand, the external factors direct the manner in which educators should conduct their lessons. For example, if learners are overcrowded in class (class size), the educator should adjust her/his teaching methods. On the other hand, the internal factors influence the depth of the teaching content the educator presents. For example, if the educator does not have sufficient mathematical content knowledge, she/he will embrace beliefs that protect her/him, such as teaching without manipulatives. The educator will then cite reasons of lack of resources (which is an external factor) and the subject matter will be taught in a superficial manner. In the centre of the figure is mathematics teaching and learning. This implies that beliefs of educators are influenced by external and internal factors, and all these have an impact on the manner in which educators teach. At the bottom is learner performance, which implies that the influence of beliefs and all the factors on the teaching of the subject matter give rise to learner performance. Beliefs have an influence on the manner in which educators teach in classrooms, and this may also even make educators prefer some teaching methods over others, which is linked to PCK. Educator SCK has an influence on the type of beliefs educators can develop. If educators have adequate subject content knowledge

in mathematics, they would be confident to teach the subject. Beliefs and knowledge are two related concepts, and sometimes it is difficult to distinguish between the two, since both of them are a result of human experiences. In other words, for an individual to have knowledge about a concept or phenomenon, the individual should first interact with it in a certain way in order to have its understanding. This will bring about knowledge of such phenomenon.

Educators do hold different beliefs about mathematics and mathematics teaching and these beliefs can either influence them positively or negatively. Beswick (2008) asserts that beliefs are susceptible to change, however the extent to which teachers changed their practices is not known, nor the extent to which such changes were sustained. It is therefore against this background that this study is based on the possibility of changing educators' beliefs about teaching mathematics to impact on the performance of learners.

This study follows a constructivist approach, since learning of mathematics requires educators to teach learners in a way that will enable them to construct their own knowledge in their unique ways, to build on the pre-existing knowledge in order to understand new concepts. Constructivist theory fits well in this study because mathematics requires application of knowledge in context, to enable learners to make well-founded judgements as constructive and reflective citizens (NCS, DoE 2003).

Beliefs are related, once an individual develop primary beliefs about something, these beliefs are used as a foundation on to which secondary beliefs are built. One belief may be used to develop other beliefs. For example: the belief that mathematics requires logic implies that learners should be able to apply their skills to solve mathematical problems step by step. In order to do this, learners should remember how to solve such problems, which they can firstly do in their heads. For learners to be able to go through all these steps, they need the guidance from the educator, who should consider all learners to be having the capacity to acquire mathematical skills. If all mathematics educators can have this belief, they will strive towards improving learner performance by trying new approaches to teaching. This calls for hard work on the side of teachers bearing in mind that in primary schools most of the work is done by the teacher, which is in preparations, assessing and re-assessing to improve learner performance and moving away from the traditional way of teaching by engaging learners in problem-solving.

3.4. Conclusion

This chapter was a discussion of the Conceptual framework adopted to be a guide to the study. It also outlined the relationship that exists between beliefs, SCK, PCK and learner performance, and how the study relates to the constructivist theory through interaction of participants with their environment, which ultimately helps them to construct knowledge. According to this framework, educators use their beliefs as a guideline to how they should conduct the teaching and learning process in their classrooms. However, beliefs alone cannot make learners perform well in mathematics if educators lack the SCK and PCK. Educators require positive beliefs about mathematics, mathematics teaching and learning of mathematics, together with adequate SCK and PCK and learner involvement and commitment in order to have good performance in mathematics

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1. Introduction

In this chapter, the research design of the study is presented. The nature of the research design, the assumptions of the research strategy, as well as the rationale for choosing the research design, are explained. The qualitative research methods as well as their strengths and weaknesses are advanced, to show that a research method is not complete on its own, and also to show why triangulation of these research methods is used in the study. The chapter also addresses how participants were sampled and how data was collected and analysed. Finally, the methodological norms which are validity and reliability as well as ethical considerations are discussed, since data could not be collected without permission to do is granted.

4.2. The nature of qualitative research

The methodology used in this study is qualitative research. According to Maree (2010) “qualitative researchers believe that the world is made up of people with their own assumptions, attitudes and beliefs” (p55). Maree (2010) further asserts that “the way of knowing reality is by exploring the experiences of others regarding a specific phenomenon to see how human beings have constructed reality by asking about it” (p55). In this study the researcher investigates the beliefs held by mathematics educators and how these beliefs influence their actions or behaviour in their classrooms. The actions and behaviour of human beings have been scrutinised with a view to bring about change in them.

Qualitative research is appropriate to be used in this study, since the researcher seeks to establish and construct meaning of a phenomenon from the views of the participants and determine shared patterns of behaviour. Moreover, the research has been conducted in the participants’ natural setting, that is, at the schools where they are teaching. The researcher did not send instruments to participants to complete, but was there as a primary data collection instrument (Tuckman and Harper 2012). The researcher followed an ethnographic approach, which means that focus was put on what was happening (participants’ actions and behaviour) and why it was happening (how participants viewed these events).

Dennis, Carspecken and Carspecken (2013) describe qualitative research as a field of study which is an interpretive and naturalistic approach which includes many methods, such as interviewing, participant observation and auto ethnography. According to Creswell (2009), qualitative research is a form of interpretive inquiry, in which the researcher makes an

interpretation of what they see, hear or understand. The researcher used observations in order to investigate the behaviour of the educators as primary participants by engaging in their day-to-day activities. Learners were only observed in the way they responded to the educator's questions.

Delamont (2012) asserts that in order for the researcher to be able to achieve descriptions, triangulation of variety of data sources should be used. In this study, the researcher used interviews, lesson observations and primary data sources (mark sheets) in order to be able to discuss the findings of the study in the context of the educators participating in the study. None of these methods can be viewed as more privileged than the other, since they can be used to complement one another in order to ensure reliability and credibility of data collected.

Qualitative research is less about describing and explaining but more about strategic understanding of lived and shared experiences of the educators being studied. This implies that data collection methods are used in an attempt to understand a phenomenon from the participants' point of view. Qualitative research also has the power of voice, (Dennis et al 2013). This implies that the researcher serves as the ear of the educators, who were interviewed, and to whom they cast on their frustrations and experiences. It is against this background that this study was based on qualitative research design.

4.3. Assumptions of qualitative research as outlined by Shuttleworth (2008)

Reality is constructed by the social actors; in this case the researcher interacted with the participants to collect data using interviews and observations.

The researcher interacted with the object of research to create findings. This was done by asking questions about the participants' experiences and life stories. These were used by the researcher to formulate research findings. The researcher has valid reasons why this research has been conducted, and the reasons are usually stated in the rationale for the study. The researcher used research techniques such as interviews, observations, in her interactions with participants to gather data related to the question been investigated.

4.4. Values of qualitative research

Qualitative research provides context and meaning (Creswell 2009), by answering the why and the how questions. For example, if most learners fail mathematics, the first question that will be asked is why? The next one may probably be how can these learners be assisted in order to improve. In qualitative research, the researcher is able to add on new pieces to the

research puzzle or new methods can be employed in data gathering as the research continues. In other words qualitative research is flexible and allows the researcher to follow leads that emerge in the process.

Qualitative research explores issues in greater depth. In interviews, the why questions are asked, in observations the how questions are understood and in document analysis the “what” questions are explored. All these methods of data collection are used to probe deeply into phenomena.

When qualitative research is completed, stakeholders can take informed action steps based on the complete picture or the findings provided in order to improve the situation.

4.5. Challenges of qualitative research

Shuttleworth (2008) outlines the following challenges found in qualitative research:

In qualitative research, the researcher may be faced with a problem of disengagement, which implies that participants may decide to drop out of the research, leaving the researcher with no option but to start looking for new participants. This can also result in more time been taken to do the research, which is not out of the researcher’s making.

Usually participants prefer to be given time to think over their responses and to process their thoughts. This can lead to bias, where the participants may deliberately sift their opinions by deciding what to give and what to withhold from the researcher, or even sharing the ideas with their colleagues who are not part of the study, and consequently taking those opinions and presenting them to the researcher as theirs. In the case when group interviews are conducted, participants may feel that they are not in the limelight, and that no one is listening and this can also lead to disengagement.

Choosing the right way to store information is also a challenge. In most cases researchers prefer to make use of video/audio-tapes in their research. This can lead to participants withholding valuable information about the research topic, because some respondents speak freely when they know that they are not taped. Language can also be a challenge in qualitative research when interviews are conducted, especially when the researcher and the participants do not speak the same language. This can result in misunderstanding and false or incomplete findings.

In order to overcome this challenge in my study, I sampled four participants instead of three, in case there was disengagements of participants. I explained to participants that they could not be given questions to answer at home, and that any question that they did not understand was clarified during interviews. Participants were requested beforehand to give consent to having their interviews recorded. I had also taken notes during interviews and observations in case I experience a problem with the recording device. Language was not a problem since I speak the same language as the participants.

4.6. Sampling

The study was conducted at four rural primary schools in Moretele area (comprising of 58 primary schools) situated in Bojanala district (North West province in the Republic of South Africa). The target population of the study was educators teaching mathematics in Grade 6 in Moretele area. Moretele area consists of more than fifty eight primary schools of which about 23 are trapped. To be trapped means that these schools did not meet the 50% average target set by the area office as a pass requirement in mathematics, see conceptualisation of the study in Chapter 1. The schools sampled in this study are those that are trapped and did not get a 50% average or pass percentage. The researcher requested a copy of the circular summoning principals and HOD's of the trapped schools to a mathematics accountability session, from the principal of her school. After analysing the circular she was able to decide which schools to include in her sample.

The schools were selected based on where they are situated. Moretele area office is divided into five clusters. Moretele area is a rural place, which is divided into five clusters, namely: Makapanstad North, Makapanstad West, Makapanstad Central, Rekopantswe and Tswaing. Of the five clusters, Makapanstad West and North are the most rural (the district categorised them in this way due to the fact that they are more than 27km away from the nearest town), whereas Makapanstad Central, Rekopantswe and Tswaing are moderately rural and about twenty seven kilometres away from the nearest town. Initially, the researcher envisaged to have three samples for her study, but she decided to have four in case other participants drop along the way or decide to withdraw from participating in the study. One educator was sampled from each cluster with the exception of one because it was very far from the researcher's work place. As a result four educators were sampled from the four schools. All educators sampled are qualified to teach mathematics in Grade 6. This implies that they both have a PTD (Primary Teacher's Diploma) or UDE (P) (University Diploma in Education for primary) and have a considerate experience of teaching Grade 6 mathematics. All the

sampled participants are black, two male and two females, however gender was not one of the criteria used in sampling.

The schools that were sampled were those with very low pass percentage, and they were also sampled on the basis of time and cost. In other words they were sampled again because the researcher could reach them without struggle. Finally four trapped schools were sampled, with one educator per school as a participant. The participants were not sampled on the basis of friendship.

Purposive sampling was used. Purposive sampling can also be called criterion-based sampling and it means that “the inquirer selects individuals and sites for the study because they can purposefully inform an understanding of the research problem and central phenomenon in the study” (Creswell 2007, p125). In this study educators were sampled based on the two important criteria, namely: qualifications and being a Grade 6 mathematics educator. Qualified means that educators should at least hold a primary educators’ diploma, depending on when the educator completed her or his studies. For example, there are educators who did the PTD (Primary Teacher’s Diploma) under the Bantu education system during the apartheid era, and there are others who have UDE (P) which was done during the Bophuthatswana regime. All these educators are qualified to teach any subject in a primary school, because during those times there was no specialisation in subjects, all educator trainees who wanted to teach in primary schools were doing all primary school subjects. In order to reduce the sample, an additional criterion that was used was that the school should be underperforming in mathematics (or be trapped). This was done because the research focus of this study is the beliefs of mathematics educators and how these beliefs affect their classroom practice in an attempt to ensure effective teaching is realised.

According to Kvale (2011), “the number of subjects necessary depends on the purpose of the study, and a general impression from current interview studies is that many would have profited from having fewer interviews in the study, and by taking more time to prepare the interviews and to analyse them” (p44). In order to achieve a maximum variation sample, a school was chosen on the basis of the cluster in which it is located, so that schools sampled may differ with regard to geographical location, but still trapped. This aspect of geographical location is very important because it was used as one of the criteria in the North West Education Department to determine which schools can be classified as rural schools. Schools that were less than fifty kilometres away from the nearest town were not regarded as rural

even if they can be situated in a village. In this study, schools that are less than 30km away from the nearest town are regarded as moderately-rural and those that are more than 45km away from the nearest town are regarded as deeply rural as represented in Table 6.1 in Chapter 6.

According to Maree (2010), practical considerations like time and cost also have to be taken into account when choosing a sample, and “the question of how big the sample should be in a specific survey is usually not easy to answer.” Therefore in this research the researcher selected the sample by shortening the vicinity of the research from province to the cluster. The cluster is the lowest level of demarcation, followed by the region or district and lastly the province. This was done taking time and cost into account.

4.7. Data collection and documentation strategies

Data was collected in the form of interviews (conducted telephonically in separate evenings); notes from lesson observations (at their respective schools) and mark sheets (prepared by educators for 2016) for all the participants. Data has been collected using observations and interviews, and the participants were observed, whereas interviews were conducted telephonically.

According to Creswell (2009), qualitative research is a form of interpretive inquiry, in which the researcher makes an interpretation of what they see, hear or understand. This implies that the researcher uses data collection strategies in which observations and interviews are involved in order to investigate the behaviour of participants by engaging in their day-to-day activities. In order for the researcher to be able to achieve descriptions, triangulation of variety of data sources should be used (Delamont 2012). In other words observations can be used in conjunction with other data collection sources such as interviews to enable the researcher to contextualise the findings.

4.8. Interviews

According to Kvale (2011), conversation is a basic mode of human interaction, in which human beings interact, pose questions and answer them. This means that when the interviewer asks participants questions, she or he is able to know their experiences, feelings, views and opinions about the world they live in. Interview is a powerful method in which the researcher constructs knowledge from the conversation with the participants. According to

Maree (2010), there are three types of interviews, namely unstructured interviews, semi-structured interviews and structured interviews.

Unstructured interviews focus on the perceptions of the participants, where the researcher explores views, ideas and beliefs of the participants, (Maree 2010). Unstructured interviews often take the form of a conversation between the researcher and the participants. With semi-structured interviews, questions are predetermined, but when the participant is ambiguous, then probing questions are asked in order to get more insight into the data provided. In structured interviews the researcher determines questions before meeting with the participants.

In this study, semi-structured interviews were used even though questions were predetermined. This was done in order to allow participants to elaborate on their beliefs freely without being hindered by the researcher's predetermined questions. See Appendix A for the questions that were asked in interviews. Before interviews commenced, permission was solicited from participants to use audio-tape. The researcher conducted telephonic interviews with all participants on separate occasions at the time agreed upon between the researcher and the participants. Interviews were used to obtain an insight into the types of beliefs educators hold and what prompted them to believe that way. In telephonic interviews, participants had time and space to elaborate on their own thinking unhindered by the presence of the researcher (Delamont 2012). This allowed for a thoughtful and personal form of conversation where participants did not have direct contact with the researcher.

In interviews, the researcher determined beforehand the questions that I asked the participants, see Appendix A. There was a heading and instructions which were explained to participants before the interview began. Probing questions were asked only when the educators' responses were ambiguous, to give them an opportunity to clarify their responses. There was also a pause after every response given by the researcher to give participants time to indicate that they have finished responding to a question.

Qualitative research explores issues in greater depth. The usage of interviews in data collection enabled the researcher to probe deeply into phenomenon by asking probing questions to participants as follow-up. Data collected from data sources were then described, analysed and interpreted in words and tables. In qualitative research every situation is regarded as unique (Maree 2010), therefore every participant was given the opportunity to respond to pre-determined and structured interview questions.

As participants were interviewed, the researcher took notes she jotted down their responses. Participants agreed to be recorded, and this was dealt with in ethical considerations. Because the interviews were recorded, the researcher was able to listen to the interviews again and when more information or clarity was required, the researcher called the participants again to seek preciseness concerning answers that were not clear. Data collected from audio-tapes was transcribed and all field notes were given identification numbers which corresponds to interviews and observations. In order for data collected to have accurate analysis, the researcher read it several times and also listened to audio-tapes again to know it well. All data collected was saved and transcribed as hard copies that were used during data analysis.

4.8.1. Weaknesses of using interviews

One of the greatest weaknesses of interviews is the ethical problem that arises because of taking the private lives or experiences of the participants and placing them in the public arena (Kvale 2011). This means that information said under the confidentiality agreement by participants is then taken and made public for interested audiences to be read. When structured interviews are conducted, pre-determined questions are set and the interviewees are compelled to follow the way of questioning set by the interviewer. In this case the interviewees do not have the opportunity to expand on their experiences. Participants may decide to withhold certain information from the researcher, even if confidentiality has been sworn by the latter. This can make it difficult for the researcher to answer the research questions posed at the beginning of the study.

4.8.2. Values/strengths of using interviews

When interviews are conducted properly, they can exhibit openness to new and unexpected phenomena. This implies that participants may bring into the picture some points that the researcher overlooked about the phenomenon under study, and this can only be done if they are given the opportunity to expand when they describe their experiences and actions. In interviews, ambiguity in questioning can be addressed on the spot. This means that if the participant does not understand a question asked, she or he can ask for clarity and the researcher as well can ask probing questions.

4.8.3. Types of interviews Transcripts

Paulus, Lester and Dempster (2014), identify four types of interview transcripts, namely, the verbatim transcript, Jeffersonian transcript, the gisted transcript and the visual transcript. The verbatim transcript requires the transcriber to write everything they hear and see from the

interview, including the nonverbal communication as well as repetitions and silences. The Jeffersonian transcript requires the transcriber to listen to the recordings in rounds as they concentrate on different features every time. The visual transcript uses still images from the video recording which can be combined with the descriptions in the transcript to represent the meaning. The gisted transcript is divided into two categories, which are, the condensed transcript and the essence transcript. The condensed transcript captures the exact words but leave out all the utterances which do not seem relevant to the research question. On the other hand, the essence transcript retains only the paraphrased version of the recorded data.

4.8.4. Rationale for choosing an interview transcript

According to Paulus et al (2014), anyone who has attempted to create a verbatim transcript will have encountered the difficulty of representing features of the talk such as the rate of speech, volume and overlapping speech. In this study, the researcher used the condensed transcript which is a category of the gisted transcript. The rationale for using the essence transcript is that the interviews were done telephonically, and the non-verbal communication of the participants were missed out, therefore a verbatim transcript may not be suitable. As the researcher transcribed the interviews, she also included in brackets the codes to identify different beliefs of educators that were prevalent, as Sullivan (2012) suggests that data preparation also involves data analysis in so far as one is continually making interpretations.

4.9. Observations

According to Tuckman and Harper (2012), in qualitative educational research, observation means that the researcher sits in classrooms in the most unobtrusive manner possible and watching teachers deliver the subject matter to learners. Creswell (2003) asserts that researchers need to respect research sites, be cognizant of their impact and minimise their disruption of the physical setting. This implies that an observer should simply sit and observe the teaching and learning process without interrupting the teacher and the overall setting in the research site which is the school in this study.

No questions were asked during observations and the researcher was only an observer. This was done in order to limit interruptions during the lesson and also to allow the educators to continue with their daily activities as if there was no observer in class.

When there was anything that needed to be clarified by educator participants, the researcher waited until the end of the lesson. Nevertheless she had an observation sheet which she used to take notes regarding the behaviour and actions of educators, the effect of that behaviour on

the outcomes of the lesson as well as learners' responses, both verbal and written. These helped the researcher to establish relationships between participants' behaviour as well as to affirm or disaffirm some interpretations that emerged from interviews during data analysis.

Data was also collected by using observation. Dennis et al (2013) use the DIKW model to illustrate how the human mind processes information. The model portrays the human minds as if they are information processors like digital computers. It is like a pyramid, which shows that progression starts with data which is processed into information, and then this information which is processed data, becomes knowledge to an individual and lastly it turns into wisdom which can be used and applied in different situations. This model also can be used as an illustration of how the researcher can use data and analyse it to construct knowledge

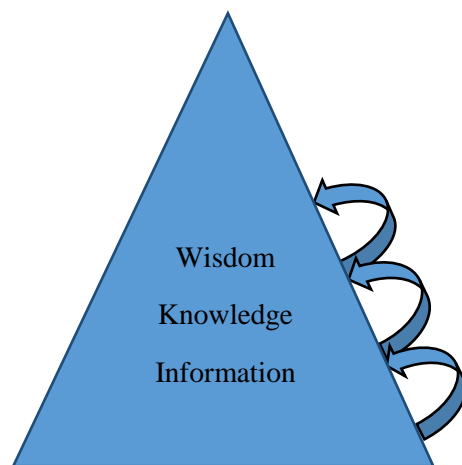


Figure 4.1: The DIKW model (adapted from Creswell 2003)

The researcher had pre-determined categories of behaviour set to be observed and compared with those mentioned by the participants during interviews. See Appendix B for the observation schedule containing behaviours to be observed. The researcher adopted a passive role. This assisted the researcher to have an understanding of how the participants use their teaching techniques to deliver mathematics content based on the information given in the interviews.

4.9.1. Challenges/weaknesses of using observation

In observations, sometimes the participants do not feel free to disclose all information about themselves and their behaviour in the presence of the researcher who is a stranger. In other words some information and behaviours may be deliberately withheld. Observation also requires the researcher to video-tape data, which poses serious challenge to the researcher

since some participants may refuse to be video-taped due to confidentiality issues. Sometimes the researcher can collect incorrect data, because the participants may not be implying what the researcher thought they did.

4.9.2. Strategies to overcome the challenges in using observations

To overcome challenges in using observation, the researcher will go back to the participants to ask clarity questions to avoid assumptions, using data from videotapes and field notes since not all behaviour can be observed.

4.9.3. Strengths of using observations

One of the strengths of using observations as a data collection strategy is that the researcher is able to see, hear and understand the actions of the participants at first hand. This implies that even if participants may attempt to conceal some truths about the phenomenon under investigation during interviews, the researcher still has the opportunity to observe some of the truths that might have been deliberately concealed.

4.10. Document analysis

Primary sources were used in document analysis. These documents were the original mark sheets prepared in schools where learners' mathematics marks were recorded on quarterly basis, from term 1 until term 3. Educators from the schools that were observed were able to hand in their mark sheets after lesson observations, see Appendix C for the example of mark sheet used. These mark sheets were also analysed. This was done in order to ascertain whether indeed learners were continually not achieving in mathematics, when comparing their performance in different terms.

4.11. Data analysis

According to Maree (2010), "qualitative data analysis is based on the interpretative philosophy. Interpretative philosophy tries to establish how participants construct meaning of a specific phenomenon, by analysing their values, feelings and experiences" (p99). The researcher is able to give meaning and interpret answers as well as body language displayed by the participants. In this study, the researcher used conversational and content analyses. According to Kvale (2011) "conversational analysis is a method for studying talk in interaction. Conversational analysis investigates the structure and the process of linguistic interaction whereby inter-subjective understanding is created and maintained" (p111). According to Maree (2010) "content analysis is a systematic approach to qualitative

data analysis that identifies and summarises message content to look for similarities and differences which will assist the researcher to confirm or disconfirm the theory” (p101).

4.11.1. Rationale for choosing data analysis method

Content analysis was chosen in this study because it is a qualitative research analysis which summarises message content. It also enabled the researcher to put data collected from interviews and observations in juxtaposition. Juxtaposing data helped the researcher to find the similarities and differences in interviews and observations which provided a deeper insight on how the researcher constructed meaning of the phenomenon under study.

According to Creswell (2003), “qualitative research is fundamentally interpretive, which means that the researcher makes an interpretation of data, including the description of the setting, analysing data for themes or categories, and finally making an interpretation or drawing conclusions, stating the lessons learned and offering further questions to be asked” (p182). Creswell (2003) further suggests the steps to be followed in analysing data using codes.

According to Kvale (2011), coding is a key feature in analysing qualitative data. In this study the researcher works with data directly, dividing and analysing it, initially through open coding for the emergence of core categories and related concepts (Bryant & Charmaz 2012). These steps were followed in this study during the stages of data analysis.

Step 1:

Data collected during interviews and observations was organised, sorted according to sources and then transcribed. Field notes written during observations were also typed.

Step 2:

The second step was to read data from each data source in order to have a general impression of what it was all about. This means that data collected from one participant was read starting with interview transcript, and the notes from lesson observation.

Step 3:

In this step, the researcher assigned codes to segments of data collected in interviews in order to divide it into meaningful analytical units. Data segments which have the same meaning were assigned the same code. Other codes that emerged as the data was being read were added. Sometimes coding in this way may require the researcher to assign specific codes for

different participants due to parallel ideas that may emerge from the data. This challenge was overcome by firstly assigning codes for themes that seemed to have similar meaning, and at a later stage when useful data had been filtered new codes were assigned. This gave the researcher a sense of how often a specific phenomenon appears in the data. All data sources, which are interviews and observations were treated in the same way until all the data was coded. This took a longer time than anticipated since it was necessary for every participant's source to be read more than once, that is at least twice or more to enable the researcher to know the data very well.

Step 4:

Once the researcher assigned codes to the transcribed data, she combined related codes into categories and each category was given an identifying name of belief. This was done in all data sources. In cases where some codes fitted with more categories, she consulted her supervisor to get her opinion in order to avoid misinterpretation and confusion in classifying codes. This process of classifying codes required the researcher to read data again and it took a considerable amount of time.

Step 5:

The next step to take was to trace if there were connections among categories. This was done by placing similar categories next to each other, where it was easy for the researcher to see them without paging and closing others. This helped the researcher not only to establish how these categories were related but also how they differed or contradicted one another. These categories were then arranged to illustrate how they link to one another. The researcher could then be able to establish the relationship between educator beliefs and their classroom practice and also to determine which beliefs should be changed if possible, in order to bring about effective teaching. It is in this step where the researcher wrote the connections of the themes in summary and also as a narrative description to discuss the findings of the study in Chapter 6.

Step 6:

Once coding was completed, the researcher sought associations within the data, which were then used to define concepts, present comparison of the findings as well as the researcher's personal interpretation. Lessons learned together with further questions to be asked were also presented in this step, and also in Chapter 7 which is the conclusions and recommendations.

4.12. Methodological norms

The methodological norm applicable in this study is trustworthiness of data. Dennis et al (2013) argues that:

Reliability and validity specifically, as far as the research instruments are concerned, are crucial aspects in quantitative research. In qualitative research, the researcher is the data gathering instrument. Thus it seems when qualitative researchers speak of research “validity and reliability” they are usually referring to research that is credible and trustworthy. (Dennis et al, 2013, p. 80).

In order to ensure trustworthiness of data in this study, the researcher referred to credibility and confirmability.

4.12.1 Credibility

According to Shenton (2003), credibility deals with the question of how congruent the findings are with reality and is essential in ensuring trustworthiness. In order for this study to be credible, the researcher used triangulation by adopting research gathering methods that are well established in qualitative research, namely; interviews and lesson observations. In addition supporting data obtained from mark sheets which were collected from educators were also analysed. These mark sheets were developed by educators who are participants in this study. If the same results are yielded by all these sources the results of the findings would be credible.

The researcher also did member checking, which means going back to the participants to ask for clarity on certain issues in order to verify data collected. This was done for lesson observations, where educators were asked questions at the end of the lesson, and for interviews where transcripts were taken to educators to verify if what the researcher has transcribed was exactly what they said. In data analysis, the researcher did not rely on one data analysis strategy; conversation analysis was also used in conjunction with content analysis to increase credibility of the findings. Shenton (2003) and Billups (2014) mention the importance of debriefing as one of the elements that increase credibility in a research project.

The researcher also had numerous debriefing sessions or meetings with her supervisor. This was done to help the researcher test her interpretations, to discuss alternative approaches and also to recognise biases and preferences. In this way the researcher had time to review and evaluate her own project study as it developed.

4.12.2 Confirmability

Creswell (2009) asserts that in qualitative research it is impossible for the entire study to be objective because the researcher is the data gathering instrument. Shenton (2003) agrees with Creswell (2009) by saying that the intrusion of the researcher's biasness is inevitable. However, the researcher's biasness can be reduced by triangulation of data gathering methods. In this study, the researcher attempted to reduce her biasness by using individual interviews and lesson observations to corroborate confirmability. The researcher also transcribed interviews that were recorded to represent the realities of what was said by the participants in order to give meaning to the findings.

4.13. Ethical considerations

According to Creswell (2003), procedures during data collection involve requesting and obtaining permission of individuals in authority to provide access to study participants at research sites. In dealing with the issue of ethics, the researcher sought approval for this research from the ethics committee at the University of Pretoria. She was granted permission by the committee, which gave her a letter of approval through an e-mail, see Appendix D. She then wrote a letter to the area manager of Moretele area office (Department of Education) to request permission to conduct this research in the area, see Appendix E. Permission was granted and she was given a permission letter to present to all the schools that she envisaged conducting her research; the letter appears in Appendix F.

After selecting her samples carefully, she also wrote letters to the principals of the sampled schools. She had to visit those schools on a number of occasions since principals were not always available at their schools and the acting principals could not grant permission. Nevertheless she was eventually granted permission from the principals, who signed the consent slips at the end of the request letter. Request letters for principals appear in Appendix G. The researcher also explained the purpose of her research verbally, to the principals. She further requested that she would require mathematics mark sheets from each selected school if the educator from the same school agrees to take part in the research.

Educators from the same schools who were teaching mathematics in Grade 6 were also given request letters. The researcher also explained the purpose of the research verbally to the educators, and that she would like to take videotape their teaching as well as to record the interviews. She also assured the educators that all the information they would provide in interviews and during lesson observations would be treated confidentially. Educators signed

the consent slips attached at the end of request letters, see Appendix H, and they promised to give the researcher their mark sheets when she visited their classes for the purpose of lesson observations, which they did. Request letters for parents and learners were also written and sent taken to participating schools for consent, see appendices I and J respectively. All the educators sampled did not have a problem with the recording of interviews; however they did not agree to be video-taped. The researcher contacted the educators to arrange for the dates that would be suitable for them to be interviewed. It was promised that at the end of the research, the findings and recommendations that emanated from the study would be made available to the North West Education Department in Bojanala district as well as to the participants.

4.14. Limitations of the study

The most limiting factors in this study was time and cost. I sampled educators based on their work proximity, where it would be easier for me to go and collect data without incurring extra costs. It was not difficult to find participating educators. Educators sampled were required to be interviewed and observed in the term of the year (between July and September 2016). When the schools opened in July 2016, some of the schools were still finalising progress reports for learners as they were not issued when the schools closed in June. Due to this, educators postponed interviews and observations, and collection of data was finalised in the fourth term (in October). One participant who agreed to participate in the study was unwilling to be observed in class. Although participants signed permission slips giving consent to participate in the study, they did not agree to be video-taped.

4.15. Conclusion

The discussion presented in this section was the process of data collection, which shows that data was collected by means of interviews; lesson observations; and mark sheets. The data collection methods used in this chapter were chosen because of their appropriateness in qualitative research, and triangulation of data collection methods would help in validating data. The data collected during interviews was recorded, and data from interviews and lesson observations was coded. All data was analysed and interpreted. The results from analysis of data were used to address the research questions asked in the study and to draw conclusions. Methodological norms related to data collection methods as well as ethical considerations were also discussed. The next section (Chapter 5) deals with the presentation, analysis and interpretation of data collected from the three methods.

CHAPTER 5: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

5.1. Introduction

In this Chapter the researcher reports on the data that was collected in four phases. The first phase of data collection began with telephonic interviews in which educator participants were requested to discuss the beliefs they have about mathematics, mathematics teaching and the learners they teach mathematics. The second phase was lesson observations in which educators were observed to see whether educators practise their beliefs in classrooms. Two educators were teaching *Fractions* one educator was teaching *Probability* and the other educator was only interviewed and did not agree to be observed. The third phase was the verification of data in which educators were simply asked to read and verify the interview transcripts. The fourth phase was the analysis of mark sheets collected from the four educators, in which learners' marks were recorded per term.

After data was collected in the four phases, it was presented, analysed (using different codes and categories of beliefs) and then interpreted. All data collected from interviews was recorded, transcribed and verified. After reading the interview transcripts, data was coded and analysed. The observations were coded, tabulated and analysed. Mark sheets collected after observations were also analysed. Thereafter a discussion on the beliefs based on data collected is given in detail.

5.2. Phase 1: Telephonic interviews

Phase 1 deals with the presentation, analysis and interpretation of data obtained from interviewing educator participants. In the presented extracts, the researcher asked four questions where P refers to the participants (four educators). Participants' responses are written in italics.

5.2.1. Responses of participants to interview question 1:

Can you please tell me about your qualifications?

P₁: *My qualifications, I did UDE secondary teaching, majoring in mathematics. Then I corresponded and completed B-Tech in educational management. I also did ACE, advanced certificate in mathematics and Natural Science teaching. I have been teaching for 16 years*

P2: *Er, I did UDE primary at college and thereafter I studied part time and completed my B.A. I then did diploma in management.*

P3: *Academic qualifications, I've got er... grade 12, and then I trained as a teacher PTD, Primary teachers' diploma, 1983 to 1985 and I started teaching in 1986 till today. Privately I corresponded and did ACE in management diploma and thereafter I enrolled with the University of Pretoria where I acquired my B.Ed. (hons) education management and policy. That is in brief my qualifications.*

P4: *Yes, I completed UDE in higher education diploma and then I did B.A. Thereafter I studied ACE in mathematics and computer science approach and technology. I have 28years teaching experience.*

5.2.1.1. Overview of educators' responses to question 1

From the responses on educators' qualifications, Participant 1 has a secondary diploma in teaching mathematics, Participant 2 has a primary diploma in teaching, Participant 3 has a primary diploma in teaching mathematics and Participant 4 has a secondary diploma in teaching mathematics. This indicates that all the participants are qualified to teach mathematics in Grade 7, however P₁ and P₄ are highly qualified since they can also teach mathematics in secondary school because they have secondary diploma. Table 5.1 shows a summary of their qualifications.

The following abbreviations were used under question 1 but were not explained:

UDE (University Diploma in Education)

B Tech (Bachelor of Technology)

BA (Bachelor of Arts).

Table 5.1 (Summary of participants' qualifications)

Participant	Qualification in mathematics	Qualifies to teach mathematics	Teaching Experience
Participant 1	UDE(S), ACE(mathematics & natural science teaching)	Yes	16yrs
Participant 2	UDE Primary	Yes	28yrs
Participant 3	PTD	Yes	30yrs
Participant 4	UDE(S), ACE(mathematics & natural science teaching)	Yes	28yrs

Table 5.1 shows that all educators have a minimum qualification in mathematics and are therefore qualified to teach mathematics in primary school. However, Participants 1 and 4 can

be regarded as being more qualified because they can also teach in secondary school as they have a secondary education diploma.

5.2.2. Responses of participants to interview question 2:

Are there any beliefs that you have about mathematics, the teaching of mathematics or the learners that you teach mathematics?

In this section, the responses of the four participants to question 2 are presented (which have three categories).

P₁ *Ja, there are beliefs that I have. Firstly, mathematics is a practical subject, it does not need rote learning. The learners must practice, because practice is more important. Why I say mathematics is practical, is that what learners do in mathematics is related to their everyday life. And then teachers should use manipulatives when they teach because they will help learners understand. Er, previously we did not have teaching aids and it was difficult to teach mathematics, that is why we resorted to textbook method. But now with the introduction of mathematics laboratories in schools it is much better. Learners become interested in the lesson when they see these things.*

Er, the other thing is that the classroom must be print-rich because when learners see what they are taught it becomes easy for them to understand. But now the problem with our learners is that there is no initiative on the side of learners. They cannot study on their own, the teacher must always be there.

P₁: *I'm not sure if I understand you clearly can you explain what you mean by beliefs?*

R: By beliefs I mean anything that you think is true according to how you perceive it.

P₂: *Er, the beliefs that I have about mathematics, firstly is that mathematics is difficult for most of the learners. Why I say this is because most of them are not serious with their work. When the teacher is not in class they make a lot of noise and they just sit and do nothing. They only do mathematics when you are here with them. And the other thing is that they must learn to practice on their own because the teacher cannot always be in class, sometimes you go to workshops or attend meetings. If they do not practice they will not remember anything when they write a test.*

P₂ continued as follows:

..... and the other thing...er, in mathematics, the learners when you teach they take time to understand, because mathematics is difficult, so there must be more periods for mathematics than any subject. Again the teacher have to repeat the topic again because they take time to understand that is why I say there must be more time allocated for mathematics otherwise learners will not pass. The big problem that we have is that mathematics teachers are given other subjects to teach apart from Mathematics. This causes overload because mathematics itself is a problem for learners.er, one more thing... about beliefs is that concrete objects should be used when teaching. This will help learners to understand easily and also encourage them to think.

R: What do you mean by overload?

P₂ continues.. *I mean you see I'm in management as a principal, and I have to teach 52 periods in a week. With other management duties that I have to do I no longer have time for learners.*

P₃: *Ja, the beliefs in mathematics are that in South Africa, er, we take mathematics as a difficult subject, for the learners and for the educators, but it is not that difficult, you see, it is just that people don't get clear light into it, or you will find that the educator is overloaded with many subjects, so that he or she don't have enough time to dwell much into mathematics concepts because it needs a lot of time. To me if I was the minister, I would say teachers who teach mathematics let them teach mathematics only so that our learners can prosper very well in it, you see.*

As far as teaching mathematics is, what I have discovered is that teachers are being overloaded as I have alluded in my earlier answering; they teach mathematics plus other subjects on top.

P₄: *The beliefs that I have, mmm... let me start by saying mathematics needs people who can think quickly, not people who cannot work with numbers. And this must start at home, for example, when parents or siblings give children food. I can give example of fruit, when there is no enough fruit and the parent divide the fruit between the four children. This is an example of fractions. I can give many examples but I just wanted to show you what I mean when I say mathematics must start at home. At school the teacher can bring along real objects so learners can see what they are being taught about. This will make them understand better when they see and touch objects.*

5.2.2.1. Overview of participants' beliefs based on the three categories

From the above extracts, it shows that there are different beliefs that are held by the four participants as evident from the following three categories.

Category 1: Beliefs about mathematics

The four educators indicated their beliefs about mathematics, which are

- Mathematics is a practical subject
- Mathematics is a difficult subject

Category 2: Beliefs about the teaching of mathematics

Beliefs that educators have in this category are:

- Using of manipulatives (concrete objects) when teaching which is according to Handal (2003)
- More time is required to teach mathematics
- Repetition of concepts should be done

Category 3: Beliefs about learners you teach mathematics

In this category, educators believe that:

- Learners should have a mathematical mind, according to Handal (2003) and Beswick (2008)
- Learners should practice on their own (take initiative in their own learning)
- Learners are not serious with their work

5.2.3. Responses of participants to interview question 3

How do the beliefs that you mentioned affect your teaching?

P₁: *mmm...they affect me, as a teacher when learners do not understand; they challenge me to come up with different teaching strategies to improve my teaching. But now in primary*

schools it is unfortunate that all learners must do mathematics and they are all expected to pass irrespective of their differences. When learners do not pass the average pass percentage becomes very low and it affects me as a teacher.

P₂: *Mmm... when I teach I always repeat the topic with learners and after doing that some learners still do not understand. This makes me hopeless because when I repeat I think they will improve, but then... and sometimes I ask bright learners who understand quickly to explain to those who do not understand, thinking that maybe if it a learner who explains they will understand.*

P₃: *Er, these beliefs affect me because with the management duties that I have, I do not manage. As the school manager with 53 periods that I must teach, it is difficult to cover the syllabus. On top of that I have to attend management meetings time and again so I don't see learners more often. Most of the time I am not at school.*

P₄: *Er... they affect me it means that learners understand better when they see and touch objects and they will not forget easily, so teachers should use teaching aids or real objects if they can bring them to class. Teachers must also start teaching from simple to abstract.*

5.2.3.1. Overview of the effects of educators' beliefs on participants' teaching

From the above extract, it is clear that educators acknowledge that the beliefs they have about mathematics, mathematics teaching and learners affect their classroom practice. Educators mentioned that as a result of the beliefs they have:

- They should come up with different teaching strategies.
- When learners do not understand, educators feel hopeless.
- It becomes difficult to cover the prescribed syllabus
- They are encouraged to use concrete objects when teaching
-

The effect of educators' beliefs on their classroom practice is discussed in detail in under findings in Chapter 6

5.2.4. Responses of participants to interview question 4

What is it that you recommend to improve the effect of beliefs on your teaching?

P₁: *Firstly, I recommend that mathematics laboratories be established in all the schools because they are very helpful in keeping learners' interest. Secondly, extra effort is required from learners, if parents can help them at home with their homework, because most of them they just come to school with their homework not done. If parents can be informed in parents' meetings to help learners at home I think it would be better.*

P₂: *You see, the problem is the PPM, it must change because they are looking at the number of learners in the class but then the teacher teaches many subjects including mathematics as well. The other thing is age cohort. Pass requirements must also change because learners pass with age cohort and when they go to higher classes they do not cope, even if you can repeat the topic. They must remove this thing of age cohort. And also time, they must allocate more periods for mathematics because maths is a difficult subject*

P₃: *I recommend study groups for learners. If learners can do study groups it will be better because there is no time to treat all these topics. The other thing is our senior management,*

they should visit schools especially the small schools. They are suffering because of the PPM. They should at least give us temporary teachers to offload the staff.

P4: *For teachers I recommend that they must start from simple to complex when teaching and they must use teaching aids. The department of education must hire assistant teachers permanently who can help learners with homework after school before they go home, just like in Gauteng Province, because some parents do not understand the homework given to learners and so they cannot help them. The department must also hire specialists, occupational therapists and psychologists who can help learners with barriers because teachers do not have time to do intervention.*

5.2.4.1. Overview of recommendations made by educators to improve the effects of their beliefs on teaching

In the above extracts, all four educators suggest their recommendations as part of addressing the problem of poor learner performance in mathematics. These recommendations are also classified as educator beliefs, which are:

- More practice is required from learners
- Parental involvement is required
- The PPM (post provisioning model) should be revised
- Pass requirements should change
- Group work should be encouraged according to Handal (2003)
- District should support schools
- Assistant educators should be hired
- Specialised help is required for learners (psychologists and educational therapists)

5.3. Individual participants' data analysis based on interviews and observations

In this section, data collected from participants is coded and analysed individually, and a summary of each participant is given. Dennis et al 2013, asserts that for “qualitative researchers, the conversation on validity is a conversation about the nature of understanding the status of truth, the possibility of justification and rational deliberation and the purpose of inquiry”. The summaries and data codes of participants' beliefs will help the researcher to make comparison and find similarities and differences of beliefs held by the educators. Table 5.2 shows different codes used for participants' responses based on four interview questions.

Table 5.2: Labelling and coding of data for interviews

Code	Meaning of code
MPN	More practice required from learners
UOTA	Use of teaching aids is important
MT	Mathematical thinking
SPN	Specialised help is required
PPM	Post provisioning model to be considered
PRC	Print-rich classroom
SG	Study groups to be formed
PRQ	Pass requirements to be revised
MTN	More time is required to teach Mathematics
TTMO	Maths teachers should teach Mathematics only
MID	Mathematics is difficult
PI	Parental involvement is crucial
DTT	Different teaching techniques
AEN	Assistant educators required

5.3.1. Coded interview transcript for participant 1

5.3.1.1. Interview question 1

The participant is a male, who after matric completed University Diploma in Education for secondary school teaching, UDE(S), and then B-Tech in educational management. From there he did ACE (Advanced certificate) in mathematics and Natural Science teaching. The participant is also an HOD of mathematics and Natural Sciences and Technology at his school, and has sixteen years of teaching experience.

5.3.1.2. Interview question 2

There are beliefs that I have. Firstly, mathematics is a practical subject and does not need rote learning. Practice is more important in mathematics but learners do not practice (**MPN**). They should relate what they learn in class to their daily life, because what they do every day is related to mathematics in one way or another. Again I think teachers should use manipulatives (**UOTA**) when teaching, to help learners understand better. Previously, we did not have teaching aids and this made us to resort to textbook method when teaching. But now with the introduction of mathematics laboratories in schools, it is better because the mathematics laboratories arouse the interest of the learners and they become interested in the lesson. The other thing is that the classroom should be print-rich (**PRC**), because seeing makes it possible for the learners to understand better, but the problem is that there is no initiative on the side of learners. They cannot study on their own. On this one, I think the teacher should encourage them to use study groups (**SG**).

5.3.1.3. Interview question 3

These beliefs affect me as a teacher and they challenge me to come up with different teaching techniques to improve the situation (DTT). In primary schools it is unfortunate that all learners are expected to do and pass Mathematics irrespective of their differences (PR). When learners do not pass and the average pass percentage becomes very low.

5.3.1.4. Interview question 4

Firstly mathematics laboratories must be established in all the schools because they help keep and maintain learners' interest in the lesson. Secondly, extra effort is required from learners and parents (PI) are informed in parents' meetings to help their children with home works at home.

5.3.1.5. Summary of beliefs held by Participant 1

- Mathematics is a practical subject and does not require rote learning.
- Practice is more important, but the learners do not practice, and they cannot study on their own.
- Manipulatives/teaching aids must be used to promote understanding (Handal 2003)
- Mathematics classroom must be print-rich because learners in primary school learn by seeing which makes it possible for them to understand easily.
- In primary school learners are expected to pass mathematics, which is one of the promotion requirements in spite of learners' different abilities.
- When learners do not understand they do not complete the work and this causes them to fail.
- The low performance challenges the teacher to come up with different teaching techniques to improve the situation.
- Extra effort is required from learners and parents should be informed and requested in parents' meetings to assist their children with homework.
- The teacher should encourage group work and brighter learners be used to facilitate the work of the group.

Participant 1 seems to have positive beliefs and in his recommendations, he tries to come up with solutions to the problems he encounters in his teaching.

5.3.2. Coded interview transcript for participant 2

5.3.2.1. Interview question 1

I passed UDE (P) and then did B.A. From there I did ACE (Advanced certificate) in Technology teaching, and then also Diploma in management. I have 26yrs experience in teaching Grade 6 mathematics.

5.3.2.2. Interview question 2

The beliefs that I have about mathematics, firstly, is that mathematics is a difficult subject for the learners; (MID) and this is because most of them are not serious with their work. They only do mathematics when the teacher is in front of them. They must practice on their own so as to remember what they have been taught (MPN). The other thing is that more time is required to teach mathematics because learners take time to understand and the teacher must repeat the concepts (MTN).

Again concrete objects must be used when teaching, because using visual aids help learners understand easily and fosters independent thinking when learners use the visual aids by themselves (UOTA).

5.3.2.3. Interview question 3

When learners do not understand, I sometimes lose hope because I repeat the topic but they still cannot do the problems they are given (HPLS).

5.3.2.4. Interview question 4

Firstly the issue of PPM must be looked into because it has a negative effect on the performance of teachers (PPM). Promotion requirements must also change because learners are progressed due to age cohort and they become a problem in the next grade (PR). Lastly, more time should be allocated for teaching mathematics (MTN).

5.3.2.5. Summary of beliefs held by Participant 2

- Mathematics is difficult for the learners
- More time is required to teach mathematics
- Concrete objects must be used during teaching
- Learners must practice on their own
- Repetition of concepts is necessary

- The post provisioning model (PPM) of allocating teachers to schools should be re-considered.
- Promotion requirements should change and learners should not be progressed due to age cohort.
- More time is required to teach mathematics, because concepts need to be repeated for learners to understand.

Participant 2 seems to be struggling and most of her beliefs are like complaints. Very few solutions are suggested to problems encountered.

5.3.3. Coded interview transcript for Participant 3

5.3.3.1. Interview question 1

I passed matric and thereafter I did PTD, then I did ACE (Advanced certificate) in management and lastly B.Ed. (hons) also in educational management. I have 30yrs of teaching experience.

5.3.3.2. Interview question 2

My beliefs let me start by saying mathematics is a difficult subject even for teachers (MID), and with the overload of work that we have, there is not enough time to teach (MTN). If I were the minister, I would say mathematics teachers should teach mathematics only (TMO). The other thing is the problem of rural schools; they experience their own unique problems especially regarding the PPM. The PPM is not user friendly (PPM), for example, I am in management but I have 53 periods to teach in a week. With these problems and lot of work it is not easy to see the learners every day, but the teachers must encourage learners to form study groups so they can study on their own when the teacher is not there (SG).

5.3.3.3. Interview question 3

There is a slow progress on the side of the learners, so I think extra-classes can help (MTN). Management duties also impact negatively on the performance of learners because the time that should be spent in class with the learners is taken by management duties.

5.3.3.4. Interview question 4

I think the senior management in the area office should visit schools to get information regarding the problems encountered in specific schools and assist them (AN). Again the issue of the PPM in schools should be considered (PPM), and temporary teachers should be employed to offload the teachers especially in rural schools (AN).

5.3.3.5. Summary of beliefs held by Participant 3

- Mathematics is a difficult subject for the learners and also for educators, and with a lot
- Mathematics teachers should teach mathematics only.
- Lot of work in management hinders effective teaching.
- There is slow learner progress since there is not enough time to teach.
- The PPM should be re-considered.
- Extra classes should be conducted to cover up for lost time (more time required)
- Rural schools and small schools with unique problems should be treated differently with regard to the PPM
- Support from senior management in the district is required.

Like Participant 2, Participant 3 is struggling and most of his beliefs are also complaints. Participant 3 raised the fact that he is in a senior post (principal).

5.3.4. Coded interview transcript for participant 4

5.3.4.1. Interview question 1

I completed UDE in higher education diploma, and then I did B.A. Thereafter I did ACE (Advanced certificate) in mathematics and Computer science approach and technology.

5.3.4.2. Interview question 2

Mathematics needs people who can think quickly (**MT**), it does not need learners who cannot work with numbers. Mathematics must start at home, with parents and siblings teaching the learner (**PI**), for example, sharing food or fruit is an example of fractions. Learners should be taught practical things first before moving to the abstract. Teachers can bring real objects to class for learners to see, touch and use them while learning (**UOTA**). This will make them understand better when they see what they are being taught about.

5.3.4.3. Interview question 3

These beliefs affect me in the way that I should make use of teaching aids to move from practical to abstract, and always refer learners to things they know from home when teaching (**UOTA**).

5.3.4.4. Interview question 4

For teachers, teaching must always start with simple things and then move to difficult. The Department of education should employ assistant teachers for schools to assist learners with home works after school (**AEN**), before the learners go home, because some parents cannot

help their children with home works as they do not understand the work themselves. Specialised help from occupational therapists and psychologists must be given to learners who need it, for example learners with barriers (SPN). These learners should not be the burden of the teacher because teachers have a lot of work to do. These people are the ones who should do intervention to learners with barriers and not teachers.

5.3.4.5. Summary of the beliefs held by Participant 4

- Mathematics need people who think quickly (Beswick 2008).
- Learners should be able to work with numbers.
- Mathematics should be taught starting from practical to abstract and moving from simple to difficult.
- Learners should be exposed to mathematics practicality from home at a very early age.
- The teacher should use teaching aids to move from practical to abstract and to help learners understand concepts (Handal 2003).
- Teaching should always involve examples from everyday life.
- Assistant educators should be provided by the Department of education to assist learners with homework before learners go home.
- Occupational therapists and psychologists should be hired to do interventions and provide specialised help to learners with barriers to learning.

5.4. Overall summary of educators beliefs based on the four participants

The participants' beliefs as summarised individually fall under the three categories, which are beliefs about mathematics, beliefs about the teaching of mathematics and beliefs about the learners they teach mathematics. Some of the beliefs mentioned are similar, for example three participants believe that mathematics is difficult whereas other beliefs are different, for example, only Participant's 2 believe that mathematics educators should teach mathematics only. Although these beliefs differ from one participant to the other, they can still be classified under the three categories of beliefs mentioned earlier. Participant 1 and Participant 4 display similar beliefs and try to come up with solutions to problems encountered in their teaching. Participant 2 and Participant 3 also display similar traits which involve complaints with limited solutions to the problems they are faced with.

5.5. Phase 2 of data collection: Lesson observations

Data collected from lesson observations was also coded. Table 5.3 shows the codes which were used in lesson observations and their meanings.

Table 5.3 Codes used in lesson observations

Code	Meaning of code
TCSS	Teaching concepts step-by-step
HLS	Hopelessness
TR	Teacher reflection
CFLU	Concern for lack of understanding
ITE	Independent thinking encouraged
RPTN	Repetition of concepts
CA	Consistent accuracy
PR	Positive remarks
LP	Lively participation
LEJY	Learners enjoy the lesson

5.5.1. Participants' lesson observations

A common observation schedule was used for all participants who were observed. The actions and behaviours of participants were recorded in the form of a tick in the appropriate column in the schedule.

5.5.1.1. Lesson observation for Participant 1

Participant 1 was observed on the 18th October 2016, and below is the table for the behaviour observed. The participant is an HOD of mathematics and Natural Sciences and Technology in the intermediate and senior phases. He is a male who qualified for UDE(S), a three years' diploma for teaching in secondary school, and majored in mathematics. He also completed a Bachelor of Technology degree (B.Tech), and lastly completed a diploma in educational management. The participant has a sixteen years' experience in teaching and is currently teaching mathematics in Grade 6.

The class was moderately large, with about 53 learners. The tables in the mathematics laboratory were arranged permanently in which learners can sit in groups of three, six or nine. There were charts on the walls of the classroom explaining the objectives of the mathematics laboratory.

5.5.1.2. The teaching process for Participant 1

The participant had manipulatives (labelled pieces of hard paper used to demonstrate the concept of fractions) which were supplied together with the mathematics laboratory on the table. The participant taught a topic of adding and subtracting fractions in the mathematics laboratory very well using a step-by-step procedure. No previous knowledge was referred to at the beginning of the lesson. He started by introducing the topic of fractions, and requested learners to give examples of common fractions they know. Learners responded and gave a few examples which were correct, and then the educator did examples of adding and subtracting of fractions simultaneously. The educator had one hour to teach, that was a double period of thirty minutes each. He spent almost 75% of the period teaching the concept of adding and subtracting fractions using examples written on the white board. When this was done, some learners were not facing to the front as the sitting arrangement did not allow them to do so, and the educator seemed not to notice that some learners had a difficulty facing the front. One of the examples used was: $\frac{5}{6} + \frac{3}{7} = ?$

The topic was well presented to learners using step-by- step procedure. Oral questions were used as part of the lesson to ask learners to give the LCM of **6** and **7**, as well as to calculate the numerators after identifying the LCM. As the educator was asking questions, learners took a long time to respond, and the educator was required to repeat the questions. Even after repeating questions, learners would in some instances not raise hands to show that they want to respond to the questions asked. Then the educator turned to the researcher and said, “Do you see the type of learners we teach in this area?” At this reaction, the educator did more examples to show learners how they should add and subtract fraction. This consumed a lot of time. After teaching the learners, the educator gave them an activity on the white board which they had to do orally as he wrote their responses. When learners were asked oral questions, they attempted to answer and some of their answers were correct. Where they made mistakes, the educator corrected them. At the end of the lesson, the educator gave a brief summary of what was taught, explaining again the steps that were followed in the examples.

5.5.1.3. Overview of Participant’s 1 teaching process

Participant 1 demonstrated that he had good mastery of the content of the concept taught, however some learners did not pay attention to the lesson and he did not notice. Teaching aids were ineffectively used, they were only used at the end of the lesson as a summary. There was poor time management, as learners were given an activity to test their understanding only

towards the end of the lesson. Most of the learners did not finish writing. Table 5.4 shows the beliefs of Participant 1 that were observed.

Table 5.4 Observed beliefs for Participant 1

Behaviour/Actions of the participant	Frequency of behaviour		
	consistently	Sometimes	never
1. Teaches concepts/skills step-by-step	√		
2. Teacher demonstrates hopelessness when learners give incorrect answers more than twice for the same concept.			√
3. Teacher reflects on his/her teaching.		√	
4. Teacher expresses great concern for learners' lack of understanding.	√		
5. Teacher encourages independent thinking and tries to move away from using visual aids.	√		
6. Teacher incorporates repetition/more exercises given on Mathematical concepts (from learners' books).	√		
7. Teacher credits learners for correct procedure for consistent accuracy even if their answers are incorrect.			√
8. Teacher uses positive remarks during teaching.		√	
Other noticeable behaviour			
9. Learners not concentrating on the lesson		√	

Table 5.5 shows an analysis of beliefs of participant 1 from interview put side by side to the beliefs observed from the teaching process. When beliefs are put in this way, it helps to guide the researcher to compare what the participant said and what has been done in the classroom. The comparison also indicates whether there is affirmation or contradiction in participant's beliefs.

Table 5.5: Juxtaposed codes for Participant 1

Interview codes	Meaning of codes	Observation codes	Meaning of codes
MID	Mathematics is difficult	TCSS	Teaching concepts step-by-step
MPN	More practice required	HPLS	Hopelessness
PRC	Print-rich classroom	PR	Positive remarks
UOTA	Use of teaching aids	TR	Teacher reflection
DTT	Different teaching techniques	CFLU	Concern for lack of understanding
SG	Study groups		
RPTN	Repetition of concepts		
PRQ	Pass requirements		
PI	Parental involvement		

5.5.1.4. Interpretation of lesson observation for Participant 1

Participant 1 started by saying mathematics is difficult for learners nevertheless all of them are required to pass it in order to be promoted to the next grade. By so saying the participant expresses a concern about the pass requirements, and that it is not always possible for all learners to pass mathematics. Participant 1 asserted that the use of visual aids is crucial for Grade 6 learners, classroom should be print-rich, and learners should be encouraged to form study groups.

During lesson observation, learners were taught in the mathematics laboratory which was indeed print-rich. Teaching aids were available even though they were used towards the end of the lesson. Participant 1 presented the topic of adding and subtracting fractions well step-by-step. There was a sign of hopelessness when learners did not understand. The researcher noticed this when the participant said, “You see what type of learners we teach in our area?” This indicates some sense of hopelessness, and that the educator already knows how the learners behave in the class. When the researcher heard the participant say this, she immediately assumed that the participant had already given up on his learners. During teaching, the educator made some calculation mistake and one learner corrected him in the example of: $\frac{5}{6} + \frac{3}{7} =$. After finding the LCM of 42, the numerators were supposed to be **35** and **18**, of which the final answer was: $\frac{5}{6} + \frac{3}{7}$

$$= \frac{35}{42} + \frac{18}{42}$$
$$= \frac{53}{42}$$

Instead of writing $\frac{53}{42}$, the educator wrote $\frac{56}{42}$. The educator welcomed the correction from the learner and indicated that it means they were paying attention. This is also an indication that the educator accepts that he can also make mistakes and this is some form of self-reflection. The educator also mentioned some form of educator reflection when he said different teaching strategies should be used when learners do not understand.

In an interview, Participant 1 indicated that he believes that the use of study groups can help learners and it should be encouraged. However, during teaching, learners were neither encouraged to form study groups nor divided into groups, and nor were they given any group activity. This shows a contradiction between teacher belief and his classroom practice.

In the observation schedule, using positive remarks was one of the behaviours to be observed, and they were not used during teaching and marking. It is important for educators in primary school to use positive remarks during teaching and marking as a form of motivation, because primary school learners are still dependent on their educators, they need to be taught the importance of independent studying. Participant 1 took a long time to teach the topic of adding and subtracting fractions at the expense of written assessment, to the extent that some learners were no longer listening to him. This indicates that there was no adequate planning of the lesson, since assessment was not accommodated as part of teaching. More oral questions were however asked, and not all learners were responding to them.

Learners were given a task towards the end of a one-hour period, of which some of them did not finish. The researcher thinks that the participant could have given learners more written work so that more is done by learners rather than him, then the performance would have been much better. The fact that the educator took a long time to teach, indicates that his behaviour agrees with his belief when he said different teaching strategies must be used for learners who do not understand or perform poorly. Nevertheless, the educator used the same approach throughout his teaching. This indicates that he recognises the problem and how the problem can be solved, but no steps are taken towards finding a solution.

The participant also indicated in an interview that learners require more practice at home, which calls for parental involvement. The participant mentioned that parents should be informed in parents' meetings of the importance of helping learners at home with their school work. The researcher finds this startling because the participant himself did not give learners enough time to complete the task after teaching, and there was also no drill work from the learners' books, yet it is expected from the learners' parents, whom some of them may not even be conversant with some mathematics topics, since they are live in a rural area where most parents have not had any formal education. This could be the reason why learners do not complete their work as stated in the participant's belief that learners perform poorly as a result of not completing their work.

Participant 1 presented the lesson well, however there were learners who were not paying attention and he did not notice. Most of the time he taught abstractly and teaching aids were only used at the end of the lesson when he summarised the lesson. Participant 1 also taught for a long time as a result learners could not finish the activity that was given to them.

5.5.2. Lesson observation for Participant 2

On the 18th October 2016 Participant's 2 classroom was observed and summarised in Table 6. The participant is a female who completed a UDE (P), a teacher's diploma for teaching in primary school. She also studied towards a B.A degree academic, and a diploma in management. The educator has 26yrs of teaching experience and is teaching mathematics in Grade 6. The classroom was neat, tables and chairs were arranged in rows with all learners facing to the front. Learners were about 50 in the classroom.

5.5.2.1. The teaching process for Participant 2

Before the educator started with the lesson, she confessed to the researcher that she did not prepare for the lesson of that day, however, she indicated to her that the topic she was supposed to teach was adding and subtracting fractions, which she had already taught in the second term, as most of the topics are repeated every term. The educator then started presenting the topic of adding and subtracting common fractions. The educator presented the topic very well using a step-by-step procedure. No visual or teaching aids were used during the lesson. Several examples were used to teach learners how to add and subtract common fractions. The time allocated to teach was a double period of 30 minutes per period.

During teaching, the educator asked learners questions frequently to see if they follow the lesson. Each time a question was asked, learners answered in a group. The educator appreciated the learners' response by saying "yes" or "good". There were a few learners who always gave correct answers to questions asked. When learners gave incorrect answer, the educator repeated the question or asked a follow-up question to clarify the first question. There was also a boy sitting in the front who did not raise a hand, but the educator tried to involve him by directing the question to him, but the boy gave incorrect and very irrelevant answers every time he was asked a question. The educator took a lot of time to teach, approximately the whole period of forty minutes. The lesson was dominated by the educator's oral questions. After doing a lot of explaining the educator wrote a problem on the chalkboard and asked learners if they could go the front and solve it on the chalkboard. One learner came and solved the first problem correctly. She then wrote the second one, and the boy sitting in the front volunteered to solve it. The problem given was:

$$\frac{4}{5} + \frac{3}{4} = ? \text{ And the boy's answer was: } = \frac{7}{16} + \frac{9}{16} \\ = \frac{16}{16} \text{ which was incorrect.}$$

The educator asked the class if there was an alternative solution to the problem. One girl came and solved the problem correctly. Then the educator gave a summary of the lesson by explaining again the procedure to follow when adding and subtracting common fractions, and then gave learners an activity from the Department of Basic Education (DBE) book, usually called the workbook. The researcher checked the activity given and found out that it consisted of diagrams which indicated shaded fractions, and learners were supposed to add and give answers without working out the LCM. In other words it was an activity of adding fractions but all the fractions in the activity were pictures and the learners just gave answers without showing their workings. Only a few learners managed to complete the activity as it was given towards the end of the lesson, and there was no enough time to complete the activity..

5.5.2.2. Overview of Participant’s 2 teaching process

The lesson was lively and passionately presented. The educator demonstrated she has a good knowledge of the subject matter she presented. However, she did not prove to be good in time management. She spent a long time teaching and consequently learners were not provided sufficient time for the activity given towards the end of the lesson.

Table 5.6: Beliefs of Participant 2 as recorded on the observation schedule

Behaviour/Actions of the participant	Frequency of behaviour		
	Consistently	Sometimes	Never
1. Teaches concepts/skills step-by-step	√		
2. Teacher demonstrates hopelessness when learners give incorrect answers more than twice for the same concept			√
3. Teacher reflects on his/her teaching.	√		
4. Teacher expresses great concern for learners’ lack of understanding.	√		
5. Teacher encourages independent thinking and tries to move away from using visual aids.		√	
6. Teacher incorporates repetition/more exercises given on mathematical concepts (from learners’ books).	√		
7. Teacher credits learners for correct procedure for consistent accuracy even if their answers are incorrect.		√	
8. Teacher uses positive remarks during teaching.		√	
Other noticeable behaviour			
9. Learners were lively and actively involved in the lesson.	√		

From Table 5.6 it can be inferred that Participant 2 is consistent in her teaching actions, looking at the ticks she got from the frequency of behaviour. In most cases, the consistent behaviour of Participant 2 (in items 1, 2 3, 4 and 6) deals with the delivery of subject matter. However, there are instances where the Participant is not consistent in items 5, 7 and 8. The inconsistent behaviour deals with learner motivation, for example using positive remarks and crediting learners for correct procedure even if the answer is incorrect. In overall it can be inferred that Participant's 2 actions in the classroom are acceptable.

5.5.2.3. Interpretation of lesson observation for Participant 2

In the interview, Participant 2 asserts that mathematics is difficult for learners and teaching aids should be used to improve understanding of mathematical concepts, yet no teaching aids were used during the lesson and learners were just taught in an abstract way. In this way there is no attempt by the participant to make it easy to for learners to understand. This is therefore a contradiction between what the participant believes and what is being practised in the classroom.

The participant taught the topic of adding and subtracting fractions well, step-by-step even though no visual aids were used during the lesson. However, the researcher observed that more oral questions were asked, and the participant spoke most of the time during the lesson, at the expense of written work. Moreover, the participant also indicated that she forgot that the researcher was coming and did not prepare for the lesson. The problem of lack of preparation became evident when learners were given written work to check their understanding. A diagrammatic activity was given to the learners yet no example involving diagrams was taught.

Participant 2 also believes that more time is required to teach mathematics. Without the use of visual aids, the participant will repeat concepts over and over again but this will not help as it encourages rote learning. The other interesting fact is that the participant believes that it is important that learners practise on their own. The researcher does not share this belief with the participant since learners in Grade 6 are still not independent and they always need to do everything under the teacher's guidance. During teaching and marking, no positive remarks were used. I think primary school learners still need to be motivated time and again, even those who are high achievers, so that they continue doing well.

Table 5.7 Juxtaposed codes for Participant 2

Interview codes	Meaning of codes	Observation codes	Meaning of codes
HPLS	Hopelessness	MPN	More practice required
TR	Teacher reflection	UOTA	Use of teaching aids
ITE	Independent thinking encouraged	SG	Study groups
RPTN	Repetition	PRQ	Pass requirements
PR	Positive remarks	PI	Parental involvement
UOTA	Use of teaching aids	TCSS	Teaching concepts step-by-step

Table 5.7 indicates the beliefs mentioned by Participant 2 in the interview and those observed from lesson observations. It is clear that there is a contradiction of what the educator said and how she teaches. For example, the educator said it is important to use teaching aids but during the lesson no teaching aids were used.

5.5.3. Lesson observation for Participant 3

Participant 3 was only interviewed and did not avail himself for lesson observation. The researcher made several calls to set a new date for observation, and every time there was a reason for postponement until learners started with their final examinations.

5.5.4. Lesson observation for Participant 4

Participant 4 was observed on the 7th November 2016, and below is a table for her observed behaviour in the classroom. The lesson was presented in the mathematics laboratory. The tables were permanently mounted on the floor and only the chairs can be moved. This setting allows learners to sit in groups of three, six and nine. The class had approximately 50 learners and they were seated in groups of nines. The mathematics laboratory had charts on walls which explained the objectives of the mathematics laboratory.

5.5.4.1. The teaching process for Participant 4

The time allocated for mathematics period on the day of observation was a double period of 30 minutes per period. The educator presented the topic of probability (experimental frequency), and used the white board to write. There were manipulatives such as dice, small spinner board and cards which the educator used to teach the topic. The educator started from simple to complex, integrating the topics. She started reminding learners about common fractions to explain why probability of an event is written as a fraction. She involved the learners in every activity she was doing, for example, she asked learners what should be done

to allow her to write on the white board. Learners responded by saying that the educator should first select the option of using a pen. Learners seemed to be used to being taught in the mathematics laboratory, they did not struggle with anything, from using the white board and handling the manipulatives.

After teaching for a few minutes, the educator gave learners manipulatives. Each table was given its set of manipulatives which were different from the others, because she could not use the same set of manipulatives as they were not enough to cover the whole class. The educator explained to learners that they were going to do an experiment, and requested learners to have a group leader who would use the manipulatives and the other learner who had to be a scribe, recording the results of the experiment. After handing out the manipulatives, the educator moved from one table to the other, checking and helping learners to carry out the instructions.

The researcher also moved around the tables to see if learners understood and did what the educator instructed them to do. Learners were lively and they all paid attention to the activity. Group leaders performed the experiment as required and the scribe wrote the results. The educator assisted the groups when they were making mistakes. Learners were required to write the experimental probability of events given by the educator. The lesson was presented within the teaching time of one hour allocated in the time table and time management was good because the educator was able to teach and give learners a practical task which they managed to complete during the lesson. The researcher also observed that the educator is patient with her learners, but worked within the time limit. The learners were also well disciplined and task focused.

5.5.4.2. Overview of the teaching process for Participant 4

Participant's 4 learners were lively and enjoyed the lesson. Concrete objects were used effectively and learners were fully involved during the lesson. The educator demonstrated adequate content knowledge in the way the lesson was presented, was able to maintain the interest of learners throughout the lesson. Group work was incorporated successfully in the lesson. The educator had good time management and was able to give learners the activity to test their understanding. She was also able to check the work of all the groups to ensure that they did the task. Learners were able to complete the activity before the end of the lesson.

Table 5.8: The observed beliefs of Participant 4

Behaviour/Actions of the participant	Frequency of behaviour		
	Consistently	sometimes	never
1. Teaches concepts/skills step-by-step	√		
2. Teacher demonstrates hopelessness when learners give incorrect answers more than twice for the same concept.			√
3. Teacher reflects on his/her teaching.	√		
4. Teacher expresses great concern for learners' lack of understanding.	√		
5. Teacher encourages independent thinking and tries to move away from the use of visual aids.	√		
6. Teacher incorporates repetition/more exercises given on Mathematical concepts (from learners' books).	√		
7. Teacher credits learners for correct procedure for consistent accuracy even if their answers are incorrect.			√
8. Teacher uses positive remarks during teaching.	√		
Other noticeable behaviour			
9. Teacher enjoys being with learners.	√		
10. Learners are lively and enjoy the lesson	√		

It is clear from Table 5.8 that Participant 4 had a consistent behaviour throughout the lesson. Apart from having good command of the content knowledge, Participant 4 is consistent in motivating learners by using positive remarks while teaching. The educator together with learners enjoyed the lesson.

5.5.4.3. Interpretation of lesson observation for Participant 4

In an interview, the participant did not talk much about the beliefs she has about mathematics, as it is evident from the interview codes in the table above. She indicated the importance of using visual aids in teaching that learners need to be taught from simple to difficult using visual aids. She even gave the example of sharing fruit with siblings at home. During observations, the participant taught the topic of probability, using teaching aids. Learners were taught in a mathematics laboratory, where they were seated in groups. Learners were free and they even called some of the teaching aids used by the teacher in their correct names, to show that they know them and that it was not the first time they saw the teaching aids.

Learners were seated in groups and after being taught they were given a group activity. Most of the learners got correct answers in the task. The educator's responses in an interview (beliefs) corresponded well with what she did in the classroom (classroom practice). Actually, the beliefs were more enacted than merely being said. During teaching, some of the beliefs that were not mentioned in the interview such as encouraging the use of study groups and repetition were observed in practice. On this belief the researcher noted that there was a relationship between the participant's belief and her actions in the classroom, and the belief influenced classroom practice.

During observation, the participant taught the topic of probability well, step-by-step using visual aids. Learners were lively and participated willingly. Seemingly, they were used to being taught with visual aids and they were assisting the teacher with distribution. A healthy and warm relationship was observed between the educator and the learners. The class was tension free.

Participant 4 also indicated that mathematics needs learners who can think quickly and are able to work with numbers. According to Participant 4, if learners cannot work with numbers and cannot think quickly, then they cannot do mathematics. Unfortunately, in primary schools all learners do the same subjects from Grade 4 up to Grade 6, with mathematics being included.

Participant 4 also believes that specialised help from psychologists and educational therapist is required for learners with learning barriers because educators have a lot of work to do, and besides, they are not the right people to do interventions as they do not have proper training for that. She also indicated that assistant teachers should be hired to assist learners with homework after school. The interesting thing is that unlike Participant 2, Participant 4 acknowledges that parents are not the right people to assist learners with school work and she believes that it should be assistant teachers.

During observations, the participant was so engaged with learners, explaining and showing them what to do in the activity. No time was reserved for learners with barriers towards the end of the lesson. The educator was time conscious, helping learners in a group and then moving to another group, she did not stay long in one group. This indicated that she was practising what she mentioned in the interview when she said that learners with barriers should get specialised help. When the researcher asked about the actions that she takes for these learners, she clearly indicated to her that the department should hire specialists for that

because time does not allow. In this way, the participant's actions in the classroom affirm what she said in an interview.

Table 5.9: Juxtaposed codes for Participant 4

Interview codes	Meaning of codes	Observation codes	Meaning of codes
UOTA	Use of teaching aids	TCSS	Teaching concepts step-by-step
MT	Mathematical thinking	TR	Teacher reflection
SPN	Specialised help required	CFLU	Concern for lack of understanding
TTMO	Maths teachers to teach maths only	ITE	Independent thinking encouraged
AEN	Assistant educators required	RPTN	Repetition
		PR	Positive remarks
		LEJY	Learners enjoy the lesson
		UOTA	Use of teaching aids
		LP	Lively participation

5.5.4.4. Summary of Participant's 4 beliefs

Table 5.9 is a brief summary, which shows the beliefs which Participant 4 mentioned during interview and how she conducted the lesson based on her beliefs. It also shows that there is limited contradiction of beliefs. For example, she indicated the importance of using teaching aids during interview and in her lesson presentation teaching aids were used. As a result it can be concluded that the beliefs she mentioned during interview were affirmed in lesson observations.

5.5.5. Summary for lesson observations of the three participants: P₁, P₂ & P₄

From the juxtaposed beliefs of the participants, it is clear that educators hold beliefs that are contradictory to one another. Participants 1 and 2 did not practise what they said they believe. There was none (for P₂) or a limited use of teaching aids (for P₁) during teaching, and no study groups were used by both participants. Although there was similarity of beliefs between P₁ and P₄, P₄ did not demonstrate a contradiction in her beliefs during teaching. P₁ and P₂ demonstrated contradictions. According to Smith (2014), when educators have beliefs that are contradicting, it shows that the clusters of their beliefs are in a weak relationship or their beliefs are not related at all.

5.6. Phase 3: Verification of data collected from interviews

The interview transcripts were taken to participants for member checking. The researcher requested the participants to take the interview transcripts home to check if they were not misrepresented. No changes were made to the transcripts. Participants agreed that what was written is what they said in interviews.

In the section that follows, the researcher presents a discussion of data obtained from mark sheets that were submitted to her by educator participants.

5.7. Phase 4: Document or mark sheet analysis

The mark sheets from the educators participating in the study were analysed in order to verify if indeed the schools were underperforming in mathematics. These mark sheets were used to record learners' in all the terms. Mark sheet 1 belongs to participant 1, mark sheet 2 belongs to participant 2, and mark sheet 4 is for participant 4. Participant 3 was only interviewed and never observed, because every time he postponed, until the examinations started. As a result there is no mark sheet for him and also no observation data was obtained for him.

The mark sheets were discussed with special reference to the overall pass percentage of the learners, the class average percent and the Area office target of 50% set as the pass percentage for schools in mathematics. This 50% target has been discussed in Chapter 3 under contextual background of the study. Mark sheets are numbered according to the numbering of participants.

5.7.1. Mark sheet 1 for participant 1

Mark sheet 1 contained 70 learners who were divided into two classes of 35 learners each. When the researcher scrutinised the mark sheet, she found that out of 70 learners, 29 passed with 50% and above. This number converts to an average pass percentage of 42, 6%. This mark was used by the area office in determining whether schools were trapped or not. Therefore, participant 1's school was trapped because their average pass percentage is below the 50% benchmark set by the area office. However, the researcher also noticed that there were 19 learners who passed with a mark between 40 and 49% who were not counted in the average pass percentage of 42, 6%. The percentage of these learners who were not counted makes 27%. If these learners were counted, the average pass percentage of the school would have been 70, 6%. This implies that the area office does not count 40% as a pass for mathematics, or they only consider quality results starting with 50%.

The other fact that the researcher noted from the mark sheet is that learners perform well in School Based Assessment (SBA), which is set and administered by individual educators within their respective schools. The researcher realised that two learners were withdrawn and they were, as a result no longer 70, and only 17 learners out of 68 passed the June examination, which makes the average pass percentage to be 25%. From the 17 learners who passed the June examination, only 6 passed with 50% and above. The pass percentage of 8,8% is the one which is considered by the area office. This implies that the North West Provincial Assessment (NWPA) examination is failed by most of the learners and in order to progress to the next grade they will be boosted by the school based assessment to pass mathematics. The question is, if learners can pass the SBA so well, what is it that makes them fail the NWPA examinations so badly? This is a question that may be addressed in further studies as this study only focused on whether learners are indeed failing mathematics, and whether the beliefs of educators have any influence on learner performance.

The findings that were mentioned above affirm that the school in which participant 1 is teaching is indeed trapped and underperforming in mathematics according to the standards set by the area office. Secondly, the school does not perform well in the NWPA examinations but only pass the SBA. There are many reasons that can be cited as the cause for this discrepancy of performance between the NWPA and the SBA, for example, the standard of the question papers set by the school for the SBA, the level of in-school monitoring, the completion of the (ATP), which is the syllabus. The research questions in this study do not give room for these matters to be looked into; as a result they can be addressed in further research studies.

5.7.2. Mark sheet 2 for participant 2

Mark sheet 2 contains 49 learners, which is only one class. The performance of learners in the School Based Assessment (SBA) is good. Out of 49 learners, 28 passed with a mark ranging between 50 and more than 90%. This number converts to 57, 1% of quality results, that is, no learner in this range obtained below 50%. However, there again learners who were not counted in the 57, 1% pass rate. These learners constituted 26, 5% and they were only 13. The overall pass percentage including learners ranging between 40 and 49% is 83, 7%. The average pass percentage of the class is 55, 8%. All these percentages are only for the SBA. In the June examinations which were set by the provincial department of education, the North West Provincial Assessment (NWPA), learners did not perform well. Only 15 learners managed to pass the June examination. The percentage of all the learners who passed is 30, 6%. Out of the 15 learners who passed, only 8 achieved a mark of 50% and above. This is an

indication that learners do well in the SBA but perform badly in the NWPA examinations in mathematics.

5.7.3 Mark sheet 3

Mark sheets were submitted to the researcher during lesson observations. Participant 3 did not agree to be observed and did not submit his mark sheet.

5.7.4. Mark sheet 4 for participant 4

Mark sheet 4 consisted of 42 Grade 6 learners. In this mark sheet, 28 learners achieved between 50 and 80% in the SBA. This number converts to 66, 7% of quality results earmarked by the area office. However, 8 learners who achieved between 40 and 49% were not counted in the average pass percentage. The number of learners not counted makes 19%, which could have made an overall pass percentage of 85,7%. The overall pass percentage in the mark sheet is 85, 7% whereas the average pass percentage is 54%. The pass percentage of learners in the NWPA was 33, 3%. The school is not trapped for the year 2017 since the average pass percentage is 54%, which is now more than the 50% benchmark set by the area office. Nevertheless, the performance of learners in the NWPA examinations of 33, 3% is still below the 50% set by the area office. This is also an indication that learners do not perform well in the examinations set outside the school. The school's 66, 7% is twice that of the NWPA examinations.

5.7.5. Summary of data collected from mark sheets

From the mark sheets that were received from schools, learners' marks were recorded from term 1 up to term 3 for the year 2016. The marks were recorded from the tasks that learners wrote, for example: tests; assignments and projects. The tasks were prepared by individual educators in schools (SBA). Learners performed well in assessment tasks that were prepared by educators in their respective schools (SBA). In all the terms, learners did well, with only a few number of learners failing.

In school 1, 12 learners out of 66 failed mathematics in term 3, which gives a pass percentage of 81,8%. In school 2, 8 learners out of 50 failed, which gives a pass percentage of 84%, and 7 learners out of 49 failed in term 3. This gives a pass percentage of 85, 7%.

School 4 was the highest in learner performance in all the terms, out of 42 learners only 4 failed mathematics in term1, with a pass percentage of 90, 4%. In term 2 again the pass percentage was 90, 4% with only 4 learners failing. Term3 experienced a drop from 90, 4% to

85,7%. The overall pass percentage for school 4 in the June examinations (NWPA) with the SBA included was 69, 1% including all learners who scored from 40% and above.

In overall, in all the schools, learners perform well in the SBA, but the performance drops when the SBA is added to the June examination. Nevertheless, learner performance for school 4 is still the best when compared to the learner performance in the other two schools.

5.8. Conclusion based on the four phases of data collection

From the data analysed in this chapter, it is evident that educators interact differently with learners in their different environments, according to their beliefs even though they taught the same mathematical content from the CAPS document (for example fractions). Learners also respond differently to the instruction they receive from their educators. This is as a result of the beliefs educators have about mathematics, the teaching of mathematics and the learners they teach mathematics. The behaviour which the learners exhibit after being taught is what causes them to make meaning of the instruction presented to them by their educators. What the study found in this chapter is that educators perform their duties in a different way and there is no cut and dried rule that they should follow when teaching. In other words, when they are in their classes, they are the masters in their own right. They can choose (or not choose) appropriate teaching methods and strategies as well as teaching aids suitable for the lesson, according to their beliefs. This is what brings the differences in the educators' performances in the classrooms, which also have a lasting effect on the learners' performance as well. The results of the data analysis from participants' interviews and observations show that there are similarities of beliefs for Participant 1 and 4 and also between Participant 2 and 3.

The next chapter provides a discussion of these similarities and what could be the reason for this.

CHAPTER 6: DISCUSSION OF THE FINDINGS

6.1. Introduction

This chapter provides a discussion of the research findings of the data gathered from the interviews, observations and mark sheets received from educators. The researcher begins the discussion with the findings from interviews held with educators, which informed her of the beliefs they held. The discussion from interviews is done concurrently with that from lesson observations. This is done in order to compare the beliefs that educators mentioned when they were interviewed, with the beliefs that were manifested during lesson observations when they were teaching. Beliefs from interviews and lesson observations were put in juxtaposition in Chapter 5 of data presentation. This helped the researcher to identify similarities and differences that existed in the participants' beliefs, and to check for contradictions if there were any. The answers to the research questions are then provided. Thereafter, the researcher explains how her study is related to the conceptual framework designed, and also how the study relates to the research design.

6.2. Findings based on data collected

After having compared all data collected from interviews; observations and mark sheets, the researcher found that all the educators sampled for the study were suitable to teach mathematics in primary school in respect of their qualifications. The UDE (P) and PTD were the diplomas done by educators who wanted to teach in primary schools. Educators who completed a secondary educators' diploma, UDE (S) have done mathematics as a major subject in college, as a result they can also teach mathematics in primary school. Educators sampled have more than five years in teaching mathematics in Grade 6, see Table 6.1.

Table 6.1: Summary of educators' qualifications and teaching experience

Participants	Gender	Qualifications	Teaching Experience	Type of school
Participant 1	Male	UDE (mathematics), B-Tech, ACE (management)	16yrs	deeply rural
Participant 2	Female	UDE (P), B.A. Diploma in management	26yrs	moderately rural
Participant 3	Male	PTD, ACE (management), B.Ed. (Hons)	30yrs	deeply rural
Participant 4	Female	UDE(S), ACE (Mathematics & Computer technology).	28yrs	moderately rural

Having analysed data from interviews with all participants, the researcher found that Participant 1 and Participant 4 have similar beliefs. Both of them did not regard mathematics as a difficult subject, rather, they opted for using different teaching aids and approaches. Participant 1 valued parental involvement in home works while Participant 4 was against it. The reason for this could be that they have done UDE (S) which makes them qualified to teach mathematics in secondary school, because they did mathematics as a major subject. Although the researcher's study did not focus on qualifications and experience, it could be deduced that educators who are more qualified to teach mathematics have positive beliefs about mathematics and mathematics teaching. However, when comparing the results of lesson observation for Participant 1 and 4, the researcher realised that some of Participant's 1 learners were not involved in the lesson but he did not notice it. Even the time management during the lesson for Participant 1 was poor as compared to that of Participant 4. When the researcher compared their qualifications in mathematics she found that they were the same, but Participant 4 was more experienced than Participant 1, with 28yrs of experienced as opposed to 16yrs of Participant 1. It is clear from the findings that educators who have more experience (with same qualifications from both teachers) perform better in classroom teaching than educators who have less experience, and have positive beliefs, which assist them in providing solutions to problems in teaching.

The researcher also found that Participant 2 and 3 have similar qualifications; both completed a diploma in teaching primary school education. They also have similar beliefs, for example, they believe that mathematics is difficult; more time is required to teach; the PPM should be revised and pass requirements should be changed. During the lesson observations, it was evident that both participants did not attempt to provide solutions by themselves, but they sought solutions from the departmental officials. In this way, one might question their level of pedagogic commitment because of their lack of providing alternative solutions to the problems they face while teaching. Nevertheless, Participant's 2 lesson observation results showed that she never becomes hopeless even when learners do not understand, as compared to Participant 1 who said, "You see the type of learners we are teaching in our schools?"

Participant 3 has the most teaching experience than all the three participants (30yrs), however, he did not avail himself for lesson observations and his beliefs do not provide alternative solutions but expects the department of education to provide everything. This differs with Participant 4 who has 28yrs experience. This indicates that experience needs to be coupled with the necessary qualifications to achieve better results.

As discussed under section 6.2, it is evident that educators have different beliefs, which are influenced by certain factors. Some of the factors that come into play are the level of academic training educators received and their teaching experience. These factors were discussed in the section of literature review in Chapter 2 and also presented in Figure 3.1 in Chapter 3. The findings discussed in section 6.2 will form the basis of providing answers to the research questions asked in the study.

6.3. Answering the research questions

The aim of gathering data was to answer the two main research questions which are;

1. Which beliefs are held by mathematics educators teaching Grade 6 in primary schools?
2. How do these beliefs influence educators' classroom practice?

6.3.1. Research question 1: Beliefs held by mathematics educators teaching Grade 6 in primary school

From the interviews and observations done, it was evident that educators have differing beliefs about mathematics; mathematics teaching and learners who do mathematics. All the educators who were interviewed indicated that they have beliefs about mathematics teaching. After interviewing all the participants, and having coded all the data collected, the researcher then classified the educators' beliefs into four categories, as follows, like Polly et al (2013):

- ❖ Beliefs about mathematics
- ❖ Beliefs about mathematics teaching
- ❖ Beliefs about mathematics learning
- ❖ Beliefs about learners who do mathematics

In the next section, I present a discussion of the beliefs held by educators as mentioned in interviews and also observed in classrooms as summarised according to the categories listed in 6.3.1 above.

6.3.1.1. Beliefs about mathematics

The following is a combination of all beliefs mentioned by educators during interviews

- ❖ Mathematics is a difficult subject.
- ❖ Mathematics needs understanding and not rote learning.

- ❖ Mathematics consists of a set of rules or procedures so it must be taught step-by-step.
- ❖ Mathematics requires practice in order to enhance recall.
- ❖ More time is required to teach.

6.3.1.2. Beliefs about mathematics teaching

The beliefs about mathematics teaching that are listed below is a combination of what the educators said during interviews and how they were observed during their classroom practice.

- ❖ When teaching mathematics, a step-by-step procedure should be followed since mathematics consists of a set of rules and procedures.
- ❖ Teaching aids or manipulatives should be used when teaching mathematics to make it easy for learners to understand.
- ❖ Learners should be encouraged to form study groups, and educators should use bright learners to help those who do not understand.

6.3.1.3. Beliefs about learning mathematics

The beliefs listed in this sub-section are those that were mentioned by the educators during interviews.

- ❖ Learners should always practice concepts taught in class in order to remember them.
- ❖ Parents should help learners with home works at home.
- ❖ Specialised help should be given to learners with barriers.
- ❖ Learners should learn by seeing and doing.

6.3.1.4. Beliefs about learners doing mathematics

In this section, all the beliefs listed are those that educators mentioned during interviews.

- ❖ Learners who do mathematics should be able to think quickly and be able to work with numbers.
- ❖ They should have a mathematical mind.
- ❖ Learners should be willing to go extra mile, and not wait for the educator, by practising on their own.

The beliefs mentioned in the four categories explain the nature of mathematics and how it should be taught, especially beliefs about the teaching of mathematics, with one belief leading to the other, although they may not be the only beliefs that can be identified. However, the belief that mathematics is a difficult subject can be argued, when it is compared with the other subjects. The researcher would rather use the word demanding instead of ‘difficult’. If we say

mathematics is a demanding subject, this statement encompasses most of the beliefs in all categories. For example, the educator should prepare for the lesson, check which teaching aids are available and appropriate for the lesson, how the content is to be taught, and which assessment activities should be given to learners. On the other hand, learners should pay attention to the educator's instructional activities, do and complete the work given, take part in the lesson by asking questions and answering the educator's questions. These activities demand that all parties involved in instructional practice should play their role in order to make teaching and learning effective. Parents are also stakeholders whom educators believe that they have to play a significant role by extending the educator's activities at home, by helping learners with home works. Nevertheless, not all educators have this belief, and those who hold it support it strongly.

6.3.2. Research question 2: The influence of educators' beliefs on their classroom practice

Most of the research done on beliefs of educators for example the studies of Zakaria and Maat (2012), Polly, McGee, Wang, Lambert, Pugalee & Johnson (2013), and Philipp (2010), show that beliefs have a crucial role to play and determine the daily classroom activities of the educator. When juxtaposing data gathered from interviews with that obtained from lesson observations, the researcher realised that in some instances there was an affirmation of what was said by educators during interviews, and in other instances there was a contradiction. She found that most of the beliefs that educators have about mathematics can be classified as central beliefs, as Philipp (2010) found, because most of the beliefs that were mentioned during interviews were enacted in the classroom during teaching.

Beliefs that affect educators' classroom practice more directly are beliefs about mathematics and mathematics teaching. Below is a discussion of how beliefs held by educators during interviews were related to their behaviour in the classroom, to show the effect or non-effect of those beliefs on classroom practice.

6.3.2.1. Teaching content using teaching aids or manipulatives

All educators interviewed believe that mathematics is difficult and should be taught using teaching aids or real objects in order to enhance understanding. Educators support this view by saying that learners in primary school are still small and they learn best by seeing and touching. The researcher agrees with educators on this view; however she noted that only one educator could use teaching aids effectively during the lesson. Other educators relied on their

experience to teach, without using any other technique to simplify concepts as well to come to the level of the learners. This was also caused by the lack of preparation that one educator confessed. If the lesson is well prepared for before going to class, educators would have thought of utilising available resources in order to achieve the outcomes of the lesson. These resources include simple flash cards that can be made using charts, cardboards, and papers. This demonstrates a contradiction between the educators' belief and classroom practice. Teaching mathematics using manipulatives especially in primary school is in line with the constructivist theory as learners will construct meaning of concepts taught so as to understand these concepts.

6.3.2.2. Teaching concept step-by-step:

All educators who were observed believe that mathematics consists of a set of rules and procedures, and they therefore taught concepts step-by-step. In this case, there is an affirmation of the belief. In other words, the educators' belief affected their classroom positively, to teach learners to understand concepts. This was evident in the time they spent to teach learners. Educators took most of the time teaching than assessing learners. However, the researcher finds this to be a weakness on the side of educators, because teaching does not necessarily mean that the educator should be the one who does all the talking while learners remain passive. Teaching involves far more than that, it should include learner participation, since learner participation is one of the prerequisites of effective learning and it will indicate to the educator whether learners follow the educator's instructional practice, and whether the educator should change her or his teaching techniques. It is therefore through feedback from learners that the educator can attest that learning has taken place. Teaching in this way indicated that educators still use traditional ways of teaching which is not in line with the constructivist approach.

6.3.2.3. Belief that different teaching strategies should be used

Only one educator holds this belief that different strategies be used to teach when learners do not understand a topic. One of the strategies that can be used is cooperative learning by grouping learners, according to their abilities so that intelligent learners can help weaker ones. The educator who mentioned this belief during the interview did not use this strategy during teaching, even though he showed to be supporting the idea. This shows a contradiction between what the educator believes and what he practises. This is in agreement with Nisbet

and Warren (2000), when they assert that what educators believe does not necessarily reflect their classroom practice.

6.3.2.4. Belief that mathematics is a difficult subject

When educators mentioned in interviews that mathematics is a difficult subject, the researcher expected that during lesson observations she would observe them teaching in a manner that teaching would be simplified in order for learners to understand and enjoy the lesson. In other words it would have been better if educators could have devised some strategies to help learners understand concepts easier. Among other things that the researcher expected was the use of teaching aids available at their respective schools, or at least bring to class real objects, use fraction walls for the topic of adding and subtracting fractions, during teaching. Only one educator out of the three that were observed used manipulatives effectively.

The researcher also expected to see how educators use learners' previous knowledge, gathered from home in teaching as a link and basis for teaching the new topic, because educators indicated the importance of parental involvement in learners' academic work. Only the educator who used manipulatives effectively could also link the learners' prior knowledge to the new topic. All these things that the researcher expected based on data gathered from interviews did not happen in respect of the other two participants observed. The question that the researcher asked herself as a researcher was that, what is the role of the educator, seeing that mathematics is difficult? One participant mentioned that mathematics is even difficult for educators. The researcher assumes that the educator has to prepare thoroughly before going to class. If preparation can be done honestly, then the particular educator would make sure that she or he understands the topic before presenting it in class.

6.3.2.5. Belief that more practice is required

Educators also believe that learners who do mathematics should be able to practice on their own, in the absence of the educator. It is argued that this will help them remember concepts learned. Learners in primary school still require a lot of supervision to ensure that learning takes place. The researcher believes that educators have an obligation to give learners work for assessment, and supervise them to do the work. Extra work can be given for enrichment as an extension of work done in class. This work can be done in class or taken to be completed at home. If the work is done in class, supervision is required. Participant 1 mentioned that parents should assist learners with practice in the form of homework, while participant 4 is against this view, arguing that some of the learners' parents themselves do not understand the

content learners are doing. As a result participant 4 suggested that the department of education should employ assistant educators who can assist learners with homework before going home.

6.3.2.6. Belief that repetition of concepts or drill work should be done

The researcher observed that educators hold repetition as one of their beliefs. One participant also mentioned in an interview that she has to repeat what she teaches because learners take time to understand. The participants' actions affirmed this belief because they taught for a long time. When learners did not answer educators' oral questions, the educators repeated the steps and demonstrated more examples. However, repetition was only done orally by the educators during the teaching process. There was no evidence of repetition in the learners' informal books.

According to the mathematics ATP drafted from the CAPS document, revision is allocated time. This implies that it is mandatory for educators to do drill work of concepts in the form of revision. Since primary school learners learn best by doing, it is essential that revision is done in the form of written work. This will not only ensure learner involvement, but the educator as well will be able to distinguish learners who understand from those who do not and still require assistance of some kind. I find the absence of repetition in the learners' books to be a contradiction to the belief that more practice is required by learners. Repetition should be one of the topics and not necessarily one of the problems that were previously experienced by learners. Rather it should be different problems based on the same topic so that learners do not memorise, but can be able to solve to show that they understand.

6.3.2.7. Belief that learners should use study groups

Educators also believe that learners should be encouraged to use study groups, in which bright learners are given the opportunity to assist the weaker ones. This technique also requires a lot from the educator with regard to planning. When study groups are used in class, educators should give learners work to tackle as a group. These groups need to be monitored to check if they really do exactly the work that has been allocated to them. Since this study is for primary school educators, learners in these schools need supervision and cannot be left to work in the absence of an educator.

Groups should also be monitored for discipline because the bright learner cannot take the place of the educator in matters relating to discipline. In other words the educator should be

present when the groups work to ensure that learning takes place. Working in groups is one of the strategies used in cooperative learning and is also constructivist in nature. If the technique of study groups is used efficiently, it can yield good results. However, only one participant used this strategy of group work during teaching, even though all educators indicated the importance of group work.

6.3.2.8. Belief that the classroom should be print-rich

Only one participant believes that a classroom should be print-rich. The educator taught in a mathematics laboratory, which was indeed print-rich, on the walls there were posters and pictures explaining concepts related to mathematics laboratory for example, the palm of a hand on which it was written five words, namely, interest, immitate (which is not an English word but formed from for imitate and initiate), investigate, interact and improve. There were also posters showing conversion of time starting with seconds and ending up in days.

It is sufficient to say that the educator's actions are an affirmation of his belief. However, the words printed on the walls were not directly related to mathematics and the Grade 6 class that was taught because of their level of difficulty. However, the poster showing conversion of time was on the level of Grade 6 learners and could be used in mathematics lessons. The print did not contribute to the learners' understanding of mathematical concepts. Some learners were still not paying attention even in a print-rich classroom because they also could not relate what was written on the walls to the lesson presented. Constructivist theory requires that classrooms be print-rich and encourage learners to think even when they are not engaged in formal instruction (Adam 2012). When learners see posters and pictures on walls, they are challenged to read and think about what they see.

6.3.2.9. Belief on educator reflection

One of the crucial behaviours to be observed during teaching was educator's reflection. The aim of doing this was to check if educators were able to reflect on their own teaching with a view to improve their teaching practice. It is important for educators to reflect constantly on their teaching practices because each year they come across different learners and each class is different from the other and so are the learners in a class. If educators reflect on their own teaching, they will objectively evaluate their teaching practices and come up with different teaching techniques or methods, or even change their assessment techniques.

Participant 1 indicated some form of reflection during interview when he said that when learners do not perform well, the educator is challenged to come up with different teaching strategies to improve the situation, however, the different strategies mentioned were not used. Instead the educator demonstrated some form of hopelessness when he said, “do you see the types of learners we are teaching”? Educators demonstrated some form of reflection during teaching when they committed calculation mistakes. When they were corrected by learners they appreciated and commented positively, by saying that it showed that learners have paid attention. It was not easy to observe educator reflection during teaching since lesson observations were done only once in each school and no lesson plans were requested from the participants to check for the section of educator reflection.

6.3.2.10. Belief that specialised help is required for learners with barriers

Educators mentioned that more time is required to teach mathematics. This view was evident in the educators’ teaching practices when they repeated concepts. This demonstrated that learners are used to the fact that educators repeat while they teach. Due to the repetition and emphasis of concepts and steps that were taken during teaching, it is evident that educators do not provide time for doing interventions. One participant clearly mentioned that it is not possible for the educators to do intervention since the time that is available for teaching is not enough. If time allocated to teach mathematics is seen to be not enough, then asking educators to do intervention for learners with barriers becomes impossible. One educator mentioned that specialised help is required to help learners with barriers because educators do not have time and the necessary knowledge to do intervention. The educators’ actions in class affirmed what they mentioned during interviews. This belief can then be termed central, strongly held and not easy to change (Philipp 2010 & Liljedahl 2007).

Taking a long time to teach during the lesson is not in line with the constructivist theory. Learners did not take part in their own learning and they were passive recipients of what the educators said. During the lesson, Participant 2 asked questions to involve learners. This cannot guarantee optimum learner engagement because most of the answers were provided by same learners. When learners become involved only at the end of the lesson, they would forget easily what has been taught.

6.3.2.11. Belief that assistant educators be employed

Only one educator indicated that assistant educators be employed to assist learners with their homework before they go home. This belief was motivated by the fact that educators do not

have time to supervise learners when doing homework. Participant 1 also indicated that learners do not do their homework when given. Participant 4 cited the reason that parents do not understand the work given to learners, so it is not helping to give learners work to do at home.

There were also beliefs that were mentioned by participants, which are related to policy. These are:

6.3.2.12. Beliefs that are policy related

- More time is required to teach mathematics (number of hours allocated to teach).
- The post provisioning model (PPM) should be reconsidered.
- Specialised help is required for learners with barriers.
- Assistant educators should be employed to assist learners with homework.
- Pass requirements should be revised.
- Mathematics educators should teach mathematics only

Educators' belief that more time should be allocated to mathematics requires policy makers to amend policy, which is the CAPS in order to increase the number of hours allocated to teach mathematics. This change cannot happen overnight, and requires recommendations and motivations that will convince policy makers of this change. On the other hand, the PPM for allocating number of educators in schools, and employment of specialist to offer specialised help to learners with barriers, have huge financial implications to the department of education, and also requires the department of education to make provision in the budget. It also requires the department to assess the situation and make comparisons between primary and secondary schools because these schools have different needs and also function differently. These matters need all stakeholders to be involved before they can be resolved, which can take a long time.

Educators did not make any provision of time to assist learners who struggle in mathematics. This indicates that their actions and behaviour in the classroom support their voice. These beliefs that are policy related are used by educators as weapons, used to defend themselves against unfavourable conditions (Liljedahl 2007). When the departmental officials visit schools and question their behaviours and actions educators will then use these reasons always when they are confronted regarding issues around learner performance.

For pass requirements to be changed, also requires consultation with stakeholders in education. Learners, who progress due to age cohort, are expected to be supported in the next grade, just like all the learners who are progressed for different reasons. The department of education supports progression of learners, stating that when these learners can get the necessary support, they can do well in the grades they are progressed to. However, if educators are unable to help learners with barriers then it can be guaranteed that progressed learners in primary school will not receive the necessary support in the next grade.

For mathematics educators to teach mathematics only can be a matter that can be arranged in the school when doing allocation and this cannot mean that mathematics educators will teach lesser periods. It could mean for example, that a mathematics educator can teach Grade 4 to Grade 6 mathematics, and it would also depend on the number of classes in a grade. Apart from that it would cause divisions and conflicts among educators.

6.3.3. The extent on which beliefs can change

Based on the literature used in this study, beliefs are not held in isolation but in clusters (Schlöglmann & Moab 2009, Adam 2012, and Liljedahl 2007). Clustering of beliefs makes it difficult to change them. However, Handal (2003) contends that when there is a weak relationship of beliefs in their clusters, it is possible to change them. A weak relationship in belief clusters causes educators to have beliefs that contradict one another. From the lesson observations done, I realised that educators' beliefs are contradictory, for example; they believe in the use of teaching aids but they do not use them during their teaching; they believe in encouraging use of study groups but they do not use grouping of learners when they teach. The fact that educators' beliefs are contradictory is an indication that their beliefs are not related. This provides a possibility of changing their beliefs and implies that only those beliefs that are in weak relationship with one another can be changed.

Smith (2014) also maintains that educators' beliefs can change and this change depends on their ability and readiness to make self-reflection of their instructional practices. Educators observed in my study (P₁ and P₄) demonstrated some form of self-reflection. This was evident when they committed some calculation errors and they were corrected by the learners. Educators accepted corrections from learners. The fact that educators were ready to accept their mistakes is an indication that they can do self-reflection. They only need to be trained on how to do reflection based on their instructional practises. In this way some beliefs that are not strongly held can be changed.

6.3.4. Summary from the two research-questions

The answers provided for the two research questions, show that educators have many different beliefs. These beliefs sometimes contradict, showing that they are not related and can be changed. The beliefs that can change are less strongly held, and require educators to make self-reflection of their instructional practices (which means accepting that they have beliefs that affect learner performance in a negative way). Educators also have beliefs that are policy related (the PPM, providing assistant educators and specialists for learners who experience learning difficulties) and require consultation with the necessary stakeholders in education in order to change them. It is difficult to change these beliefs because changing them will have serious financial implications on the department of education. In other words, provincial budget in the department should be revised to accommodate the changes.

6.4. The possibility of changing educators' beliefs to enhance effective teaching of mathematics?

The literature consulted reveals that for educators' beliefs to change, they should be dealt with as early as when educators are still trainees in tertiary institutions, before they enter the teaching fraternity. This is caused by the fact that beliefs are established long before they become educators. Tertiary institutions should identify the types of beliefs held by educator trainees (Adam 2012). For in-service educators, content and pedagogic workshops should be conducted on regular basis to equip educators with mathematical knowledge they lack. The other way of attempting to change educators' beliefs is by following four step program provided by Adam (2012), starting with educators identifying the types of beliefs they have; checking whether their instructional practices are contradictory; trying new practices and reflecting on their new practices in order to rectify any mal-practices that might be there. In this way, educators will improve their confidence in teaching the subject and also influence the manner in which they deliver the subject matter to learners. My study revealed that educators can identify the types of beliefs they have. This was revealed when they answered interview questions. Educators' reflection is not based on their instructional practices, but on petty mistakes that are committed in calculations. The inability to reflect on their teaching practices calls for officials in education to train educators how self-reflection should be done.

6.5. Reflections

The section that follows is a discussion of how the conceptual framework and methodology used were incorporated in the findings of the study.

6.5.1. The application of the constructivist theory in the study

According to Dennis Barbara (2013), conversation is a mode of knowing, that enables human beings who converse with one another to understand themselves as well as others through speaking. Human beings interpret one another's conversations and give them meaning based on the context in which these conversations take place. In this study, the researcher has interpreted interviews that were held with educators and assigned meanings through coding to the conversations the researcher had with them. The researcher was able to construct meaning from lesson observations by relating data collected from interviews to that collected from observations. In this way the researcher was able to discern an understanding of the beliefs held by mathematics educators and how these beliefs affected their classroom practice.

The researcher found that in lesson observations, educators spent a long time teaching while learners were listening. This is not in line with the constructivist theory. It is a traditional way of teaching, which does not recognise the capability of the learner and therefore encourages rote learning. When the educator speaks a lot during the lesson, learners are unable to apply their thinking. They are compelled to take everything that is said by the educator. Educators did not give learners the opportunity to be actively involved in the lesson by applying their thinking. This shows that the educators' actions in class were no in line with the constructivist theory. When learners are not actively involved in their learning, it is difficult for them to understand and to remember what was taught. This contributes to poor learner performance in mathematics.

6.5.2. The relationship between the findings and the Conceptual framework

The Conceptual framework in this study is based on interpretivism; the constructivist theory; and the way beliefs of educators are associated with their SCK, PCK and their influence on learner performance. The constructivist theory deals with the process of constructing knowledge, through interaction with fellow human beings (Creswell 2003). Without this interaction, it would be virtually impossible for an individual to understand what prompted other individuals to act the way they do. In this study, constructivist theory was used in a dual mode. Firstly, it was used by the researcher to guide the study in order to understand the beliefs of the participants by interviewing them, and also to understand their actions as well as their reasons for acting the way they did in lesson observations. Secondly, it was used to evaluate the learners' responses during lesson observations, as a measure to determine whether the learners understand what they have been taught. When learners understand the lesson, it reflects positively on their performance in mathematics. The researcher did not

observe much concerning learners' understanding since educators asked oral questions most of the time, where few learners repeatedly responded to questions asked. Educators also could not measure their learners' understanding, since learners were unable to finish the tasks given. If educators continue with this behaviour, they would only realise that learners do not understand when they write formal tasks and examinations.

The topic of the researcher's study is Educators' beliefs about effective classroom practice in Grade 6. All the participants who took part in the study were asked an open ended question concerning the beliefs they have about mathematics. The researcher did this in order to give them an opportunity to expand when they express their beliefs. The participants explained their beliefs which the researcher then classified into four categories which are in line with those mentioned by Polly et al (2003). The researcher found that educators have beliefs that did not fall in these four categories. Therefore, the fifth category of beliefs was added, which is beliefs policy matters related to mathematics teaching. These categories are:

- Beliefs about mathematics.
- Beliefs about the teaching of mathematics.
- Beliefs about the learning of mathematics.
- Beliefs about the learners who do mathematics.
- Beliefs about policy matters related to mathematics teaching.

Participants were then observed in class in order to get an understanding of the relationship between their voice (interview) and their classroom practice (actions and behaviour). The researcher found that in some instances there was an affirmation between participants' voice and their actions, whereas in other instances there was a contradiction. The researcher learned that all participants taught concepts step-by-step to show learners procedures for problem-solving. For this belief there was an affirmation between voice and behaviour. Generally, participants did not use teaching aids, in the exception of one (Participant 4). It should be borne in mind that educators' beliefs do not emanate from the situation they face at a particular moment, but they come a long way even before they started teaching (Liljedahl 2007).

Observing participants teaching gave the researcher an understanding of how they embrace the teaching processes, strategies, methods related to classroom practice, with reference to their beliefs regarding these circumstances. The researcher found out that in many instances,

these participants used their beliefs as weapons that protect them against unfavourable conditions (Liljedahl 2007). Educators who did not use teaching aids cited reasons of lack of resources, and those who have resources could not use them effectively because they were already used and adapted to the environment of lack of resources. All educators interviewed believe that mathematics is a difficult subject. This is demonstrated by their reluctance in using teaching aids or improvising real objects in an attempt to simplify content for learners.

Participant 4 also mentioned that she cannot ask parents to help learners with homework since some parents do not even understand due to their poor educational background. The schools in which the study was conducted, are mostly rural, see table 10. This may explain the fact that some parents are unable to assist their children with homework. Participants indicated that mathematics requires people who can think quickly and have the ability to work with numbers. On the contrary, they indicated that it is important to do repetition or drill work because learners forget easily. It is very essential for educators to use teaching aids and manipulatives, even if they can improvise. This would be beneficial to learners for construction of knowledge, especially those who do not have an aptitude for mathematics and cannot think quickly.

In primary schools all learners do mathematics, regardless of whether they have a propensity and ability for mathematics or not. Educators should also understand the social background of their learners in order to teach them effectively and make them pass mathematics. Providing real objects or improvising teaching aids in cases where there are none, for example pictures that will be suitable and in line with learners' social background are important. When educators' beliefs contradict, it is a sign that their beliefs do not influence the PCK they have. In cases where there was an affirmation of beliefs in lesson observations, is an indication that educators' beliefs influence their PCK.

When relating the results of this study to the conceptual framework based on Figure 6.2, it was evident that educators had many different beliefs which are influenced by a number of factors. Figure 6.2 is a representation of how the five factors mentioned above affect educators' beliefs on the middle column and how that relates to the internal factors on the right column.

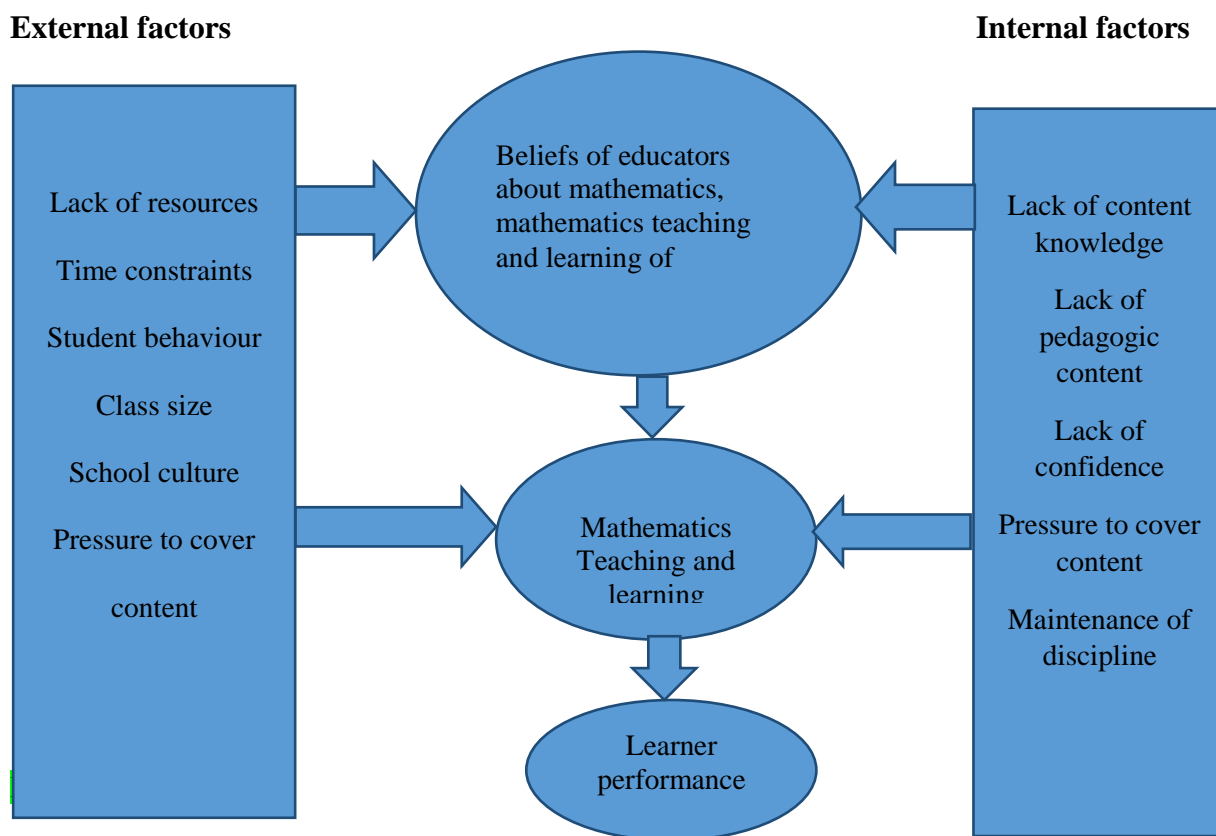


Figure 6.2: The influence of beliefs on learner performance (ADAPTED from Adam 2012)

Educators with negative beliefs were P2 and P3. This was demonstrated by the manner in which they conducted their lessons, not using teaching aids and also the problem of discipline in class. The two participants completed a primary educators' diploma and did not have mathematics as a major subject, (adequate SCK) whereas those who completed a diploma for teaching in secondary schools and have mathematics as a major subject (P₁ and P₄) have positive beliefs about mathematics teaching. However, among all the participants, it was only Participant 4 who displayed positive beliefs, have more experience in teaching, displayed no contradiction of beliefs during lesson observation and whose mark sheet reflected good learner performance in the SBA and in the June examination. This is a clear indication that adequate SCK influences the beliefs of educators, and beliefs influence the manner in which educators conduct themselves in the classrooms (instructional practice which is influenced by the PCK of educators) using resources that are available in the school. Although the impact of beliefs on learner performance cannot be directly determined, the PCK together with other factors like availability of resources and pressure to cover content have a direct influence on learner performance. The constructivist theory in this study helped the researcher to find the relationship that exists between educators' effective teaching and learner performance, and educators' teaching and their beliefs. There is no change in the way figure 6.2 is presented as

a theoretical framework in Chapter 3. Therefore, it can be concluded that the results of this study affirmed the conceptual framework

6.6. Reflections on the methodology

The research design of this study was the qualitative approach. This methodology deals with understanding how and why human beings interact with their environment the way they do, by seeking information from them by coming next to them (Creswell 2003). By observing the way people act in their environments, enables the observer to understand. Asking questions helps them to justify their actions. In this study, data was collected from participants through interviews, observations and primary data sources (mark sheets) which participants compiled in their respective schools. The researcher was able to analyse the data collected from all data collection instruments and to draw a conclusion which is credible and reliable, because more than one data collection instrument was used in the study. As a result, she can assert that the research design of her study was suitable for use because most of the information that she required in order to complete the study was available and supplied by the participants. However, there is no methodology that is complete on its own, and all of them have strengths and weaknesses (Creswell 2003). The weakness that the researcher encountered in her study about the qualitative approach (lesson observations) as used in this research is that of participants refusing to be observed, even though they agreed to participate in the research study. Therefore, a mixed method approach would have been more appropriate to use in order to compliment the research design used in the study.

6.7. Conclusion

This study enabled the researcher realise that educators of mathematics have different beliefs and these beliefs are influenced by many factors. The factors that emerged strongly in this study are educators' qualifications and experience, however, experience alone did not show positive beliefs. The researcher also learned that qualification in mathematics does not necessarily imply that an educator can perform well in class and produce better results. Educators can identify the types of beliefs they have, but they are not aware of how powerful their beliefs can be influential on their daily classroom practice. It is important that educators be given continuous support to help them reflect on their teaching in order to improve learner performance.

CHAPTER 7:

CONCLUSIONS AND RECOMMENDATIONS

The purpose of my study was to investigate how beliefs of educators can be changed if possible, to enhance effective classroom practice. In this section the researcher suggests recommendations to different practitioners in education (which are policy makers in provincial and national departments of education, subject education specialists as well as educators in schools), about how beliefs of educators can be influenced to enhance effective classroom practice.

7.1. Recommendations to policy makers

Educators make the largest group of education practitioners (Conrad & Serlin, 2011; Terrel, 2015). There are educators in primary schools, secondary schools and tertiary institutions. Besides these practitioners, there are also those in education departments such as Subject Education Specialists (SES), district officials and administrators. The latter mostly work with the formulation and monitoring of policies that guide the education system, for example, conditions of service for educators in respect of leave and working hours. Since educators constitute the largest group of practitioners in education, the district, provincial and national officials and administrators should consider and pay attention to their voice and take part in the process of changing their beliefs to improve the performance of learners in mathematics.

All educators who were interviewed in this study indicated that they have beliefs. After categorising their beliefs, I found that there were other beliefs which can be classified as policy related beliefs, which are revising the PPM for allocating educators in schools; employing homework assistants for learners; and also educational therapists and psychologists for learners with learning difficulties. Firstly, the issue of the PPM is seen as a burning issue which affect learner performance not only in mathematics but in all the subjects. In other words schools are under resourced when it comes to human resources. Secondly, policy makers need to ensure that for educators to be effective in their duties, they should be allowed to do what they know and have been trained to do, which is teaching.

The issue of intervention as explained by educator participants needs to be done by specialists. This implies that the department of education should employ educational therapists, educators for learners with special needs and psychologists who can use their

expertise to identify learners with barriers and behavioural problems that may hinder them from learning. These specialists can assist such learners according to their specialty and make referrals where necessary. Thirdly, the department of education should employ homework assistants who can assist learners with homework after school before they go home. This will bring an improvement on learner performance and since learners will be guided by knowledgeable people when completing their homework.

Policy makers should have regard for research results by not only becoming audiences, but also by putting into trial the recommendations suggested in the research findings. Some of the changes made in the education system are done based on comparative education, not knowing how these changes will impact on our own education system as a country, of which the damage may have lasting effects. The findings of research are based on evidence, so if policy makers can consider and implement them, there might be job satisfaction among education practitioners and also improvement in learner performance in mathematics.

Once research results are submitted to districts, education officials in the districts should make them available to their respective circuits (area offices) and encourage subject education specialists to pilot them at specific schools for a certain period. In this way, they will be able to detect if the results of the findings can provide solutions to problems encountered by educators in their classrooms, and whether to adopt or reject the recommendations.

7.2. Recommendations to educators

Poor learner performance in mathematics is a worrying factor. When learners perform badly in mathematics, educators should initiate the process of diagnosing the problem, by reflecting on their teaching and their behaviour in classrooms. Besides all other factors that contribute to poor learner performance in mathematics, it is also important for educators to make continuous self-reflection of their own teaching. This will not only assist them to identify their weaknesses regarding their own instructional practices, but also to seek alternative teaching strategies that can help in improving the performance of learners. Self-reflection of educators will help them identify the types of beliefs they have. In that way educators would be involved in attempting to change the negative beliefs they have. Educators should also be engaged in discussions involving their teaching, topics that are taught in mathematics. Such discussions can help them to gain valuable information concerning the problems encountered in teaching.

It is important for educators to be research audiences by reading the research findings. Even though environments and learners are different, the recommendations that are made based on the research findings may assist in alleviating the problems if they can be put into trial. If educators do not have time to read these findings themselves, they should at least try the recommendations suggested by the district officials and see if they do not work, because the research findings are based on evidence.

7.3. Recommendations to subject education specialists

One of the things that subject education specialists can do to address the issue of poor learner performance in mathematics is to encourage educators to do self-reflection. The section of educators' self-reflection should be part of daily lesson preparation. If this section is incorporated in the lesson template, educators will be compelled to do it. In this way they will be able to reflect on their teaching. Monitoring should be done to ensure that self-reflection of the teaching practice is continually done, and educators should also be supported and trained on how to do self-reflection.

When educators are called to teacher support forums, subject advisors should engage them in discussions about their beliefs in mathematics, mathematics teaching and the learning of mathematics. In this way educators can identify the types of beliefs they have. It is during such discussions that negative beliefs can be criticised by citing disadvantages and advantages of those beliefs. This will encourage educators who have negative beliefs to attempt to change them, because it is only through self-reflection and realisation of the effect of the beliefs in their classroom practice that educators can change their beliefs.

Subject education specialists can encourage educators to try and implement the research recommendations that are curriculum related, for example, using teaching aids(which most educators do not do), and using new instructional techniques, and so on. After putting a technique on trial for a certain period, education specialists can then meet with educators to discuss how the technique is helping, as well as where to improve. The other way of trying recommendations is by piloting. Few schools can be selected and then if the system works, then all the schools can be involved.

7.4. Recommendations for further research

Researchers who wish to study and investigate the topic of Educators' beliefs and their impact on classroom practice in Grade 6 should use data collection instruments (interviews

and lesson observations) used in this study to build on the results found in this study. Using these instruments will assist the up-coming researchers to support or extend the results found in this study, by providing answers to the questions not addressed adequately in this study, such as what causes the discrepancies in the relationship between educators' beliefs and their practice, and how educators' changed beliefs can be sustained.

7.5. Limitations of the study

After having been careful about choosing the appropriate research design and the conceptual framework of the study, the researcher acknowledges that no research study is perfect and no research design is complete on its own. This research study also has limitations. Qualitative research was used for data collection and analysis. Qualitative research cannot on the overall be objective because data is collected and analysed by human beings, who can sometimes be subjective.

Although educators agreed to participate in the research voluntarily, and have signed permission slips, they did not agree to be video-taped. As a result of this the researcher could not use video-tape in order to respect the wishes of educators. Data from lesson observations was collected by taking notes.

The research sample of the study was a representative set of data collected from a small population, which are the educators in the same area office of Moretele. This sample was very limited and was chosen on the basis of time and cost.

Educators were each observed in one day, for one lesson of one hour each. The findings obtained from these lessons may not yield the same results if the researcher were to observe educators on numerous occasions. Knowing that they would be observed only once, educators may try by all means to withhold relevant data crucial for the study. Moreover, all behaviour cannot be observed in a single day of one hour.

Observations were done in one class in all the schools that were sampled. From the four schools that were sampled, three schools had only one Grade 6 class, in the exception of one school, which had two Grade 6 classes. The findings obtained for the school having two Grade 6 classes where only one class was observed, might not give a credible and confirmable picture. This is as a result of the uniqueness of the learners, the educator's approach to the classes if they are different, and the organisation of the learners in class (if

learners are placed according to ability). Due to all these limitations this study cannot be generalised.

7.6. Conclusion regarding educator beliefs

This study showed that educators hold differing beliefs about mathematics, the teaching of mathematics and also about the learning of mathematics. These beliefs are held in clusters, which make them difficult to change, once educators have a strong conviction in them. Nevertheless, there are beliefs that can change depending again on the educators' convictions. Beliefs that are easy to change are less strongly held. The most important factor is to identify these beliefs as early as when educators are still in training institutions so that they can be dealt with at a very early stage.

The study helped the researcher realise that although beliefs influence educators' classroom practice, educators do not usually practice what they believe in. There is often a contradiction between beliefs and educators' classroom practice. It is this contradiction that causes a change of beliefs to be possible. The concept of changing beliefs does not occur overnight and can be a long or lifelong process. Taking educators to development courses can help but may not be a guarantee of bringing a desired change. Educators have a vital role to play in changing their own beliefs. This can take place if they can do self-reflection and realise that such beliefs have a negative impact on their classroom practice, and that those beliefs affect learners' performance adversely. To change educators' beliefs require all stakeholders involved in education to play their role responsibly. These stakeholders are educators, subject education specialists and policy makers in the education departments for basic and higher education.

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APPENDICES

APPENDIX A: INTERVIEW QUESTIONS



Date: 29 April 2016

Place: Makapanstad

Interviewer: Rosina Ngoako

Interviewee:-----

- Instructions:
1. All interviewees should be asked the same questions
 2. Do not interrupt the interviewees
 3. Interviewees should be allowed to take all the time they need to answer.

Questions

1. Tell me about your academic qualifications.
2. Are there any beliefs that you hold about the teaching of Mathematics, Mathematics or learners?
3. Take me through these beliefs.
4. How do the beliefs that you mentioned earlier affect your performance in the classroom?
5. Is there anything that you can do or recommend to be done to change the situation?

Thank you very much for taking part in this interview.

APPENDIX B: LESSON OBSERVATION SCHEDULE

Participant _____

Name of the school _____

Date _____



Researcher: Rosina Ngoako

Behaviour/Actions of the participant	Frequency of behaviour		
	Consistently	Sometimes	Never
1. Teaches concepts/skills step-by-step			
2. Teacher demonstrates hopelessness when learners give incorrect answers more than twice for the same concept (body language)			
3. Teacher reflects on his/her teaching or regards himself/herself as always right			
4. Teacher expresses great concern for learners' lack of understanding			
5. Teacher encourages independent thinking and tries to move away from using visual aids			
6. Teacher incorporates repetition/more exercises given on Mathematical concepts(from learners' books)			
7. Teacher credits learners for correct procedure for Consistent accuracy even if their answers are Incorrect			
8. Teacher uses positive remarks during teaching and marking			
Other noticeable behaviour			
9.			
10.			
11.			
12.			

COMMENTS:

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APPENDIX C GRADE 6 MARK SHEET EXAMPLE

Name of school:															
Year:															
Task	1	2	3			4	5	6			7	8	9		
Date:															
Total	40	25	60	100	1-7	40	40	60	100	1-7	25	40	60	100	1-7
Learner name															
1.															
2.															
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APPENDIX D: ETHICS APPROVAL LETTER



Ethics Committee 18 August 2016

Dear Mrs Ngoako

REFERENCE: SM 16/06/06

We received proof that you have met the conditions outlined. Your application is thus approved, and you may continue with your fieldwork. Should any changes to the study occur after approval was given, it is your responsibility to notify the Ethics Committee immediately.

Please note that this is not a clearance certificate. Upon completion of your research, you need to submit the following documentation to the Ethics Committee:

Integrated Declaration Form (Form D08), Initial Ethics Approval letter and, Approval of Title.

Please note:

- Any amendments to this approved protocol need to be submitted to the Ethics Committee for review prior to data collection. Non-compliance implies that the Committee's approval is null and void.
- Final data collection protocols and supporting evidence (e.g.: questionnaires, interview schedules, observation schedules) have to be submitted to the Ethics Committee before they are used for data collection.
- Should your research be conducted in schools, please note that you have to submit proof of how you adhered to the Department of Basic Education (DBE) policy for research.
- Please note that you need to keep to the protocol you were granted approval on should your research project be amended, you need to submit the amendments for review.
- The Ethics Committee of the Faculty of Education does not accept any liability for research misconduct, of whatsoever nature, committed by the researcher(s) in the implementation of the approved protocol.
- On receipt of the above-mentioned documents you will be issued a clearance certificate.

Please quote the reference number: SM 16/06/06 in any communication with the Ethics Committee.

Best wishes

A handwritten signature in black ink, appearing to read 'Liesel Ebersöhn', written over a light blue horizontal line.

Prof Liesel Ebersöhn
Chair: Ethics Committee
Faculty of Education

APPENDIX E: LETTER OF INFORMED CONSENT FOR NORTH WEST EDUCATION DEPARTMENT



Faculty of Education

Fakulteit Opvoedkunde
Lefapha la Thuto

UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE,
MATHEMATICS AND TECHNOLOGY
EDUCATION

Groenkloof Campus
Pretoria 0002
Republic of South Africa
Cell: 072910 7181
Date: 29 April 2016

Dear Sir/Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN SOME SCHOOLS IN THE NORTH WEST PROVINCE

I am a teacher as well as head of department of Mathematics at Swarisanang Primary School. I am at the same time enrolled for a Master's degree at the University of Pretoria in the Department of Science, Mathematics and Technology Education under the supervision of Dr B. Mofolo-Mbokane.

I hereby request you to permit me to conduct research in some primary schools situated in the Moretele area of your province.

My research topic is: **Educators' beliefs about effective classroom practice in Grade 6**

This study investigates the beliefs held by Mathematics educators and the effect such beliefs may possibly have on learner performance in Mathematics. It is hoped that at the end of this

study, there will be some recommended solutions to poor performance by most learners in Mathematics.

Data collection at schools will entail conducting of recorded telephonic interviews with Grade 6 educators at their own free time, outside school hours. To support data collected during interviews I will also have to observe teaching and learning processes during school hours.

You need to be rest assured that no school programme will be disrupted by my research activities. It is also important to understand that data collected from the schools will be used in compiling the findings and recommendations, which will be published, but the identity of the participants will never be revealed. They will remain anonymous at all times.

Taking part in the study is completely voluntary but each participant may decide at any point in time to stop participating without any consequences.

Thank you in anticipation for your permission and support.

Yours Sincerely

Ngoako R N

Supervisor

Dr B. Mofolo-Mbokane Email: batseba.mofolo-mbokane@up.ac.za

I _____, grant permission that the selected schools, as determined by the researcher, cooperate by participating in the above-mentioned research. I am aware that the findings of this research will be used to promote teaching and learning and will be published. I am furthermore aware that identities of all participants will be protected and they will therefore remain anonymous.

In addition each participant has the right to decide to discontinue her or his participation as she or he deems fit, without any consequences

Signed _____ Date: _____

APPENDIX F: APPROVAL LETTER FROM THE NORTHWEST



Education and Sport Development

Department of Education and Sport Development
Departement van Onderwys en Sport Ontwikkeling
Lefapha la Thuto le Tlhabololo ya Metshameko
NORTH WEST PROVINCE

Private Bag X365,
Makapanstad
0404
Tel.: (012) 714-3905
Tel.: (012) 714-3906
Fax.: (012) 714-3912

OFFICE OF THE AREA MANAGER: MORETELE AREA OFFICE

Enq : Baleseng Maekane
Contact : 083 365 5379

To : Rosina Ngoako

From : Mosala M.K.Z
Area Manager

Date : 29 – 08 – 2016

Subject: Request to conduct research in the Moretele AO Schools

You are hereby granted permission to conduct research in the Moretele AO schools.

As a researcher you must present a copy of this written permission to the principal at the school before any research is undertaken.

The participation of the school in study is voluntary and free from any form of coercion whatsoever.

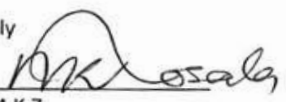
The research should not interrupt educational programmes, except in exceptional cases with the approval of the office.

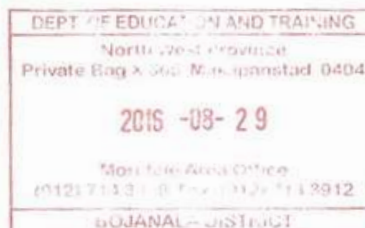
The copy of the completed thesis shall be provided to the office of the District Manager through this office.

We wish you the best in this important study/researcher.

Thanking you in advance

Yours truly


Mosala M.K.Z
Area Manager



“Towards Excellence in Education”

APPENDIX G: LETTER OF INFORMED CONSENT FOR THE PRINCIPAL



UNIVERSITY OF PRETORIA

FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE,
MATHEMATICS AND TECHNOLOGY
EDUCATION

Groenkloof Campus
Pretoria 0002
Republic of South Africa
Cell: 072910 7181
Date: 29 April 2016

The Principal

.....
.....

Dear Sir/Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT YOUR SCHOOL

I am a teacher as well as head of department of Mathematics at Swarisanang Primary School. I am at the same time enrolled for a Master's degree at the University of Pretoria in the Department of Science, Mathematics and Technology Education under the supervision of Dr B. Mofolo-Mbokane.

I hereby request you to permit me to conduct research at your school. I will require your consent to gain access to some of your school's Mathematics mark sheets, teachers and learners.

My research topic is: **Educators' beliefs about effective classroom practice in Grade 6**

This study investigates the beliefs held by Mathematics educators and the effect that such beliefs will have on learner performance. It is hoped at the end of this study, there will be some recommended solutions to poor performance by most learners in Mathematics. Should I be granted permission to conduct this study at your school, I will conduct recorded telephonic

interviews with Grade 6 educators at their own time, outside school hours. To support data collected during interviews I will also need to observe teaching and learning processes during school hours.

I will only be in direct contact with you when I explain the purpose of my study and hand out consent letters, and will not disturb your programme or take any more of your time. It is important to understand that data collected from your school, including from you personally, will be used in compiling the findings and recommendations, which will be published, but your identity will never be revealed. You will remain anonymous at all times. Your Mathematics teachers who will participate in the study will also remain anonymous.

Taking part in the study is completely voluntary and you will remain nameless. Your identity will remain confidential at all times and you may decide at any point in time to stop participating without any consequences.

Thank you in anticipation for your permission and support.

Yours Sincerely

Ngoako R N

Supervisor

Dr B. Mofolo-Mbokane Email: batseba.mofolo-mbokane@up.ac.za

I _____ grant permission that the above-mentioned school participates voluntarily in this research. I am aware that the findings of this research will be used to promote teaching and learning and will be published. I am furthermore aware that my identity will be protected and I will therefore remain anonymous.

In addition I know that each participant has the right to decide to discontinue her or his participation as she or he deems fit, without any consequences.

Signed _____ Date: _____

APPENDIX H: LETTER OF INFORMED CONSENT TO EDUCATORS



.....UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
.....DEPARTMENT OF SCIENCE,
MATHS AND TECHNOLOGY
.....EDUCATION

Groenkloof Campus
Pretoria 0002
012 420 5734
Cell: 072 910 7181
Date: 29 April 2016

Mr/Mrs.....
.....

Dear Educator

REQUEST TO PARTICPATE IN A RESEARCH PROJECT

I am an educator as well as head of department of Mathematics at Swarisanang Primary School. I am at the same time enrolled for a Master's degree at the University of Pretoria in the Department of Science, Mathematics and Technology Education under the supervision of Dr. B. Mofolo-Mbokane hereby request you to participate in my research project.

My research topic is: **Educators' beliefs about effective classroom practice in Grade 6**

The aim of this study is to investigate the beliefs of Mathematics educators in Primary Schools and how they affect learner performance. The outcome of this study may lead to some solutions to the current poor performance of learners in Mathematics. At the end of this

study I am hoping to support participating educators by working together with their respective area offices to empower them by conducting workshops on the subject content.

You will be required to take part in recorded telephonic interviews that would take place at your convenient time outside school hours, and would not last longer than 60 minutes. During the interview some questions related to your education and training, biographical information as well as probing questions into your beliefs about Mathematics will be asked. Apart from the interview, I also request you to grant consent to be observed while teaching during school hours, as well as to be videotaped whilst teaching in order to support our conversation from the interview.

It is important to understand that if you agree to participate in the research all information arising therefrom will be treated as being sensitive and confidential; and your identity will never be revealed. Participation in this study is therefore voluntary and anonymous. You may withdraw from the study at any point with no consequences.

Yours sincerely

Ngoako R N

Supervisor:

Dr Mofolo-Mbokane

Email: batseba.mofolo-mbokane@up.ac.za

I _____ consent to participate in the above research by taking part in recorded telephonic interview and also being observed in the classroom, during which a videotape may be recorded. I am aware that findings of this research will be used to promote teaching and learning, and will be published. I am also aware that my identity will remain anonymous.

In addition I understand that I have the right to decide to discontinue my participation as I deem fit, without any consequences.

Signed _____ Date: _____

APPENDIX I: LETTER OF INFORMED CONSENT FOR PARENTS



UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE,
MATHEMATICS AND
TECHNOLOGY EDUCATION

Groenkloof Campus
Pretoria 0002
Republic of South Africa
Tel: 012 420 5734
Cell: 072 910 7181

Date: 29 April 2016

Dear Parent(s)/Guardian(s)

REQUEST FOR YOU TO GRANT YOUR CHILD PERMISSION TO PARTICIPATE IN THE RESEARCH PROJECT

I am a teacher as well as head of department of Mathematics at Swarisanang Primary School. I am at the same time enrolled for a Master's degree at the University of Pretoria in the Department of Science, Mathematics and Technology Education under the supervision of Dr B. Mofolo-Mbokane.

I hereby request you to grant your child, who is in Grade 6, permission to participate in my research project.

My research topic is: **Educators' beliefs about effective classroom practice in Grade 6**

The aim of my research is to investigate beliefs of Mathematics educators in primary schools and how these affect learner performance. It is hoped the findings that will arise from this study will contribute to finding solutions for the current poor performance of learners in Mathematics. I furthermore request to be granted permission to videotape learners in the classroom while the educator is busy teaching. The researcher will by no means interrupt the educator whilst teaching. The focus will be on how the educator teaches the learners but the responses of the learners may also be necessary for the purpose of this research. The videotapes will only be used by the researcher and the University of Pretoria, no other persons will be allowed to watch the videos taken.

I promise that all the data collected during this research will be treated with the strictest confidentiality. The participation of learners in this study is completely voluntary and their names will not be revealed to anyone. Their identity will remain confidential at all times. The learners may withdraw from the study at any time without any consequences. You also have the right not to grant permission for your child to participate in the above study.

Yours sincerely

Ngoako R N

Supervisor:

Dr Mofolo-Mbokane

Email: batseba.mofolo-mbokane@up.ac.za

I _____ give my consent for my child _____, to participate in the above-mentioned study. I in addition grant permission that video clips on my child, taken in class, may be used in this study.

I am aware that findings of this research will be used to promote teaching and learning and will also be published. I am furthermore aware that my child will remain anonymous.

In addition I know that each participant has the right to decide to discontinue her or his participation as she or he deems fit, without any consequences.

Signed: _____ Date: _____

OR

I _____ DO NOT give my consent for my child _____, to participate in the above-mentioned study.

Signed: _____ Date: _____

APPENDIX J: LETTER OF INFORMED ASSENT TO LEARNER



UNIVERSITY OF PRETORIA
FACULTY OF EDUCATION
DEPARTMENT OF MATHS, SCIENCE AND
TECHNOLOGY EDUCATION

GROENKLOOF CAMPUS

PRETORIA 0002

012 420 5734

Cell: 072 910 7181

03 May 2016

Dear Grade 6 Learner

REQUEST FOR YOUR CONSENT TO PARTICIPATE IN A RESEARCH PROJECT

I am a teacher as well as Head of Department of Mathematics at Swarisanang Primary School. I am studying for a Master's degree at the University of Pretoria in the Department of Science, Mathematics and Technology Education under the supervision of Dr. B. Mofolo-Mbokane.

I hereby ask you to take part in my research project. If you agree to take part, you will only sit in the class and continue with the lesson with your teacher. I will only be listening as your teacher teaches Mathematics. Take note that I may take videos of the lesson as the teacher will be teaching.

My research topic is: **Educators' beliefs about effective classroom practice in Grade 6**

I hope that at the end of the research there may be answers to why learners do not do well in Mathematics. If you take part in this research, I will only use the answers that you give to the teacher and the recorded videos. I promise not to disturb your teacher while teaching.

If you agree to take part in this research, I promise that the videos will not be shown to anyone, and no one will know who took part. Your Mathematics teacher will also be asked to take part in the study. You are not forced to take part in the study. You can stop taking part at any time you want and you will not be punished for stopping to take part.

Yours sincerely

Ngoako R N

Email: rosina.ngoako01@gmail.com
mbokane@up.ac.za

Supervisor:

Dr Mofolo-Mbokane

Email: batseba.mofolo-

I _____ hereby agree to take part in this research. I am aware that the results of this research will be used to promote teaching and learning and may be used to help future learners. I am also aware that a photograph of my face will not be shown to anyone.

In addition, I understand that I am allowed to decide to stop taking part in this study at any time and that I will not be punished.

Signed _____ Date _____