AN INVESTIGATION INTO THE PERSISTENCE OF TRADITIONAL TEACHING METHODS IN GRADE 9 MATHEMATICS CLASSROOMS IN RUNDU: A CASE STUDY

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By

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DECLARATION OF ORIGINALITY

I ***Charity M. Ausiku*** (**Student number: 05A5503**) declare that this thesis ***on the persistence of traditional teaching practices in mathematics classrooms is my*** own work written in my own words. Where I have drawn on the words or ideas of others, these have been acknowledged using the reference practices according to the Rhodes University Education Department Guide to Referencing.

Charity M. Ausiku — 15 December 2008

(Signature) — (Date)

ABSTRACT

I embarked upon this study to investigate mathematics teachers' practices that have led to the persistence of traditional teaching methods in grade 9 mathematics classrooms in Rundu. The study was conducted from a learner-centred (L-C) perspective or reform approach in the Namibian context. It is a qualitative study oriented in the interpretive paradigm- a paradigm that seeks to understand the meanings attached to human actions.

The participants involved in this study were purposively selected and they are composed of two mathematics teachers and their grade 9 learners. This study was conducted at two schools in Rundu. One is an urban school while the other one is a rural school on the outskirts of Rundu.

The research tools employed in this study are questionnaires, interviews and observations. The questionnaires were used to identify and select my participants while the observations were used to investigate the participants teaching strategies. The purpose of the interviews was mainly to investigate teachers' understanding, interpretation and implementation of learner-centre education (LCE).

Amongst other findings, this study reveals that inadequate teacher-training, controversial educational policies and challenges such as overcrowdedness in mathematics classrooms, lack of teaching and learning materials, lack of cooperation among mathematics teachers and learners' negative attitude towards mathematics are some of the contributing factors to the persistence of traditional teaching methods in mathematics classrooms. Moreover, the study reveals that the persistence of traditional teaching methods in mathematics classes can no longer be attributed to the lack of understanding of LCE. The teachers in this study seem to be well acquainted with the theoretical aspect of the LCE framework while the implementation aspect seems to be a concern.

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DEDICATION

This thesis is dedicated to my beloved sons, the late Samuel Shindimba Ausiku and his surviving twin brother Samson Shikongo Ausiku for being my source of inspiration.

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ACRONYMS

BETD- Basic Education Teacher Diploma

ETSIP- Education Training Sector Improvement Programme

FDE- Further Diploma in Education

L-C- Learner-Centred

LCE- Learner-Centred Education

RCE- Rundu College of Education

T-C- Teacher-Centred

TCE- Teacher-Centred Education

MBEC- Ministry of Basic Education and Culture

ME- Ministry of Education

CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

This study was carried out to investigate mathematics teachers' practices that have led to the persistence of traditional teaching methods in mathematics classrooms. In this chapter I introduce the study by examining factors that necessitated a study of this nature. This will be presented by looking at the following aspects: the background, rationale, goals, the Namibian educational reform, methodology and findings. The chapter will be concluded by giving a brief overview of the study.

1.2 BACKGROUND TO THE STUDY

My own experience as a mathematics teacher and a head of department for mathematics and science inspired me to pursue this research. As a teacher, I found it difficult to implement some of the mathematics lessons in a Learner-Centred (L-C) manner. This was due to the fact that the contexts in which I taught did not support the use of the Learner-Centred Approach (LCA). There were many challenges such as overcrowded classrooms, lack of teaching aids, the nature of the mathematics content and most importantly, learners' negative attitude towards mathematics. It was discouraging to find out that amidst other challenges, I had to deal with learners who had given up on ever succeeding in mathematics.

My experience as a head of department was similar to my previous experience as an ordinary teacher in the sense that when I conducted my class visits I discovered that teachers still practiced Teacher-Centred Education (TCE). This was a great concern

because some teachers did it to such an extent that, in my view very little learning occurred in their classes. Despite the fact that Learner-Centred Education (LCE) was introduced in Namibian schools17 years ago and many workshops had been conducted to help teachers adopt the new approach, its implementation in mathematics classrooms has remained a concern. This prompted me to investigate teacher practices that have led to the persistence of the traditional teaching methods in mathematics classrooms.

1.3 RATIONALE

The rationale of this study lies in its potential to bring about change in the teaching and learning of mathematics. Many learners in Namibian schools do not succeed in mathematics and they give up on it in their early grades and this has been a well known trend in mathematics. Therefore if teachers can open up and share some of the challenges that they encounter in their attempts to teach mathematics effectively, it can serve as a learning experience for others. This study can also reveal teachers' attitudes towards LCE and indeed whether LCE is the answer to the challenges that mathematics teachers encounter.

1.4 CONTEXT OF THE RESEARCH

After independence in 1990, educational reform was seen as a priority by the new Namibian government. This was due to the disparities that existed in the colonial education system. In its attempt to make education accessible to all Namibians, LCE was adopted [Namibia. Ministry of Basic Education and Culture (MBEC), 1993] as an alternative to TCE. TCE was seen as "inefficient and frustrating and certainly not consistent with the national goal of education for all" (MBEC, 1993:10).

LCE is an educational framework that places the learner at the centre of learning. The learner is seen as having some knowledge (prior knowledge) that can enhance his/her own learning. No longer are learners regarded as empty vessels who have nothing to contribute to their own learning. In a LCE framework, teaching and learning starts with

learners' prior knowledge. LCE has its origins in constructivism. Constructivists believe that learning is an active process and that learners construct their own knowledge. Knowledge is not passively passed from the teacher to the learner (Richardson, 1997).

At independence, LCE was seen as a framework that would improve the quality of teaching and learning in schools. However, there has been very little change with regard to the teaching and learning of mathematics. Mathematics is still regarded as a subject for a selected few because only few learners succeed in mathematics in many schools, especially at the senior secondary phase. Most of them bid goodbye to mathematics in grade 10 because mathematics is compulsory up to grade 10. If LCE is the solution to the problems experienced in the past then this trend is not supposed to continue. One would ask whether reform has really taken place in the education system. Theoretically, the paradigm shift can be acknowledged theoretically but in practice, especially in mathematics classrooms there have been very few noticeable changes.

According to Hinchey (1998), one cannot use positivist methods to achieve constructivist goals or vice-versa. If we claim to be constructivist teachers then this should be reflected in our practice. My general impression of the reform approach is that it has not brought about significant changes in the teaching and learning of mathematics.

1.5 GOALS OF THE STUDY

This study revolves around two goals. The main goal of this study if to investigate mathematics teachers' practices that have led to the persistence of traditional teaching practices in mathematics classrooms. The other goal is to establish the relationship between mathematics teachers' interpretation of LCE and their classroom practice.

1.6 METHODOLOGY

This research is orientated in the interpretive paradigm as it seeks to make sense of human actions (teacher practice). I used three research tools to collect my data namely; questionnaires, interviews and observations.

The questionnaires were used to identify the teaching orientation of my participants. Provision was made on the questionnaires for the teachers to indicate whether their teaching practice is: a) more L-C orientated b) both T-C and L-C orientated and c) more T-C orientated (appendix A). The interviews were used to investigate my participants' interpretations of LCE and the observations served the purpose of observing their classroom practice.

1.7 FINDINGS

A detailed documentation of my findings can be found in chapter 4. However, I will highlight some of the main findings here.

The findings from the interviews reveal that mathematics teachers understand the concept of LCE quite well but they are forced to revert to traditional teaching methods due to various challenges that they encounter in their respective classrooms. Most of the challenges cited are shared by all three participants. These include, overcrowded classrooms, lack of teaching aids and learners' negative attitude towards mathematics.

It also came to light that many mathematics teachers still practice TCE. This is mainly due to the fact that teachers are not well prepared for the implementation of LCE practically and the fact that there is a conflict between the new and the old approach. Teachers who were trained in the colonial era feel comfortable with TCE and as a result, they influence the novice teachers when they are recruited after their training. The three participants involved in this study all admitted that the implementation of LCE is indeed a challenge.

From the lesson observations I discovered that teacher A, who claimed to be a more L-C teacher showed minor discrepancies in the way she presented her lessons. Her lessons qualify to be classified as L-C using the analysis model that was constructed using the Posner, Strike, Hewson & Hertzog model (Brophy, 1996:126) and the radical and traditional teaching table (Olson, 1997: 57). However, there were major discrepancies in teacher B's lessons. Teacher B claims to be practicing both TCE and LCE. The first lesson was presented in a more T-C way while the second lesson was presented in a more LC way. Pedagogically, these two lessons were very different from each other although they were presented by the same teacher.

The persistence of traditional teaching practice can be attributed to the fact that mathematics teachers still cling to certain teaching routines. They have not yet moved out of "the boxes." The difference between teacher A and teacher B is that teacher A is trying to move out of these boxes. It was evident that teacher A had put in more effort in her lesson preparations as she had come up with relevant activities that enhanced understanding. Most of these activities were self-designed. On the other hand, teacher B was textbook-bound and all the activities that were used as examples or given to learners as exercises came from the learners' prescribed textbook. The reform approach calls on teachers to move away from such practices and employ "expertise and skills that stimulate learning" (MBEC, 1993:57).

1.8 SIGNIFICANCE

This study is significant because firstly, it created new ground for further research since it is now clear that the problem does not lie with the interpretation of LCE. It is the implementation which is a challenge. Secondly, the interviews made teachers reflect on their practice, especially when they were asked to provide examples of activities that can be regarded as L-C. This was a challenge because LCE is a concept that is taken for granted by both teachers and policy makers. The reform does not provide clear guidelines

on L-C activities. As a result, many teachers still employ the traditional book-bound exercises.

Thirdly, this study revealed that LCE is not a popular educational framework among mathematics teachers since data from the questionnaires shows that out of approximately 14 teachers who completed the questionnaire only one teacher indicated that her teaching approach is more L-C. It is therefore unrealistic to expect these teachers to fully implement this concept. This calls for more sensitisation workshops on LCE in mathematics classrooms.

1.9 OVERVIEW OF THE STUDY

This thesis is composed of five chapters. Chapter one provides a brief introduction to the thesis. Chapter two deals with the literature that has informed my research. It covers amongst others, issues pertaining to the educational reform in Namibia, definitions of LCE and TCE, implications of the reform approach for the mathematics teacher and the persistence of traditional teaching methods in mathematics classrooms. Chapter three is about the research process (methodology). It gives a detailed description of the research context, the tools used for data collection, how these tools were used and why they were used.

The fourth chapter deals with data analysis and discussion of findings. The data from the interviews was analysed using the framework of the interview schedule while the observations were analysed using the Posner, Strike, Hewson & Hertzog model (modified). The last chapter presents the recommendations, limitations, personal reflections about the research and avenues for further research.

CHAPTER TWO
LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, I review sources that have shaped and inspired my research. Reading and making references to what my predecessors in this research field have written about educational reform strengthened my understanding and arguments in this study. My main argument in this study is: If mathematics teachers understand a learner-centred philosophical approach to education, they should be in a position to implement it well. Research however shows that putting learner-centred education (LCE) into practice in mathematics classrooms is problematic (Fennema & Nelson, 1997).

I will start by giving a brief historical background of the learner-centred education framework. This section explains why LCE was opted for by the Namibian government after independence. This will be followed by the definitions of LCE and teacher-centred education (TCE) because one needs to define terms and concepts if you are going to study them. These definitions will help in interrogating the difference between LCE and TCE.

The implications of LCE for the mathematics teacher will also be discussed. Mathematics teachers need to know what is expected of them in the reform approach. What does LCE mean for the mathematics teacher in a teaching-learning context? This chapter will be concluded by looking at the possible causes of the persistence of traditional teaching methods in mathematics classrooms.

2.2 HISTORICAL BACKGROUND OF THE NAMIBIAN EDUCATIONAL REFORM

After independence in 1990, Namibia embarked upon a process to reform education. Reform in the education system was prioritised in order to address the inherited imbalances from the colonial era. In one of his speeches Verwoerd, a prime minister of South Africa and architect of apartheid stated: "When I have control over native education, I will reform it so that natives will be taught from childhood that equality with Europeans is not for them" (quoted in Christie, 1991:12).

This statement was echoed by Rohrbarch when he said: "White settlers require native servants, they can only ensure a continuous supply by seeing to it that the servants are kept in a state of education inferiority. To educate them... (would) inculcate such mischievous and intolerable ideas as democracy, the brotherhood of man...human freedom and the like" (Rohrbarch quoted in Amukugo, 1993:45). This was the foundation that framed the South African and Namibian education systems-the kind of education that current reform education wishes to move away from.

Therefore, the Namibian government deemed it necessary to revise the whole education system. The Bantu education system was segregatory. It divided people along ethnic and racial lines (MBEC, 1993). According to the former Namibian minister of education John Mutorwa "The goal was to establish a national unified system of education and training and to promote unity in diversity in the sphere of culture" (Sguazzin &van Graan, 1999:11).

A divisive type of education could not be accommodated in an independent Namibia. A better alternative was therefore necessary. As stated by Molobi "The real struggle now is to replace an undemocratic, coercive, ineffective and irrelevant education system with a democratic participatory and relevant alternative" (Molobi quoted in Christie, 1991:14). For Namibia, this meant establishing a new educational framework called learner-centred education (LCE).

Learner-centred education was opted for because it corresponds with the four important educational goals for Namibia namely; access, equity, quality and democracy (Namibia. National Institute for Educational Development (NIED), 2003 & MBEC, 1993). However, the realisation and implementation of this policy in general and in mathematics in particular has remained a concern. One study concludes that "there have been very different understandings of what is meant by LCE and how to put it into practice" (NIED, 2003:1). This is further confirmed by Sguazzin and van Graan (1999:56) "...there seems to be a lack of common understanding of learner-centred education on all levels of the educational continuum."

In a 1998 educational conference on LCE held in Okahandja (NIED) under the auspices of the Ministry of Basic Education, Sport and Culture, many participants indicated that a need exists to talk about learner-centred education on all levels in the workplace-not only to ensure a clarification of one's own understanding but also to create a common understanding (Sguazzin & van Graan, 1999:49).

Recent findings on teacher education reform reveal that the problem of putting LCE into practice has not yet been resolved (Macleod et al, 2002). These findings reveal that teachers cling to traditional teaching practices because amongst other things it saves time, there is a lack of exposure to teachers who use L-C methods and the fact that school administration insists on proper classroom control. In a report on teacher education reform by Crebbin et al (2008) LCE is still perceived by some teachers as simply groupwork while others perceive it as a non-failure assessment approach. This is due to the misinterpretation of the goal of equity which to some means not failing any learner.

A comprehensive definition of LCE should therefore be the starting point in our attempts to address this problem. Firstly, one should define one's terms or key concepts if they are to be researched. Secondly, there seems to be a need for a common understanding of LCE. A working definition that would guide their practices is what teachers need to be able to differentiate between reform and traditional practice.

2.3 DEFINITIONS OF LCE AND TCE

2.3.1 Definition of Learner-Centred Education (LCE)

LCE was introduced in Namibian schools in 1991. This educational framework emerged from a constructivist perspective. Constructivism is an educational paradigm that views the acquisition of knowledge as a process of knowledge construction (Hinchey, 1998 & Richardson, 1997).

According to Hinchey (1998:46), "The constructivist believes that knowledge is constructed by human beings when they give meaning to data; it is not simply sitting out in the world waiting for us to find. Therefore, in constructivist education the processing of information is more important than the information itself." In the constructivist's view emphasis is not placed so much on how much the learner knows but on how adaptive the knowledge is i.e. whether the knowledge acquired can be used in different contexts or not.

As stated by Jarworski (1994:16), constructivism asserts two principles: the first is that knowledge is not passively received but actively built up by the cognising subject. Secondly, the function of cognition is adaptive and serves the organisation of experiential world, not the discovery of ontological reality.

The sense that learners make out of any learning situation is more important than the facts that they are expected to memorise and reproduce. The personal experience of each learner also plays an important role in the meaning that they attach to facts (Hinchey, 1998). Therefore, learners' prior knowledge contributes to their own learning and their personal understanding. According to Jaworski (1994:16), "What we each know is the accumulation of all our experiences. Every new encounter either adds to that experience or challenges it."

The experience that each learning situation arouses therefore surpasses the accumulation of facts in a constructivist setting. The point of departure for teachers should therefore be the learner's prior knowledge. However, learners have often been regarded as empty vessels having very little (or nothing) to contribute to their own learning. As stated by Smith, diSessa & Roschelle (1993:115), "Students have often been viewed as holding flawed ideas that instruction must confront and replace. We argue that this view overemphasises the discontinuity between students and expert scientists and mathematicians, making the acquisition of expertise difficult to conceptualise."

The knowledge that is constructed becomes part of the knower. As human beings are adaptive in nature so is the knowledge that they acquire through construction. Such knowledge can be used to make sense out of different situations. According to Ernest (1994:1), "... the developing human intelligence also undergoes a process of adaption in order to fit with its circumstances and remain viable. Personal theories are constructed as constellations of concepts and are adapted by the twin processes of assimilation and accommodation in order to fit with the human organism's world of experience."

There is a direct relationship between constructivism and learner-centred education. The shift in focus from the teacher as the provider of knowledge to the learner as the constructor of knowledge is aligned to a shift in the educational paradigm from behaviourism to constructivism. The focus is now on helping learners make sense of facts (Hinchey, 1998) rather than merely giving them the facts.

Learner-centred education is viewed "as a means to implement the new philosophy of education in Namibia at all levels of the education system..." (Sguazzin & van Graan, 1999:14). It is a new approach to education that facilitates the accomplishment of the new educational philosophy. It intends to provide quality education to all Namibians. Quality education is advocated for by the Namibian government because amongst other things it promotes independent and critical thinking thus, liberating the human mind.

According to the report on teacher education reform access and are fundamental educational recognised universally. An education system that fails many learners is said to be of poor quality. The report further reveals that that the goal of quality has received little attention in the Namibian reform education (Crebbin et al, 2008). LCE was seen as instrumental in achieving these goals.

The development brief for education, culture and training calls for the understanding of quality in a broader sense. It is not merely measured by the performance of learners in examinations. The quality of education is promoted by teacher education programmes, support for teachers from education officers, type of assessment, access, equity and the availability of resources (MBEC, 1993).

The role of the teacher in providing quality education cannot be overstated. Clark (1995:3) points out that: "Teachers have the potential for enhancing quality by bringing life to the curriculum and inspiring students to curiosity and self-directed learning." A teacher can bring life to the curriculum by making it accessible to the learners. School activities make much more sense to the learners if they can relate to them. This is the teacher's role-to ensure that new knowledge is linked to the learner's prior knowledge. The conceptual change model (Brophy, 1996: 122) can be instrumental in helping teachers implement LCE effectively. This model outlines the stages involved in the implementation of LCE. It describes how teachers can use learners' ideas at the beginning of their lessons and develop them into mathematical concepts. This model is useful because it addresses implementation aspects of LCE.

Teachers can help promote quality education if they are actively involved in educational matters. They should therefore be acquainted with the curriculum and should be involved in any curriculum changes. As stated in the development brief for education, culture and training, (MBEC, 1993:38) "To be effective, teachers must see themselves as active participants, not passive intermediaries. They must be able to communicate their ideas to those who design curriculum and set examinations."

The teachers' role in the implementation of LCE is further empahsised in the broad curriculum for the Basic Education teachers' Diploma (BETD, 2006:1-2). It states that quality can be achieved if:

> teachers have a holistic view of the learner, valuing the learner's life experiences as the starting point of their studies. Teachers should be able to select content and methods on the basis of a shared analysis of the learner's needs, use local and natural resources as an alternative or supplement to ready-made study materials and thus develop their own and the learners' creativity.

The quote above summarises the core of LCE. LCE is essentially about the learners and developing their cognitive, emotional and creative capacities to their fullest potential (Crebbin et al, 2008). Scaffolding plays an important role in developing these capacities. Teachers are therefore expected to pave the way for better understanding by building on learners' pre-existing knowledge and allowing them to explore and make sense of the knowledge presented to them.

2.3.2 Definition of Teacher-Centred Education (TCE)

For Namibia, a traditional approach to education meant practicing TCE which entails more teacher-talk. It also implied having different education systems for different ethnic groups (Amukugo, 1993). Moreover, it also meant reserving some subjects such as mathematics for the elites, mainly males (MBEC, 1993). These are some of the educational barriers the new education system had to address. This section examines the issue of TCE.

Teacher-centred education emerged from the behaviourist epistemology. Behaviourists perceive knowledge as a "thing- factual and verifiable information resulting from scientific investigation" (Hinchey, 1998:39). From this perspective, knowledge is perceived as some kind of unquestionable truth out there waiting for us to find it.

Knowledge in TC-setting is about learning facts to gain more knowledge rather than to construct knowledge and make sense of facts. The teacher in a teacher-centred context is

therefore seen as a supplier of knowledge (Sguazzin & van Graan, 1999:18). He/she determines the content, methodology and pace of learning (Farrant, 1980:129). This can be termed restricted learning because the direction of learning (or educational route) is determined by the teacher. In other words, the learner plays a passive role in his/her own learning. The teacher "who knows best" directs the learning process.

Differences among learners are not taken into account as learners are expected to learn at the same pace. As stated by Farrant (1980:129) "Pupils tend to be regarded as more or less uniform groups of learners rather than as individuals with different gifts and needs." Success is measured in terms of the teacher's expectations usually based on the ability of learners to recall facts.

The Teacher-Centred Education educational framework takes very cognisant of the learner's prior knowledge. Prior learning is seen as an obstacle to learning. "Students have often been viewed as holding flawed ideas that are strongly held, that interfere with learning, and that instruction must confront and replace" (Smith et al, 1993:115). As a result, teachers adhere to the prescribed curriculum strictly ensuring that they cover as much content as possible.

The TCE framework is characterised by curriculum content which is "neatly divided and subdivided to smooth the way for its acquisition by others..." (Hinchey, 1998:41).This makes it difficult for learners to establish relationships among disciplines. They tend to perceive such knowledge as isolated pieces of information rather than wholes. Moreover, the teacher directs the learning process. Learners are rarely given the opportunity to explore and discover new concepts. They develop a dependency syndrome that deters their learning potential. The teacher is seen as a source of true and unquestionable knowledge.

The classroom situation is characterised by more teacher-talk. Learners talk when they are asked to reproduce information. Teachers often ask questions that test the retention of information. How well a learner is able to recall facts determines his/her success.

Traditional practice relies heavily on the acquisition of information. Learners are expected to acquire more information and reproduce it in tests and examinations. According to Brophy, (1996:57), "The goals are loosely related to methods" This implies that the achievement of the goals is more important than the means (teaching methods) by which the goals are achieved. As a result, teachers tend to resort to drilling to ensure that learners can repeat facts and apply formulas correctly.

The other characteristic of traditional practice as stated by Brophy (1996) is that teacher authority is vested in subject expertise. Teachers maintain their authority by showing off their expertise in their subject fields. Therefore learners are expected to listen and obey their teachers without questioning them. Moreover, Perrot (1982:2) regards TCE (which she terms direct teaching) as an approach that is characterised by teacher reliance on lecture, criticism, justification of authority and giving of directions.

2.4 IMPLICATIONS OF LCE FOR THE MATHEMATICS TEACHER

2.4.1 Knowledge and understanding

Although the nature of mathematics is such that it is composed of "certain unquestionable objective truths," constructivists argue that it should still be taught in a manner that allows learners to make sense of these facts (Ernest, 1994). Constructivists hold the view that learners should be allowed to construct their own mathematical knowledge rather than expecting them to passively take in already existing knowledge or use formulas which make little sense to them (Brophy, 1996).

Dilemmas in implementing LCE arise when the theory of the ideal encounters some of the realities of the classroom. "A vast gulf appears to separate the work place of the school, with their resources and tasks, from the kind of work places reformers would want" (Westbury, 1993:152 quoted in Brophy, 1996:58). According to Richardson (1997:129), many preservice teachers have adopted the constructivist approach.

However, he admits that adopting such an approach "involves considerable conceptual change for most preservice teachers and achieving this is not necessarily easy."

"We know nothing we have not made" (Vico quoted in Ernest, 1994:1).This is the basis of constructivism. Active construction of knowledge is the prerequisite of meaningful learning. The mathematical formulas and symbols that learners are so acquainted with are meaningless if no meaning is attached to them. The challenge in teaching mathematics is to find ways for learners to find these meanings. Without meaning there are many consequences for learning for example, poor understanding of mathematics concepts, memorisation of concepts and learners developing a negative attitude towards mathematics. In most instances, learners are not able to apply the knowledge gained from one context to another context. They see every mathematical problem as new, needing more instruction from the teacher.

According to Glasersfeld (in Ernest, 1994:5) "... symbols do not generate concepts that constitute their referents; they have to be linked to them by a thinking agent even then this sound or a mark on paper becomes a symbol only when it is deliberately associated with a conceptual meaning." However, mathematics teachers have often overlooked the importance of this linkage in teaching mathematics

From the foundation years, learners are taught to memorise mathematical symbols that they do not understand. This results in rote learning.

Constructivists believe that learners come to any learning situation with some knowledge and it is the teacher's responsibility to expand this knowledge by developing it or modifying it. "Thus, knowledge results from individual construction by modification of experience" (Jarworski, 1994: 17).

The mathematical knowledge that children bring to school should therefore not be disregarded as it is the key to helping learners understand this subject better. According to Cobb "The teacher's role is not merely to convey to students information about

mathematics. One of the teacher's primary responsibilities is to facilitate profound cognitive restructuring and conceptual reorganisations" (Cobb quoted in Jaworski, 1994:23).

2.4.2 Fennema and Thomas' L-C approach to the mathematics classroom

Fennema and Thomas who are promoters of a L-C approach to mathematics (1999:20-23) identify five ways in which understanding and proficiency in mathematics can be enhanced:

a) Constructing relationships

This entails the recognition of prior knowledge and helping learners to relate new mathematical knowledge to their prior knowledge. If such relationships are not established, learners develop two separate systems of mathematical knowledge: one is formal (school mathematics) while the other one is informal (out of school mathematics). According to Taylor and Waldrip, unless students can relate the school view of the natural world to their own well-established worldviews, teaching strategies are likely to be less effective in enhancing the permeability of students' worldviews to their school views (Waldrip & Taylor, 1999:290).

b) Extending and applying mathematical knowledge

This refers to the creation of rich, integrated knowledge structures. "This structuring of knowledge is one of the features that makes understanding generative" (Fennema & Thomas, 1999:21). When equipped with these strategies, learners are able to handle new knowledge by fitting it into the existing networks. This stage is reached when basic concepts and skills are mastered.

The understanding of mathematical concepts can be enhanced by establishing a strong knowledge base. This can be achieved by finding out what learners already know about a given topic and refining it. According to Gates (2001) recent studies have placed emphasis on the desirability of understanding as opposed to the ability of learners to remember routines and demonstrate particular basic skills. Learners' experiences out of the classroom should be taken into account because it can influence knowledge construction, use, and interpretation (Waldrip & Taylor 1999). It is therefore, the teacher's responsibility to unveil learners' worldviews and implement teaching strategies that will promote meaningful learning. This demands a certain degree of creativity and innovation on the part of the teacher as a lack of it would cause teachers to resort to traditional methods.

c) Reflecting about experiences

This refers to the reflection of what one already knows and how they have come to know what they know. Reflection plays an important role in problem solving as the learner reflects on what he/she already knows to find the solution to a problem. It also helps learners to reorganise their pre-existing knowledge. Often learners use mathematical rules and formulas without understanding. However, at this stage learners begin to question familiar routines used in solving mathematical problems.

d) Articulating what one knows

Understanding is expressed through articulation. Reflection is a prerequisite of this stage as learners are required to reflect on their existing knowledge for proper articulation. Knowledge can be articulated in any form (writing, verbal, diagrams, pictures, etc). The final product usually depicts the critical element of reflection.

Teachers should engage learners in writing activities. The traditional trend of accepting answers only is inadequate. Writing should not be reserved for other subjects. It is also an important skill in mathematics classrooms. This can provide significant evidence of learner-achievement range. This skill can be promoted through journal writing. Clark, Waywood & Stephens (1993:237) assert that:

> By keeping a mathematics journal, we intend that students will formulate, clarify and relate concepts; appreciate how mathematics speaks about the world; think mathematically-that is practice the processes (e.g. problem solving) that underlie the doing of mathematics; formulate physical relations mathematically.

e) Making mathematical knowledge one's own

Through understanding, learners "develop their own stances about different forms of practices of mathematics" (Fennema & Thomas, 1999:22) .They are able to make decisions about the areas of mathematics that appeal to them. Kilpatrick refers to this stage as productive disposition. Learners begin to "see mathematics as a meaningful, interesting and worthwhile activity. They believe that they are capable of learning it and are motivated to put in the effort required to learn" (Kilpatrick, 2001:171). This is a stage all mathematics teachers should strive to reach. As it is, mathematics is a subject that is imposed on many learners. They struggle with it until they reach grade 11 when they are placed in subject fields that do not include mathematics. Very few learners opt for mathematics in the senior secondary phase.

In their conclusions and recommendations, Kilpatrick et al (2001:401) who is known for his extensive research in mathematics and is renown for his five strands of mathematical proficiency stated:

> Our experiences, discussions and review of the literature have convinced us that school mathematics demands substantial change. We recognise that such change needs to be undertaken carefully and deliberately so that every child has both the opportunity and support necessary to become proficient in mathematics.

The performance of learners in mathematics indeed leaves much to be desired. There is a need to develop learners' proficiency in mathematics.

To address this problem, teacher practice needs to be revisited. Research on why teachers continue with the traditional pedagogies in light of the reform process should

be conducted to identify factors which have contributed to this trend. Kilpatrick further asserts that:

> Proficiency for all demands that fundamental changes be made concurrently in the curriculum, instructional materials, classroom practice, teacher preparation and professional development. These will require continuing coordination on the part of policy makers, teacher educators, teachers and parents (2001:401).

Learner-centred education implies change in teacher practice. Mathematics teachers are expected to change their traditional, familiar ways of teaching mathematics. In the past, teaching mathematics effectively meant drilling learners to follow rules and formulae that led to correct answers. According to Gates (2001) traditionally, the teaching of mathematics has relied heavily on exposition by the teacher while learners have been expected to exhibit certain mathematical skills through practice. In addition, Biehler, R.; Scholz, R.W. & Winkelmann (1994:452) state that "Mathematics and science education emphasise techniques, formulae, and theories geared towards drills, exam-focused topics and not aimed at contextualised understanding of science and mathematics" This practice is still prevalent in mathematics classrooms in Namibia.

Learner-centred education entails teaching constructively, helping learners make sense of the content presented to them. As stated by Fennema and Nelson (1997), it is no longer adequate to turn from one page to the next, introduce a new topic and give learners exercises. It means more than "posing different problems, asking different questions or calling on different students; it demands that teachers make more changes in their basic epistemological perspectives, their knowledge of what it means to understand and thus learn mathematics, and their classroom practice" (Cobb, Wood, Yackel & McNeal, 1993; Schifter & Fosnot, 1993 cited in Fennema & Nelson, 1997:255). This entails changing the mindset of teachers on pedagogical perspectives.

2.4.3 Active participation

The mathematics subject policy calls for the implementation of LCE in mathematics classrooms by encouraging active participation of learners (Subject policy guide,

Mathematics, Grades 5-12, 2006:19-20). Teachers have different interpretations of active participation which lead to different teacher practices.

Active participation, from the mathematics point of view, means involving learners in their own learning and developing their understanding of mathematical concepts. It entails establishing an active link between learners' prior knowledge and the new knowledge. Mathematics has often been perceived as an abstract discipline due to the fact that it is seldom related to the learners' worldviews (prior knowledge).

2.4.4 Learning with understanding

Learning with understanding is at the core of LCE (Mathematics syllabus 8-10, 2006). This "involves the creation of rich integrated knowledge structures" (Fennema & Thomas, 1999:21). It enables learners to apply their knowledge in different contexts and as such knowledge is not context-bound. It is generative. Understanding is developed by "building on the initial and often fragile understanding that children bring to school and make it more reliable, flexible and general" (Kilpatrick et al, 2001:170).

2.4.5 Implementation

The role of the teacher as a facilitator should therefore not be interpreted as doing less. Although the preaching task of the teacher is discouraged, he/she is required to do thorough and better planning. The teacher is expected to take into account the learners, the content, the availability of resources and the context in general. The success of any lesson rests on the teacher's plan and implementation. As stated by Clark (1995: xv) "Teaching can never be completely thoughtless in the first sense of the term. If you teach, you must think at some level about what you are teaching, how you are teaching, and who you are teaching. Teaching is inescapably intellectual."

Teachers should become more resourceful to be successful in the reform process. The learner and the environment around them should be used as a resource to enhance learning. "In a learner-centred approach, there's a greater acknowledgement of the human resources for teaching and learning than otherwise. The knowledge and the experience of the community, the learners themselves and the teachers are recognised as learning

resources" (NIED, 2003:28). The use of the immediate environment as a resource broadens the learner's view of education unlike the heavy reliance of teachers on textbooks as the main teaching aid. As stated in the NIED document, entitled learner-centred education in the Namibian context "A leaner-centred curriculum and learner-centred teaching uses a far broader and relevant range of knowledge, intelligence, contexts and skills than any other" (NIED, 2003:28).

Teachers should provide learners with opportunities to develop structured knowledge (Fennema & Nelson, 1997:26-27). Structured knowledge is developed by employing teaching practices that promote elaborated and integrated mathematical knowledge (Kilpatrick et al, 2001).

In his approach to teaching of mathematics Kilpatrick (2001) advocates the need for teachers to have three types of knowledge i.e. knowledge of the content, the learners and pedagogical perspectives. These play an important role in developing learners' proficiency in mathematics.

A sound knowledge base should be built from the foundation grades. Mathematics should be taught explicitly to help learners understand the basic concepts and develop a positive attitude towards the subject. "In helping students learn, teachers must take abstract ideas and unpack them in ways that make the basic underlying concepts visible" (Kilpatrick et al, 2001: 376). Understanding is made difficult when mathematics is taught using procedures that are not made explicit (Orton & Frobisher, 1994).

Non-explicit procedures result in learners developing the perception that mathematics is a discipline of formulas and symbols that have to be used in calculations but don't necessarily have to be understood. For instance, the way division and multiplication are taught in the lower grades influences the conceptual development of learners in mathematics. Relationships are not made explicit. Paling (1982) agrees that learners should be assisted to see the relationship between multiplication and division for them to master these two operations.

Thus, learners see the two operations as isolated tools for calculations. Wall & Posamentier (2007) encourages teachers to help learners understand how multiplication and division relate to each other. According to Sguazzin & van Graan, "The quality of the learning experience will be enhanced in classes where teachers have a real belief in the value of the learners deconstructing myths and existing knowledge and practicing the skill of locating information" (Sguazzin & van Graan, 1999:56).

Learners understand concepts better when teachers explain the meaning of procedures and formulas that they are expected to use in solving problems. Often teachers introduce a formula, use it in an example and ask learners to use it without explaining how it came into being (or how it was constructed). The ability of learners to substitute correctly in a given formula is often perceived as success.

It is the disconnection of mathematics from humans that makes it incomprehensible and monstrous. Teaching it by linking it to what learners are familiar with makes it more learner-friendly and human. This approach might change learners' attitude towards the subject.

How mathematics is taught influences learners' attitude towards it. Mathematics teachers should try to make the subject interesting by making it as practical as possible (Fennema & Thomas, 1999). According to Perrot (1982:2), LCE (which he terms indirect teaching) is characterised by teacher reliance on asking questions, accepting pupils' feelings, acknowledging pupils' ideas and giving praise and encouragement.

The abstract nature of mathematics is perpetuated by the way it is taught. As stated by Hersh "Mathematics is human. It is part of and fits into human culture. It is not Frege's timeless, objective abstract reality" (Ernest, 1991:14).

2.4.6 Critical thinking

Splitter and Mallet argue that critical thinking can be taught from pre-primary grades (Splitter, 1991 & Mallet, 1994). Moreover, Wall & Posamentier (2007:95) say "Students need to explain and justify their thinking and learn how to detect fallacies and critique

others' thinking." Mathematics can be taught constructively by involving learners in the construction of mathematical knowledge and helping them make sense of it.

2.5 SHORTCOMINGS AND LIMITATIONS

> While some scholars report success in promoting preservice students to examine, reconsider, and modify their pedagogical perspectives and practices, many others write about less successful attempts or the complete failure of programs to impact on the typically traditional views that preservice candidates bring to teacher education programs (Richardson, 1997:129).

This applies to the Namibian context as well. Seventeen years since the introduction of LCE, few teachers in mathematics have been able to implement this approach successfully.

There are a number of shortcomings that have led to this situation. "McDiarmid reported that when elementary preservice mathematics teachers were confronted with mathematics instruction that challenged their assumptions about teaching, some reflected on and re-evaluated their beliefs while others resisted and retained their prior conceptions" (McDiarmid cited in Richardson, 1997:129-130). Inasmuch as the Ministry of Education, policy-makers and other stakeholders in education would like to see change in the way mathematics is taught in schools, we have to acknowledge the fact that such change is not easy to implement. Teachers should first change their beliefs about mathematics as a subject and about what it means to teach and learn mathematics. Mathematics teachers' own experience of learning mathematics also contributes to the way it is taught.

According to Fosnot (1996), when we teach mathematics, we implicitly teach values. These values have long-lasting effects on the way teachers perceive mathematics. Even after being introduced to new approaches of teaching mathematics as teachers, they might still draw on their experiences of learning mathematics in school. Change is not easy to accomplish. After centuries of teaching and learning mathematics in the traditional way, change cannot be expected overnight. For some teachers the traditional approach works and for these teachers it difficult to change. Their learners perform very well in

examinations so changing to LCE might result in their learners' performance declining and this is a risk many might not be prepared to take.

2.6 THE PERSISTENCE OF TRADITIONAL TEACHING PRACTICES IN MATHEMATICS CLASSROOMS

Reform is a process that takes time to achieve since it requires people to abandon or modify practices that have become part of them. Seventeen years since the introduction of LCE in Namibian schools, its proper implementation is still a challenge. According to Fennema and Nelson (1997:283), "The new approaches to teaching and learning suggested by reform thinking are likely to contrast sharply with the more traditional didactic form of professional development."

Some teachers are eager to put the reform principles into practice but proper guidance on how to do that is lacking. They seem to know a lot about LCE but their classroom practice is still teacher-centred. In a pilot study on teachers' worldviews, I discovered that although teachers can boldly defend LCE (in interviews), their classroom practice tends to be traditional. As stated by Fennema and Nelson (1997:20) "The motivation for helping teachers develop new forms of practice is high, but the means by which teachers actually do so are not well understood." There is no blue print on how to implement LCE in mathematics classrooms but there is a paradigm shift from positivism to constructivism that teachers are advised to use as a guide in their lesson preparations and presentations. The difference between constructivism and positivism is clear so any classroom practice that does not promote understanding and knowledge construction should be avoided.

One of the contributing factors to this trend is the fact that teachers are accustomed to traditional ways of teaching and learning mathematics. In school, they were taught to memorise formulas and use them to solve problems. During their training as teachers some of them were taught that the best way to teach mathematics is to drill learners through practice. According to the report on teacher education reform by Crebbin et al (2008), the implementation of LCE has been a challenge because teachers and learners

who are accustomed to the transmission-reception model of teaching and learning do not usually understand how the transition to learner responsibility can be achieved.

However, it has come to light that even teachers who seem to have embraced the learner-centred approach still cling to traditional practices. The conventional roles of teachers as providers of knowledge and learners as receivers of knowledge still persist in mathematics classrooms. However, change in teacher practice is inevitable in light of the reform process. According to Hinchey (1998:39), "teachers who have not yet identified their goals and checked their practices against them may lose their way. It makes no sense to use positivist methodology to reach constructivist goals and vice-versa." We cannot claim to be constructivists while employing positivist methods in our classrooms. A paradigm shift implies a change in our practices. As stated by Fennema & Nelson (1997: 285)

> transmission-reception model of learning in professional development needs to be reevaluated. If we accept that learning is an active process, we can hardly expect didactics presentation of uniform information to be an effective way of changing either teachers' understanding of their work, or their practices.

Change in practice should be preceded by change in beliefs. Teachers' beliefs about knowledge, teaching and learning influence their classroom practice. According to Cooney and Shealy (in Fennema & Nelson, 1997) "the teachers' level of consciousness about their beliefs influences their disposition to realise change." Teachers' deep-rooted beliefs in teacher-centred approach should change before they can change their practice.

Some teachers do not see the need to change from the traditional approach to the reform approach as they associate LCE with indiscipline and lowering of educational standards (Sguazzin & van Graan, 1998 and Farrant, 1980). Teachers should therefore be helped to understand that in the reform process they are "expected to see themselves as authorities in that they can evaluate materials and practices in terms of their own beliefs and practice, and be flexible in modifying their beliefs when faced with disconfirming evidence"(Fennema & Nelson, 1997:88).

The reform approach gives more authority over the handling of the subject matter and pedagogical aspects. Teachers do not have to adhere to practices that do not promote

meaningful learning in their contexts. They should be flexible in their attempts to implement LCE. Townsend (1997:14) asserts that: "Researchers, policy-makers and practitioners must always remain open to the possibility that what works well for some might not work for others." Sometimes the situations teachers find themselves in dictate the use of TCE. The way forward as suggested by Sguazzin & van Graan (1999) is to enlighten teachers on the learner-centred philosophical approach to education through continuous staff development activities.

2.7 CONCLUSION

The literature in this chapter confirms that a paradigm shift should be accompanied by change in practice. From the definitions of the concepts TCE and LCE, it is evident that these are two different frameworks. Therefore change in practice is indispensable in light of the reform approach (LCA). Literature also advocates for change in the way that mathematics has been taught over the years.

Obviously, such change is bound to be met by resistance from teachers who are used to the traditional methods of teaching. However, literature also provides teachers with mechanisms of dealing with disconfirming realities. Mathematics teachers should therefore be encouraged to comply with the reform policy and teach mathematics in a more L-C way.

Research should focus on how to help teachers implement LCE in mathematics classrooms. The misconceptions regarding the implementation of LCE should be studied. Teachers need to be assisted to become highly skilled in terms of the mathematics content and the interpretation of children's language and actions (Fennema and Nelson, 1997:291). On their part, teachers need to see the need to change. "For teachers to become invested sufficiently in this process of professional development, they must first come to believe that their current practice is in some way problematic or at least that change would be clearly beneficial" (Cobb, Wood & Yackel, 1990 and Simon,1994 cited in Fennema & Nelson, 1997:291).

The urge to pursue this research is drawn from my own experience of learning and teaching mathematics. There is a need to change the way mathematics is taught in schools because if the current practice continues, the perception of mathematics as a subject that is reserved for a selected few will persist. This is the perception that has been held by many people resulting in some learners giving up on passing mathematics in school. Change in teacher practice is therefore the key to making mathematics content accessible to all learners.

Pedagogical change is a process- a process that can be slow or fast depending on a number of factors. These include; the attitude of the implementers towards the change, their perceptions, knowledge and understanding of the new concepts and the degree of supervision and assistance rendered by their supervisors. These factors determine the pace at which change occurs to a large extent.

CHAPTER THREE
METHODOLOGY

3.1 INTRODUCTION

In a small-scale study conducted in 2007, I discovered that there seems to be a mismatch between mathematics teachers' interpretations of LCE and their classroom practice. In other words, I discovered that although these teachers understood what the concept LCE meant and how to implement it, their classroom practice seemed to perpetuate traditional teaching methods. Moreover, early literature on the implementation of LCE in Namibia asserts this trend (NIED, 2003 & Sguazzin & van Graan, 1999). The implementation of LCE in mathematics classrooms seventeen years since its inception is still problematic. As stated by Fennema & Nelson (1997:87) "Reform necessitates change that is, doing things differently. For many mathematics teachers, changing their teaching of mathematics is problematic and fraught with difficulties."

The goal of this study was to investigate teachers' practices that have led to the persistence of traditional teaching methods in mathematics classrooms. In this chapter, I discuss the research process employed in this study.

3.2 RESEARCH ORIENTATION

This is a qualitative study situated in the interpretive paradigm. According to Cohen, Manion & Morrison (2000: 22), "... the central endeavor in the context of the interpretive paradigm tends to understand the subjective world of the human experience." As stated earlier, the purpose of this study is to investigate the practices of mathematics teachers which have led to the persistence of traditional teaching methods in grade 9 mathematics classrooms in Rundu. It is therefore important to try to establish and understand the meaning and significance that these teachers attach to their practices. Bleicher believes

that "the meanings of human creations, words and experiences can only be ascertained in relation to the contexts in which they occur" (Bleicher cited in Blanche and Durrheim, 1999: 125). The context of my research will therefore have an impact on my findings.

Through this study, I intend to make sense of my participants' beliefs, knowledge about mathematics teaching and learning and use of children's thinking in the classroom (Fennema & Nelson, 1997: 264). The interpretive paradigm helps us "discover the meanings and beliefs underlying the actions of others" (Connole, 1998: 17). This study was designed in a way that would help me shed light on three mathematics teachers' interpretations and implementation of LCE.

3.3 DESIGN OF RESEARCH TOOLS

In this study, three tools were used namely; questionnaires, interviews and observations. The questionnaires were used to identify my participants since the three participants were purposively selected. Below, I describe how each of these tools was used.

3.3.1 Questionnaires

On the questionnaire, provision was made for respondents to indicate the orientation of their teaching practice. Three options were given:

1. More L-C
2. Both L-C and T-C
3. More T-C

From these options, my intention was to have three representatives (one representing each option). However, what transpired is that, I managed to get one representative for option one; several representatives for option 2 but none for option three. This was anticipated since TCE is regarded as an old fashioned way of teaching that is not supported by the reform policy. Teachers are aware of this since they are encouraged to move away from the traditional approach. As a result, teachers were reluctant to publicly

state that they would rather continue with the traditional approach even when the new approach seems to be failing.

This matter was discussed with my supervisor who then advised me to interview a mathematics education officer who has been dealing with mathematics teachers for about three years. An education officer or an advisory teacher (as they are commonly known) is responsible for giving advice, guidance and support to teachers pertaining to their specific subjects. He was identified as a suitable replacement for the third participant due to his rich experience with different mathematics teachers and the fact that he was also a mathematics teacher before he became an advisory teacher. He would also be able to provide a rich and detailed perspective of the TCE and LCE approach as perceived by teachers in the broadest sense due to his interactions with many teachers in his region

3.3.2 Interviews

Semi-structured interviews were used. These allow the researcher to "... probe responses and investigate motives and feelings" (Bell, 1999: 135). Sometimes during interviews, respondents say things that the interviewer might want to probe and semi-structured interviews make provision for that. According to Cohen et al (2000: 267), "Interviews enable participants-be they interviewers or interviewees to discuss their interpretations of the world in which they live and to express how they regard situations from their own points of view."

Since my goal is to investigate mathematics teachers' practices in their classrooms, I had to find out why they opt for certain practices and not others. This could effectively be established through semi-structured interviews. The participants were asked to discuss their interpretations of the concepts LCE and TCE and how these can be implemented in a mathematics classroom. I drafted an interview framework with similar questions which I used to interview all three participants. The interview framework was designed in such a way that it would address issues pertaining to:

- The participant's experience of learning mathematics in school
- Their source of inspiration to pursue the teaching profession

- Their training
- Their definitions of LCE and TCE
- How they implement LCE
- What they regard as examples of L-C or T-C activities
- Advantages of using LCE
- Challenges that they encounter in trying to implement LCE
- Their messages or advice to their fellow mathematics teachers

3.3.3 Observations

Observations are a crucial component of this study since the issue at hand is teacher practice. As stated earlier, contradictions might occur between what teachers say in interviews and their practice in the classroom. According to Cohen et al (2000: 304) observations enable the researcher to amongst other things "see things that might otherwise be unconsciously missed, to discover things that participants might not freely talk about in interview situations to move beyond perception-based data."

Initially, I intended to observe three teachers' classroom practices but since the third participant could not be found, I only observed two. The third participant could not be observed because he is no longer a teacher. The two teachers were observed twice on topics of their own choices.

During my observations, I used an observation schedule which was designed using aspects of the Posner, Strike, Hewson and Hertzog model (Brophy, 1996: 126). This is a conceptual change model suitable for the implementation of LCE. It describes teaching and learning aspects that qualify as L-C and these are mainly the aspects that were used in my observation schedule (chapter 4 table 4.1-4.2 LCE aspects). This model was not adopted in its original form. It was modified using some aspects of the radical and traditional teaching table (Olson, 1997:57). This table distinguishes between radical and traditional teaching practices. Most of the TCE aspects in my observation schedule came

from this table (chapter 4 table 4.1-4.2 TCE aspects) since it makes a clear distinction between LCE and TCE practice.

Although all the aspects in the observation schedule were assessed during the observations (as can be seen in the observation schedules chapter 4 table 4.1-4.2) not all of them were used in the analysis framework. Only the following L-C aspects were used:

- Sound knowledge of mathematics knowledge
- Adequate knowledge of learners' prior knowledge
- Adequate knowledge of instructional practice
- Classroom environment supports learning of mathematics
- Encourages learners to ask questions
- Employs meaningful tasks and provides real-life examples

I found these useful for the purpose of this study because they determine to a larger extent how L-C a teacher is. LCE education is not only about being knowledgeable about teaching strategies, teachers are expected to have sound knowledge of mathematics to be able to teach it proficiently (Kilpatrick et al, 2001).

Learners' prior knowledge plays a very important role in the implementation of LCE. It is one of the major distinguishing characteristics between LCE and TCE. It is therefore an indispensable factor in a study of this nature.

Adequate knowledge of instructional practice refers to how well a teacher can apply different L-C teaching strategies to suit his/her context. Since the focus of this study is on the implementation of LCE in mathematics classrooms this aspect could not be overlooked.

The classroom environment is another important aspect of LCE. It is vital to make our classrooms conducive to the implementation of LCE. Some of the classroom setups do not support the implementation of LCE. This aspect does not only refer to the classroom

setup but it also incorporates the teacher's conduct in the class and the interactions that occur between the teacher and learners.

One of the aspects that seems to have received little attention in the implementation of LCE is that of giving learners the opportunity to ask questions. It seems to be an aspect that has been taken for granted so I saw it fit to incorporate it in my analysis framework. The last aspect that was used in the analysis framework is the use of meaningful tasks or real-life examples. This is also a very important aspect of LCE because it has an impact on the success or failure of the other aspects mentioned earlier. This is when a teacher tries to make mathematics content relevant to his/her learners by relating it to their prior knowledge. This is a skill that mathematics teachers need to make mathematics real and less abstract.

Some of the aspects used in the observation schedule emerge from my literature review (chapter2). From these three sources, I constructed an observation schedule in form of a table that is composed of LCE aspects and TCE aspects which I used to evaluate my participants lessons.

3.4 PROFILE OF PARTICIPANTS

Participant 1, who is referred to as teacher A is a representative of the first option (more L-C). She is a female teacher in her late twenties. She has been teaching mathematics for about seven years. Currently, she is a head of department for mathematics and science at Nawa Combined School and offers grade 9 and 10 mathematics. This is a rural school on the outskirts of Rundu. She did her initial training at Rundu College of Education (RCE) where she obtained her Basic Education Teachers' Diploma (BETD). After that she pursued a Higher Education Diploma in mathematics with the Institute of Open Learning (IOL).

Participant 2, who is referred to as teacher B is a representative of the second option (both LCE and TCE). She is also a female teacher in her mid thirties. She has been

teaching mathematics for about eleven years. She teaches grade 8, 9 and 10 at Kavango Secondary School. Kavango Secondary School is a newly built urban school in Rundu. Just like teacher A, teacher B also did her initial teacher training course at RCE. Thereafter, she enrolled with Rhodes University for a Further Diploma in Education (FDE) specialising in mathematics education. After her FDE she again enrolled with Rhodes University for the Bachelor of Education Degree (honours) specialising in mathematics education.

Participant 3, who is referred to as Mr Hausiku is a male Education Officer (EO) in his late thirties. He is stationed at the regional office in Rundu but he often goes out to visit mathematics teachers at different schools in the region. Mr Hausiku had been a teacher for about 11 years prior to his appointment as an advisory teacher for mathematics. As a teacher, he also served as a head of department for mathematics and science and a principal. Mr Hausiku was also trained at RCE. After obtaining his BETD he enrolled with Rhodes University for an Advanced Certificate in Education specialising in mathematics education. He is currently doing his Masters Degree in education (MEd) with Rhodes University.

3.5 RESEARCH SITES

Kavango Secondary School is an urban school in Rundu offering grade 8 to 12 but grade 12 will only be offered next year (2009). It is a newly built school with about twelve classrooms, a computer laboratory (which is not functional yet), a science laboratory, a library, a caretaker's house and a well designed administration block. Structurally, this school can be described as one of the modern schools in Rundu.The school is composed of about seventeen teachers. Among them are two mathematics teachers. One of them is teacher B, the teacher serving as a participant in this study while the other mathematics teacher is responsible for the senior grades.

The school is headed by a female principal who is assisted by two heads of department. The language department is headed by a female English teacher while the mathematics

and science department is run by a male science teacher. There are supposed to be three heads of department but the commerce department is still vacant. The school accommodates learners from all walks of life but the majority of these learners come from Sauyemwa, an informal settlement on the outskirts of Rundu. There are about three hundred learners enrolled at the school.

The school performed very well in the grade 10 national examinations in 2006, the year that it was established. It was ranked seventh in the region. However, the performance declined last year (2007).

Nawa Combined School is rural school on the outskirts of Rundu. The school offers grades from pre-primary to grade 10. It is one of the few schools that was selected to incorporate the pre-primary phase into the formal system. This is one of the oldest schools in Rundu. It was established in 1958.The school is equipped with a TV room, a computer laboratory, a library and a science laboratory. These are converted structures, in other words, they were meant to be classrooms but they have been converted into these facilities to cater for the teaching and learning needs of the school.

The school currently accommodates 520 learners and 21 teachers. Of these teachers, four are responsible for mathematics. There are two heads of departments, teacher A heads the mathematics and science department while the social science department is headed by a male teacher.

The performance of the grade 10 learners has improved in the past two years. The pass rate in 2007 improved by 10% (from 40% to 50%). Most of the learners come from Kayengona village, a village in the vicinity of the school where most of the inhabitants depend on subsistence farming for a living.

3.6 DATA ANALYSIS PROCESS

The data collected from the questionnaires was simply used to identify my participants. The participants were selected on the basis of the options that were chosen.

The data from the interviews was analysed using the interview framework outlined in 3.4.2. I will look at each of the aspects in the framework and justify its importance in my data analysis.

3.6.1 Experience of learning mathematics in school

This is important as some researchers associate teachers' experience of learning mathematics with their practice when they become teachers. According to Orton & Frobisher (1994:24), "Teachers will have different beliefs about mathematics depending on their experiences, particularly of being taught mathematics themselves." This would therefore guide me in trying to establish whether there is a link between teachers' experiences of learning mathematics and their teaching practice.

3.6.2 Source of inspiration

People become teachers for different reasons, some of which might have an impact on their classroom practice. Their source of inspiration might contribute to the way teachers teach to a certain extent.

3.6.3 Teacher-training

Obviously, the kind of training that teachers go through will have an impact on their teaching. Some teacher training institutions place more emphasis on content acquisition while others place more emphasis on addressing pedagogical issues. The BETD curriculum for example lends itself towards the latter as it was introduced to implement the reform approach shortly after independence.

3.6.4 Definition of LCE

LCE is interpreted in different ways resulting in different teacher practices. Teachers may claim to be implementing LCE but their interpretation of what this concept entails determines how well it is implemented in their classrooms. This will help me establish whether there is relationship between teachers' interpretation of LCE and their practice.

3.6.5 Implementation of LCE

As stated earlier, a teacher's interpretation of LCE informs his/her practice however, it is important to note that there is no direct relationship between one's interpretation of LCE and his/her practice. Some teachers may understand the LCE concept fairly well but their teaching approach lends itself towards traditional or teacher-centred. This is partly due to the fact that the change from traditional to reform approach is influenced by other factors such as teachers' beliefs. Some teachers simply do not believe in the LCE framework due to its shortcomings. However, since it's a national policy, teachers are reluctant to state that they still practice TCE. This makes the implementation aspect a policy and belief issue.

3.6.6 Examples of LC-activities

This is important because firstly, a teacher who claims to practice LCE should be able to provide examples of the type of activities that he/she regards as L-C. These activities can then be analysed to see whether they qualify to be classified as L-C. LCE education is sometimes misinterpreted and this can be reflected in the type of activities that teachers design for their learners.

Secondly, if teachers design meaningful L-C activities, those who are not succeeding could learn from them since what works in one context might work in another context. This is a concern because LCE is usually interpreted as group work and that is usually the end of the story. Little attention is paid to the way the group work is designed and the extent to which learning occurs.

3.6.7 Advantages of putting LCE into practice

The advantages of LCE might serve as a driving force that could encourage teachers to implement it. Teachers who practice LCE should be able to defend its significance in mathematics classrooms. This could help other teachers, especially those who are resistant to change see LCE as a valuable educational framework that is worth implementing.

3.6.8 Challenges encountered by participants

The goal of this study is to investigate the persistence of traditional teaching methods in mathematics classrooms. By interrogating teachers on the challenges that they encounter in their efforts to implement LCE I might find the answer to my research question. However, it is important to note that the effects of these challenges might differ from one context to another. Some contexts are L-C friendly while others are not.

3.6.9 Message or advice to mathematics teachers in Rundu

Although this aspect sounds too broad my intention is to help mathematics teachers reach out to one another. I expect mathematics teachers to share their different experiences with regard to the implementation of LCE. This is a good platform for teachers to advise one another on how to deal with some of the challenges that will be mentioned in the previous aspect 3.6.8.

3.7 PROBLEMS ENCOUNTERED

The first problem that I encountered was the fact that the third participant was not found. I had hoped to find a mathematics teacher who could boldly defend the use of TCE because this person could help me answer my research question as to why traditional teaching methods persist in mathematics classrooms. Fortunately I was able to find a substitute for the third participant. Although this person is no longer a teacher, I was able to draw on his rich experience because he had been a teacher for many years and he is a

mathematics advisory teacher whose main responsibility is to give advice and support to mathematics teachers. This made him a suitable substitute because he could help ascertain my earlier observations about teacher practice.

The second problem was that one of my participants withdrew before the completion of the data collection process. The loss of her husband compelled her to withdraw from the study.

The third problem encountered was that my first participant (more L-C) was promoted to as a head of department for mathematics and science to a school out of town. This affected my research because I could not find a substitute for her. I had to give this participant time to settle down in her new work environment before proceeding with the research. This resulted in a delay in the data collection process. Traveling to her school was also a problem because her new school is not easily accessible.

The fourth problem was that my second participant had to take church trips during the second term of this academic year (2008) and that was the time that I intended to collect my data. She was not at school most of the time and this also kept me behind schedule.

3.8. VALIDITY

Validity refers to the extent to which results can be generalised or applied in other situations. The fact that this is a case study in itself is a validity issue because case studies cannot be generalised. A case study is an in depth study specific to a given context. Subjectivity can therefore not be ruled out in this kind of study.

The fact that LCE is a national policy is another validity threat since teachers are constantly reminded to move away from the traditional teaching approach and implement the reform approach which is LCE. Therefore, it was not easy for mathematics teachers to openly state that they still practice TCE. This was revealed in the participants' responses to the questionnaires in which they were asked to state the orientation of their teaching

practice. Most of them opted for option two which is a combination of both LCE and TCE. Only one teacher opted for LCE and none opted for TCE. It is not easy to ascertain the teachers' teaching orientation but it is obvious that the new policy has an impact on what teachers say with regard to their teaching practice. However, the new approach has not gained popularity among the mathematics teachers either.

If teachers were convinced that LCE is the answer to their pedagogical problems, most of them could have opted for it since it is advocated for by the Ministry of Education. From the findings of the questionnaires it can be deduced that mathematics teachers are not comfortable with the LCE framework but they cannot openly state that they would rather continue with the old approach (TCE) so they find a comfort zone between TCE and LCE.

The choice of participants is also a validity issue since both teachers are females, except for Mr Hausiku whose classroom practice could not be observed. Gender and racial bias are potential validity threats.

3.9 ETHICAL ISSUES

3.9.1 Permissions

According to Bell (1999:39), "Research ethics is about the nature of agreement you have entered into with your research subjects or contracts." I started my research by seeking permission from the director of education in the Kavango region. Permission was granted and questionnaires which were used to identify my participants were then distributed to seven schools in the vicinity of Rundu.

Of these teachers, one indicated that her practice is orientated in the LCE framework. The rest of the mathematics teachers in the seven schools indicated that they employed both LCE and TCE in their lessons. In other words none of the teachers opted for more T-C as an option. Prior to my visits, permission was also sought from the school principals of the concerned schools. They were informed about my intention to involve their schools in my

research and they willingly granted me permission to conduct my research at their respective schools.

3.9.2 Anonymity and consent forms

My participants were all informed about the purpose of my study and they participated voluntarily. Consent forms in which participants were assured of confidentiality and anonymity were issued and signed by all participants. "The essence of anonymity is that information provided by participants should in no way reveal their identity" (Cohen et al, 2002: 61). Confidentiality is a crucial aspect of research as it is the only way that the researcher can look after the interests of his/her participants (Bell, 1999). On this basis, the real names of the participants and their schools have not been mentioned. However, this information is available in my research archive.

3.10 CONCLUSION

This chapter focused on the research orientation in which I described the research paradigm used in this study i.e. the interpretive paradigm. This type of research seeks to understand the meanings attached to human actions. This was followed by a detailed description of the research tools used for data collection and these are questionnaires, interviews and observations. I also gave a brief profile of my participants and the research sites. Thereafter, a description of the data analysis process was given. In this section, I explained how I analysed my data and justified my analysis framework.

I also reflected on the problems encountered during the research process. This chapter was concluded with a brief discussion of the validity and ethical issues pertaining to this study.

Despite the problems experienced during the research process, it was worth pursuing and a number of lessons were learnt from this experience which can be used to refine future research procedures and tools in this arena.

CHAPTER FOUR
DATA ANALYSIS

4.1 INTRODUCTION

"Tension between the new and the old is the engine which drives critical reflection-it is the source of energy for interpretation. The new always says something about the old- often the new is seen as criticism of the old. The new, wherever it comes from, causes reflection about the old- it introduces new language, upsets old assumptions, threatens loss and promises plenty. What can be made of this critical tension for professional development?" (Olson, 1992: 80)

In this chapter, I present, analyse and discuss the findings from my study. This study was conducted to investigate mathematics teachers' practices that have led to the persistence of traditional teaching methods in mathematics classrooms. The investigations were conducted through interviews and observations.

I start by presenting the research context of this study which will be followed by the presentation and analysis of the interviews. This will be done using some aspects of the framework of my interview framework, namely; the participants' experience of learning mathematics in school, what inspired them to become teachers, their teacher-training courses, their definitions of LCE, how they implement LCE in their mathematics classrooms, examples of L-C activities, what they think the advantages of using LCE are, challenges that they encounter in their attempts to implement LCE and what message or advice they have for their fellow mathematics teachers. Since it was useful to find out the kind of support that is offered to mathematics teachers from my third participant, I have included this aspect specifically for the third participant.

The analysis of the lesson observations will be done using a framework that was derived from the Posner, Strike, Hewson and Gertzog model (Brophy, 1996:126) and Olson's table on radical and traditional teaching (Olson, 1992: 57). This model helps to

distinguish between L-C and T-C practices. The chapter will then be concluded with the discussion and conclusion of my findings. The discussion will be framed around some important aspects of LCE which include: Prior knowledge, teacher's interpretation of LCE, the implementation of LCE, the advantages of using LCE and some of the challenges that teachers face in their attempts to implement LCE. These aspects might help me answer my research question as to why traditional teaching methods persist in mathematics classrooms in light of the reform approach.

4.2 INTERVIEWS

4.2.1 Brief background of participants and interview venues

The interviews with participant one or teacher A were conducted at a quiet venue on Friday 24 July, 2008 (16h00). There were no disturbances during the interview session. Teacher A has been teaching mathematics for seven years. In a questionnaire that I used to select my participants', teacher A indicated that her teaching practice is oriented towards LCE.

Participant two or teacher B was interviewed on 22 July 2008 at a quite venue at her school. The venue was less spacious but this did not affect our interviews in any way. The interviews were conducted as planned and there were no interruptions. Teacher B indicated that her teaching practice is situated in both TCE and LCE. She has been teaching mathematics for about eleven years.

The interviews with Mr Hausiku, the mathematics education officer were conducted on 18 October 2008 at a quite venue at NIED (Okahandja). The involvement of Mr Hausiku in this study was necessitated by the fact that the third participant could be not found. Of all the questionnaires that were distributed to mathematics teachers in the seven selected schools in Rundu, none of them indicated that their teaching practice is oriented towards TCE. Mr Hausiku was identified as a suitable candidate due to his rich experience with different mathematics teachers in the region. As an advisory teacher, Mr Hausiku's main

responsibility is to advice, guide and support mathematics teachers. Therefore, it was agreed that his input would enrich my study.

4.2.2 Experience of learning mathematics in school

Teacher A says mathematics was one of her favourite subjects in school. It was not easy learning it but through hard work she succeeded. She was also inspired by some of her mathematics teachers. "*It was not easy but you just... it's just through hard work. You just have to work hard. It was also inspiration from some of my teachers*" (teacher A, line 5-7).
On the other hand, teacher B regards her experience of learning mathematics as enjoyable at primary school but tough at secondary school.

At primary mathematics was enjoyful because most of the time we were using concrete materials like we were playing. So I think the problem started when I came to the secondary level so mathematics became difficult for me because like...during homework or test or examination...it was not easy to memorise all those formulas and it was just a matter of memorising them and...follow the methods so that's the way how...we were taught in school (teacher B, line 4-12)

According to teacher B, the use of concrete materials at the primary phase made the learning of mathematics easier as opposed to the abstract nature in which it was taught at the secondary phase.

Mr Hausiku, the educational officer also says he enjoyed learning mathematics in school and he attributes his good performance in mathematics to his brother with whom he shared his mathematical experiences. In line 4-6 of the interview Mr Hausiku says: "*I enjoyed learning mathematics. So this was due to the fact that my brother had a good background of mathematics...every time when I was at home we used to talk about mathematics.*"

4.2.3 What inspired them to become teachers:

Teacher A says initially, she never wanted to become a teacher. She wanted to become a doctor but when this door closed she opted for the teaching profession. The way her teachers taught mathematics inspired her to specialise in mathematics. She describes her primary and secondary school teachers as hardworking. Asked whether she regrets becoming a teacher, she said she enjoys teaching and she now thinks she made the right decision by choosing teaching as her career.

In line 8-12 of the interview, she says: "*Mainly, I never wanted to become a teacher but when the door for becoming a doctor closed, then I just opted for teaching and thinking of subjects at school...which one to go for, I just opted for mathematics and then teachers who taught us they were very hardworking and they inspired me also to work hard...*"

Teacher B was inspired by her experience of learning mathematics in school. She wanted to make a difference in the way that mathematics was taught in secondary schools and reduce the high drop out and failure rate of learners in mathematics by exploring different teaching strategies.

I think from my experience...then I thought many learners used to drop or they used to fail mathematics...then I...I just took the challenge that let me study mathematics, learn it and see how I can help my fellow Namibians, those who need to specialise in mathematics. I think at that point I thought I should uuh...I should uuh...explore this field in order to get mmh...more strategies and ideas how to give it to others (teacher B, line 27-35).

Just like teacher A, Mr Hausiku says initially, he never intended to become a teacher. His dream was to become a medical doctor or to secure a job in the field of technology. "*Teaching per se was not my option, initially when I was at school. I thought of becoming something like a medical doctor or someone in the field of technology*" (Hausiku, line 10-12).

4.2.4 Their definitions of LCE

All the three participants defined LCE as a teaching approach that places the learner at the centre of all the teaching and learning activities. *In my understanding, LC is a method whereby the teaching and learning process involves the learners most of the time... not just by letting them make noise or talk but you also help them whereby you give them problems...they solve it and then you also go in and explain and give clarification but the centre should be them.* (teacher A, line 32-35)

We are more specific at... looking at...the learner as the centre of learning so we concentrate more on the learner getting the information and internalise the information. Learners are expected to: "*catch the information, get the information and use that information*" (teacher B, line 99-102 and line 106-107).

LCE, from my understanding of the concept is the paradigm that places the learner in the centre of learning and it does not necessarily mean that the responsibilities of the teacher are taken away from him/her (Hausiku, line 43-45).

4.2.5. Their teacher-training

The three participants all received their undergraduate teacher-training at Rundu College of Education (RCE) where they obtained their Basic Education Teacher Diploma (BETD) and they all seem to agree that this training focused more on the reform approach (LCE) than content knowledge.

The content...I would say...it was there but mainly we were taught on how to teach the subject. Even though there was a bit of content but mainly we were equipped with the teaching methods (teacher A, line 26-28)

Although it wasn't much but I just got some basics, how you should approach mathematics uuh...uuh, especially in the classroom (teacher B, line 45-47).

With the college training more emphasis was put on LCE per se which was not well understood that much but with Rhodes we did much of investigative mathematics (Hausiku, line 33-35)

It is evident from the participants' views that their initial training was inadequate in certain aspects. Consequently, all of them enrolled with other institutions on a part-time basis to enrich their pedagogical and content knowledge.

4.2.6 Implementation of LCE

Teacher A believes that at the beginning of each lesson, the teacher should spend time on explaining new vocabulary so that learners are acquainted with the terminology that is to be used in that topic. "*Mostly when...I start teaching or at the beginning of the lesson, we always discuss the vocabulary that's coming in the topic so that they know what they are expected to learn in that topic" (teacher A, line 45-47)*. She also believes that learners (especially brilliant learners) should be given the opportunity to explain mathematical concepts to their fellow learners as learners could understand their fellow learners better than they understand the teacher.

When I'm giving corrections for homework, I would ask one of the learners who did well to explain to the others how he got the answers especially those who got most of the things correct...just to share with the others. Maybe the learners would understand the other one better or the method that the other learner is using can be easily understood by the other learners (teacher A, line 37-42).

Teacher A also emphasises the need to create an environment that is conducive to the implementation of LCE. The classroom should be arranged in such a way that it can accommodate group or pair work. "*Mainly, it also depends on how you arrange the*

learners in the class...because in most classes that I have seen...you enter I nto a class and the desks are in rows but the person wants to practice learner-centred" (teacher A, line 75-78). She believes that this would prepare learners (psychologically) for discussions and sharing of ideas.

The use of real-life examples is another method of implementing LCE stated by teacher A. This according to her helps learners to make sense of mathematical concepts. In line 85-90 of the interview, she says:

And then another thing is...to use guidance of real examples in the classes that are more related to daily things or you ask them...you ask the learners things that they are experiencing in their daily life which they can use in the class but you should also relate it to...you make it relevant to them that's part of class activity

Teacher B believes it is important to use both LCE and TCE because in her opinion, LCE works better when dealing with topics that learners can relate to but when dealing with difficult topics TCE is more appropriate because it gives the teacher the opportunity to teach the learners and share with them what they need to know. In line 153-165 of the interview, she says

...I'll check at the...the topic which I'm...I'm teaching. It will also determined whether I'll use more of learner-centred or of teacher-centred because there are some topics which are very easy for the learners to do on their own. So what we do is just facilitate whether they are doing it right...but some other topics they are not easy for learners to catch up. Uuh...sometimes you cannot even...it's not easy to relate them to their daily life...something which they know so they are more of abstract. So on that ...on that one I have to come in and I have to provide information for them to do their class work, home work or even test.

Mr Hausiku says as a teacher he used to implement LCE by using teaching strategies such as group work, cooperative learning, investigations, projects, pair work and

inquiries. These strategies according to him help learners develop the spirit of working together and sharing ideas. "*I learnt that aspects such as group work, cooperative learning and inquiries for example were issues that were supposed to be used in my teaching and learning activities. So I tried to...bring in those aspects of group work, group discussions and pair work*" (Hausiku, line 63-65).

4.2.7 Examples of learner-centred activities

When asked to give examples of L-C activities teacher A had the following to say:
...what I have been doing with my learners. I don't only give them homework so that they have to sit in class. I give them something like investigation...give them something they just have to go home and do and then normally...I give them in pairs or in groups (teacher A, line 65-69).

And most of the investigations they are more practical...for example I ask them to draw...if it's about measures I will ask them to measure their...the perimeter of their rooms or just something that they know about and that will also make them to enjoy the activity. (teacher A, line 70-73)

Teacher A believes that mathematics should not be classroom-or book-bound. Learners should be exposed to practical activities out of the classroom in order to enhance their understanding of mathematical concepts.

Since teacher B applies both TCE and LCE, she explained that the approach she chooses to use is determined by the nature of the content that she is dealing with. She uses LCE when dealing with easy topics while TCE is reserved for difficult topics because she has to explain abstract concepts to the learners. This is what she had to say when asked to give examples of topics in which she uses LCE and TCE:

What example should I give now? Uuh...ok let's look at...at... Let's look at statistics...statistics will be easy. You can give learners to go and...find some information

or you can just tell them to find out from your classmates: what is their favourite drink or what colour do they want? So there a teacher you don't have to...to give much. So learners will be able to do that. And when you go further so they'll need more from..from the teacher because they might not be able to...to draw a pie chart and they need to use the protractors to...to measure all the degrees so it's becoming more advanced so there I need to get more involved (teacher B, line 170-185).

Mr Hausiku cited topic tasks, investigations and projects as examples of L-C activities. Specific classroom examples of how the tasks mentioned above should be carried out were however not given. He believes that practical investigations help learners develop a better understanding of concepts. "*We take the issue of practical investigation, this makes kids to go for investigative approach and this is what the L-C is all about. Through investigation, they will develop a better understanding of the concept...*" (Line96-99)

4.2.8 Challenges they encounter in their attempts to implement LCE

Teacher A cites attitude problems from her colleagues as the biggest challenge. She says although she tries to arrange her classes in a L-C way, her colleagues keep rearranging it to suit their teaching approach i.e. TCE. "*The biggest challenge is attitude from a...other teachers because you can arrange your desks or you can arrange your learners in groups...the next teacher who comes changes...individually work and giving things which you are...not trying to...uuh to practice*" (teacher A, line 93-96).

The lack of resources is the other challenge identified by teacher A. She says teachers are heavily dependent on textbooks and learners' exercise books which are sometimes not enough. "*And then another thing is the availability of materials... so we depend more on textbooks. So if you don't have enough textbooks or learners' exercise books so it will make it difficult for you to make your teaching effectively*" (teacher A, line 102-107).

In addition, cites overcrowded classrooms as the other challenge that hinders the implementation of LCE. *"And then in other schools it's the overcrowdedness of classes, whereby there's 40 learners in a class and it will not be easy to work...to implement. Even though you try your best but it will not be successful...to implement it as you wanted."* (teacher A, line 107-111). LCE advocates for individual instruction to ensure that learners' needs are addressed. This is not possible in overcrowded classrooms.

Furthermore the negative attitude of learners towards mathematics was identified by teacher A as another challenge. With this attitude, it is difficult to get learners interested in mathematics and engage them fully in mathematics activities. *"And another thing is ...learners' attitudes because learners have very bad attitudes towards the subject so if you don't work on it then it will be very hard for you to...teach"* (teacher A, line 111-115). One of the goals of LCE is to develop learners' interest in the subject (in this case, mathematics). However, if learners develop a negative attitude towards it, it is a challenge to get them interested. As stated by teacher A, the learners' attitude should be worked on before the teacher can get them interested in mathematics.

For teacher B, one of the challenges of LCE is that *"it's a waste of time"* (teacher B, line191). She gives as an example the grade 10 mathematics syllabus that teachers are expected to complete within two terms. She says this syllabus is long and if LCE is used then it cannot be completed. This according to her is what compels teachers to use TCE most of the time-to cover the syllabus. In line 192-197 of the interview, teacher B stated:

I'd say like that...for grade 10 syllabus...it's too long and you are required to finish it within two terms so then it will force you to use more of teacher-centred because if you give more time to work...to...to the learners to do...to do the work all the time you might find that you will not finish in a period of 40 minutes.

Moreover, she says if learners are given work to do in groups, they take time to finish and this delays the teacher as well. She says the duration of lessons (40 minutes) is not enough for L-C activities and proposes that an hour would do. This also affects the

learning that takes place in a given lesson as some learners need more time to understand concepts. The other challenge is that sometimes learners get so carried away with the group or pair activities that they end up not doing what they are supposed to do. So eventually, the teacher would not achieve his/her objectives. "*Like if you say they should work in pairs...they are so...they are...the...they are so interested in working with others and they might over-do it...make a lot of noise and things like that*" (teacher B, line204-207)

The disadvantage of using TCE approach mentioned by teacher B is that sometimes learners get bored and pay very little attention to the teacher. She says this often happens in summer when it is too hot. It is therefore advisable to give learners activities that can keep them active throughout the lesson. In line 207-211 of the interview, teacher B says: "*And for teacher-centred you'll find out that sometimes learners don't concentrate that much when...when you are teaching...like this time when it's very hot...learners will be dosing when you use most of that method.*"

Mr Hausiku reiterated some of the challenges already mentioned by teacher A and teacher B such as overcrowded classrooms, lack of teaching and learning materials and the language barrier.

Moreover, he identified teacher-training as another challenge that hampers the implementation of LCE. Some of the teachers were trained during the colonial dispensation while others were trained after independence. "*...teachers who are dealing with mathematics for now were trained differently*" (Hausiku, line 137-138). He believes that these teachers were exposed to different approaches and this makes the full implementation of LCE difficult because the re-training of these teachers has been a challenge. Therefore when new teachers are trained and sent to schools, they meet teachers who have never heard of LCE using traditional teaching methods. In line 138-141 Hausiku says: "*...and the people who were trained before independence never heard of...or never heard of the concept LCE. The only method that was there was the traditional one.*"

Lastly, the fact that the LCE concept is not well defined during the training of teachers is also a challenge mentioned by Mr Hausiku. He claims that teachers get a shallow understanding of LCE when they leave the teacher-training colleges. The problem according to him is that the government employs teacher educators (lecturers) who have not been exposed to the LCE concept to implement it in colleges which he regards as a contradiction. *"I pointed out that our trainers...those who trained us...the teachers have never gone through a training that talked about the philosophy of...of BETD which employed LCE and the Ministry...the government made use of those people to train us which I...I think was a contradiction"* (Hausiku, line 158-162).

4.2.9 Advantages of implementing LCE

Teacher A believes that the biggest advantage of using the LCA is that it develops learners' personal interest towards learning in general and towards learning mathematics in particular. Moreover, she believes that it improves learners' communication skills-a skill that is not only needed in mathematics but in other disciplines as well.

The biggest advantage that I have seen so far is: it develops learners' personal interest towards learning especially the subject...but not only mathematics because when you make learners to be free in the class...to talk...to communicate, you also improve their communication skills which is not only needed in mathematics. It's also needed in other subjects (teacher A, line 119-124).

The other advantage stated by teacher A is that it helps teachers evaluate their teaching strategies and identify learners' paces of learning. In line 124-128 of the interview, she says:

And it also make...it also helps teachers to evaluate their teaching strategies whether the way you are teaching is...ok for the learners or you need to improve. And then it also

make it easier...because in our classes we have learners with different learning abilities...

Teacher B believes that using both LCE and TCE makes work easier for both teachers and learners. She says: "*You ...I think they make work easier both for the teacher and...and the...the learner*s" (teacher B, line 229-230). She believes that some learners understand mathematical concepts better when they have a teacher teaching in front of them while others prefer discussions with their classmates in groups.

If you observe in the class there are those who catch up easily when...when a teacher is...is...is talking. And at the same time, in the same class, there are those...they might not understand the teacher well so they prefer if...if I'll ask my friend, I'll...I'll do it better so they prefer working in groups. So you don't need to concentrate on one (teacher B, line 231-238).

Therefore, using both approaches would advantage both types of learners. She points out that learners who are good in mathematics usually prefer working on their own. They do not like sharing ideas with their fellow learners. They are fast to work out exercises and they perceive group work as a waste of time since they are delayed by the slow learners in their groups. According to her, such learners prefer listening to the teacher.

There are these ones...especially there are those learners who...whom you find that they are very good in mathematics, they don't like sharing their information. They prefer to do the work alone because for him when you just say: "work out this...even if he does not do it on paper he's already done so he doesn't want to work. He just wants to listen. You talk...you go to the next one...you talk (teacher B, line 238-247))

Mr Hausiku believes that what one learns on his/her own lasts longer in the mind. In line 115-116 of the interview, he says: "*...the real advantage is: something that one learns and do on his or her own eeh...lasts longer in the mind than being told.*"

4.2.10 Message or advice from the participants regarding the implementation of LCE

According to teacher A, teachers should try to implement LCE despite the various challenges mentioned earlier such as overcrowded classrooms. They should learn to manage overcrowded classes by dividing learners into manageable groups and attend to them at different times and also in the afternoons.

My message to them is that they should try to implement it even though they find themselves in overcrowded classes so they can make time 'cause in a class, you can have two or three groups. So, you divide your learners...some they can come in the afternoon so that it's...at least each learner is attended to (teacher A, line 156-160).

She further advises her fellow teachers to seek advice on the implementation of LCE. In line 161-165 of the interview, she says: "*And then they should also be open...ask if they need help because what I have seen...some people, they don't ask...either they know something or they don't know...they don't ask 'cause it's like if they ask then they think that then they are stupid.*".

Moreover, she believes the sharing of experiences amongst mathematics teachers is very important as it gives teachers the opportunity to learn from one another.

And then another thing, they should share...share with others what they know, so if you...experience the same problem as a ...certain teacher so you can sit together and discuss how you can at least make it better for yourself and then you can make it better for yourself and for your learners 'cause they are the ones who are suffering at a later stage (teacher A, line 165-169)

Teacher B advises her fellow mathematics teachers not to give up despite the various challenges that they encounter. Sometimes teachers seem to be doing their best but their results are discouraging. This should not discourage them. "*Ya...I'll say teachers in*

Rundu we don't need to give up...you see. There are sometimes when you feel that you are...doing your best but coming to results the learners don't...so we don't need to give up" (teacher B, line 258-261).

She advises teachers to try using different strategies. She says teachers need to help learners change their attitudes towards mathematics because learners believe that mathematics is a difficult subject. In line 262-268 teacher B says: "*We have to try different strategies. Sometimes eeh...we look at the psychology part. We need to change the way they think about mathematics because you can see most of the learners they are...they are resistant...they don't want to learn. They just believe that it's difficult so it's up to us to change all those believes.*"

Moreover, she encourages teachers to use more LCE approach in their mathematics classes because this approach helps learners take ownership of the knowledge gained and enables them to interpret it in their own language. "*I think we should try to use more of learner-centred. You just need to find some time to use it because it helps the learners to...to...as I said to get this information as theirs and then interpret it in their own understanding and in their own language...*" (teacher B, line 270-275). She further says memorisation should be discouraged in the teaching and learning of mathematics. Teachers should expose learners to different ways of doing calculations and they should be given the opportunity to come up with their own methods or strategies of doing calculations. Teachers should learn to view learners as people who can "*think, reason and analyse*" (teacher B, line 282).

Mr Hausiku is responsible for advising mathematics teachers from grade 5-12. He believes that the advice required by these teachers will depend on the grade that they teach. In line 330-331 he says: "*So now we are dealing with three groups with different understandings.*" He advises the grade 5-10 teachers to adhere to what is stipulated in the continuous assessment manual. He says this assessment manual is clear on what each teacher is expected to do with regard to continuous assessment and how teachers can go about achieving some of the objectives of LCE. "*for the 5-10 group, I would like them to*

stick to what is stipulated in the continuous assessment manual because that whole policy on the continuous assessment outlines what the teacher is supposed to do and how to go about achieving some of the objectives of LCE" (Hausiku, line 333-336)

Teachers are advised not to rely heavily on tests as the main form of assessment. They should incorporate investigative activities as part of their continuous assessment. "*I would like to have much of investigative activities given to the learners*" (Hausiku, line337-338). Hausiku would also like teachers to ensure that learners have mastered the mathematical content of each phase before they move on to the next phase. "*So that at least every phase that they leave...they must have an understanding*" (Hausiku, line 341-342). This will help learners attain a strong foundation in mathematics when they reach the senior secondary phase (grade 11&12).

He believes that this can be achieved if teachers make use of previous question papers and set their activities based on that standard. "*...for example if you set up a test for grade 7 you must pull out the end of year paper and see the standard and set the test according to that standard*" (Hausiku, line 349-351). Exposure to this standard will prepare learners for national examinations as they will be set according to national standards.

In addition, he advises senior secondary school teachers to use the two years that they spend with their learners to implement LCE because they are not required to do continuous assessment. "*With...with regard to the senior secondary phase continuous assessment is not there but LCE is still encouraged and...and at the senior secondary phase we have got ample time that we can implement at least 75% of the aspect of LCE...*" (Hausiku, line 357-360). They should not rush through the syllabus and complete it without ensuring that meaningful learning has taken place. "*...what I always see with my teachers they rush. They give tests...they rush and they claim they are done but if you get through to the learners you get nothing...*" (Hausiku, line 361-363).

4.2.11 Support available for teachers who are trying to implement LCE

As an educational officer, he admitted that he cannot do much to assist teachers with the problem of overcrowded classrooms but he explained that the Educational Training Sector Improvement Programme (ETSIP) was brought about to address some of these challenges. "*...to my understanding ETSIP was brought about due to the challenges that we are facing now with regard to lack of classrooms, lack of materials*" (Hausiku, line180-182). Schools are being evaluated and reports are being compiled about the condition of these schools so that they can be assisted accordingly. However, this might be a lengthy process since there are about 1600 schools in the whole country that have to be evaluated. "*...but the fear is: we have got about 1600 schools in the whole country. I don't know when each and every school will be evaluated...*" (Hausiku, line 184-186).

This programme, once implemented will ensure that all schools have adequate classrooms, running water, electricity and computers. In his own words, Hausiku said: "*ETSIP is looking at adding classrooms where there are no classrooms, putting in lights where there are no lights, bring in water where there are...where there's no water and...and then at least each and every school in Namibia must have issues that have got to do with technology...that they have to be provided with computers*" (Hausiku, line 189-193).

The concept of LCE according to Mr Hausiku can only be fully implemented if all schools are at the same standard in terms of human and material resources. This is the goal of the policy of national standards. Teachers and learners must have access to the same resources. This means teachers and learners in remote schools (e.g. Mpungu) must have access to the resources that learners in urban schools (e.g. Windhoek) have. "*They must be on the same standard. And that means if a kid in Windhoek for example talks about the computer, the kid in Mpungu, Simanya* (remote areas in the Kavango region) *must be able to talk about the computer*" (Hausiku, line194-197).

As an advisory teacher, Mr Hausiku talks about LCE when he visits his teachers. In his opinion, his teaching experience and his knowledge about different theories puts him in a better position to advise mathematics teachers accordingly. "*...with the experience that I have as a teacher and with the knowledge, the theories that I have learnt about, I think I'm in a good position to say what LCE is all about*" (Hausiku, line231-233). The problem is that some of the teachers he gives advice to cannot be re-trained and they do not possess the necessary skills to implement LCE. He says it is frustrating, to a certain extent because despite his advice some teachers continue using traditional methods. He says: "*...so to a certain extent it is frustrating that you give advice to that particular teacher, next time when you visit the same teacher you find the same mistakes. So it's like one is just wasting time giving advice to people who cannot change*" (Hausiku, line235-238).

4.3 OBSERVATIONS

Teacher A: Lesson one

This lesson was observed on 11 July 2008 at Kavango Combined School. The teacher taught about solving simple linear equations. Learners were given a few linear equations to solve in groups. On this day, 34 learners were present and they sat in groups of five. The observation schedule in table 4.1 summarises the findings of this lesson.

Table 4.1: Aspects of LCE and TCE– Teacher A (lesson one)

LCE		**TCE**	
1. sound knowledge of mathematics	✓	1. sound knowledge of mandated mathematics content	✓
2. adequate knowledge of students' prior knowledge	✓	2. teacher authority vested in subject knowledge	✓
3.adequate knowledge of instructional Practice	✓	3. emphasis placed on the mastery of mathematics content	x
4. classroom environment supports learning of mathematics	✓	4. learners expected to follow certain mathematical rules and formulae strictly	x
5. use of evidence and shared expertise	✓	5. knowledge perceived as 'out there'	x
6. promotes ownership, commitment, Shared responsibility	✓	6. little emphasis on understanding	x
7. encourages learners to ask questions	X	7. more teacher-talk	x
8. arouses learners' curiosity	✓	8. tasks are syllabus and examination driven	✓
9. employs meaningful tasks and provides real-life examples	✓	9. textbook-bound	x

Teacher A: Lesson two

This lesson was observed on 05 November 2008 at Kavango Combined School. On this day teacher A taught about calculating perimeter and area. Learners were given a task to identify given shapes and calculate the perimeter and area of each shape. There were 34 learners in her class and they sat in groups of five. Table 4.2 represents my findings.

Table 4.2: Aspects of LCE and TCE- Teacher A (lesson two)

LCE		TCE	
1. sound knowledge of mathematics	✓	1.sound knowledge of mandated mathematics content	✓
2. adequate knowledge of students' prior knowledge	✓	2. teacher authority vested in subject knowledge	✓
3.adequate knowledge of instructional Practice	✓	3. emphasis placed on the mastery of mathematics content	X
4. classroom environment supports learning of mathematics	✓	4. learners expected to follow certain mathematical rules and formulae strictly	X
5. use of evidence and shared expertise	✓	5. knowledge perceived as 'out there'	X
6. promotes ownership, commitment, Shared responsibility6.	✓	6. little emphasis on understanding	X
7. encourages learners to ask questions	X	7. more teacher-talk	X
8. arouses learners' curiosity	✓	8. tasks are syllabus and examination driven	✓
9. employs meaningful tasks and provides real-life examples	✓	9. textbook-bound	X

Teacher B

This lesson was observed on 09 July 2008 at Nawa Secondary School. There were 38 learners present on this day. They sat in groups of six. The lesson was on statistics and the teacher had planned to do corrections of the previous day's work after which she would start a new lesson on the best representation of data: Mean, Mode or Median. However, since most of time was spent on corrections, the new topic was not taught but it was given to the learners as homework. Table 4.3 summarises my findings.

Observation schedule

Table 4.3: Aspects of TCE and LCE- Teacher B (lesson one)

LCE		TCE	
1. sound knowledge of mathematics	✓	1. sound knowledge of mandated mathematics content	✓
2. adequate knowledge of students' prior knowledge	X	2. teacher authority vested in subject knowledge	✓
3.adequate knowledge of instructional Practice	X	3. emphasis placed on the mastery of mathematics content	✓
4. classroom environment supports learning of mathematics	X	4. learners expected to follow certain mathematical rules and formulae strictly	✓
5. use of evidence and shard expertise	✓	5. knowledge perceived as 'out there'	✓
6. promotes ownership, commitment, Shared responsibility	X	6. little emphasis on understanding	✓
7. encourages learners to ask questions	X	7. more teacher-talk	✓
8. arouses learners' curiosity	X	8. tasks are syllabus and examination driven	✓
9. employs meaningful tasks and provides real-life examples	x	9. textbook-bound	✓

Teacher B-Lesson two

This lesson was observed on 05 November 2008 at Nawa Secondary School. The teacher taught about solving equations. She started by doing corrections of the previous homework and then she introduced learners to more advanced equations in which learners had to solve equations were the unknown appears on both sides. There were 37 learners present and they sat in groups of about six. Table 4.4 summarises my findings.

Table 4.4: Aspects of TCE and LCE- Teacher B (lesson two)

LCE aspects		LCE aspects	
1. sound knowledge of mathematics	✓	1. sound knowledge of mandated mathematics content	X
2. adequate knowledge of students' prior knowledge	X	2. teacher authority vested in subject knowledge	✓
3.adequate knowledge of instructional practice	✓	3. emphasis placed on the mastery of mathematics content	X
4. classroom environment supports learning of mathematics	✓	4. learners expected to follow certain mathematical rules and formulae strictly	X
5. use of evidence and shared expertise	✓	5. knowledge perceived as 'out there'	X
6. promotes ownership, commitment, Shared responsibility	✓	6. little emphasis on understanding	X
7. encourages learners to ask questions	✓	7. more teacher-talk	X
8. arouses learners' curiosity	✓	8. tasks are syllabus and examination driven	✓
9. employs meaningful tasks and provides real-life examples	✓	9. textbook-bound	✓

Keys:

✓- aspect observed

x- aspect not observed

The tables above were constructed by drawing from the Posner, Strike, Hewson & Hertzog model, a conceptual change model that enabled me to distinguish between LCE and TCE (Brophy, 1996: 126). I also incorporated some aspects of Olson's radical and traditional teaching table (Olson, 1997: 57). I used the tables by ticking the aspects that were prevalent in the different lessons and indicated with crosses those aspects that were not observed. I will now discuss the lessons in detail using some aspects of the observation framework.

4.3.1 Sound knowledge of mathematics content

Mandated mathematics knowledge refers to the knowledge (incorporated in their curricula) that teachers are expected to master and teach effectively when they leave their teacher-training institutions. Kilpatrick et al (2001) advocates the importance of content knowledge in mathematics for teachers to be able to teach mathematics proficiently.

Although this aspect was not easy to observe and ascertain, it was obvious that both teachers had sound knowledge of general and mandated mathematics knowledge as could be observed in the way they presented their lessons. They seemed to possess sufficient content knowledge to teach learners at this level (grade 9) (table 4.1-4.4).

4.3.2 Adequate Knowledge of learners' prior knowledge

What was most striking about the way teacher A presented her lessons was her focus on the learners' prior knowledge. She started her first lesson by introducing the lesson and then she gave learners the opportunity to define the terms: "solve and equation" as she was dealing with a topic on solving equations. Learners were given terms to wrestle with and then she gave each group time to present the definitions of these terms. "*So today we*

are going...to talk about solving of...equations but before we go into...the topic itself, we have to find out the meaning of the key words. So what we are going to do in our groups...in your groups discuss what is to solve and what do you think is an equation" (lesson 1, line 1-9).

Learners used simple language in their definitions but she did not discourage them. For example, when group 3 presented their feedback on the definition of "solve" they reported that to solve is to stop the problem. The teacher repeated their answer in form of a question: "*solve is to stop...*?" The group responded: "*stop.*" The teacher again repeated: "*stop*?" (She was louder this time). The group repeated their response: "*stop.*" And the teacher asked the question for the last time: "*stop the problem*?" (in a tone of giving up) and the learners responded: "*Yeah.*"

The learners used direct translation of solve in this context because to solve in their local language can be defined as "*to bring a problem to an end, to stop a problem or take a problem away*" that's why they kept saying to stop a problem. These definitions do not make sense in the mathematics context where procedures are involved in solving problems but she had to start from there (the learners' prior knowledge) and gradually introduce them to the formal mathematical concepts.

In lesson two, teacher A tried to establish how much her learners knew about perimeter and area by asking them to define these terms. "*What does the word perimeter mean in your own understanding?* (lesson 2, line 31-32)...*when we talk about area so what is area?"* (lesson 2, line 67). This shows how much the teacher values the learners' prior knowledge (table 4.1 & 4.2 aspect no.2)

The aspect of prior knowledge (table 4.3 aspect no.2) was not emphasised in lesson one of teacher B's lesson as the teacher was dealing with corrections but even when doing corrections one can still try to find out whether the learners can remember what they had been taught earlier, especially if they are struggling with a certain question. There was no reference made to the learners' prior knowledge even when learners seemed to be

struggling. For instance, when learners could not find the mode that could have been a good opportunity for the teacher to explain what mode is and how to find it but she just accepted learner x's answer after learner y had failed to get the answer. Her only remark was: "*There's nothing. None. It's zero.*" (lesson 1, line 197).

However, the opposite was observed in lesson two (table 4.4 aspect no.2) as learners were more involved in this lesson. The teacher asked learners to write down the corrections of the previous homework on the chalkboard. She acknowledged the learners' work and only intervened when learners were struggling. When some learners started shouting, to draw the teacher's attention to the fact that their fellow learner's answer was wrong, the teacher told the learner who was writing on the chalkboard not to listen to those who were shouting and do what she thought was right. "*Eh, don't listen to them. Do what you know*" (lesson 2, line 25). She further encouraged learners to give explanations for their answers. "*Who said he want to do J?...Ok Johanna. And you give explanations*" (lesson 2, line 111). Through the learners' explanations the teacher is able to establish how much learners know about given mathematical concepts. That is why in the LCE framework it is recommended that learners be given more opportunities to talk.

4.3.3 Adequate knowledge of instructional practice

This was evident in teacher A's lessons (table 4.1 & 4.2 aspect no.3). According to Posner, Strike, Hewson and Hertzog's instructional model, LCE lessons should be presented in the following order: start with prior knowledge→ challenge the learners' prior knowledge→ present new concepts in ways that make sense given learners' perspectives→ support learners in finding the new ideas useful in a variety of different real-world contexts.

From my observations, after eliciting the learners' prior knowledge, teacher A tried to challenge the learners' informal understanding of the terms "solve and equation" by leading them to the formal definitions of these terms. In her attempt to lead learners to

this stage, teacher A did not create a gap between the learners' prior knowledge and the new concepts. She linked the learners' ideas to the formal mathematical concepts.

For instance, the teacher used the words "*take out*" (words used by learners to define solve) to lead learners to the term solution. *When you take out that means you are finding what?* (lesson 1, line 103-104). This prompted the learners to think deeper. They took some time to respond to the teacher's question. This is evidence that their prior knowledge had been challenged. However, after some time, one of her learners responded: *Solution*. The teacher's response to this answer in line 111-112 of lesson 1 was: *Very good! So when there's a problem that means there should be a...* (trying to put the learner's answer into a mathematical perspective).

In lesson two, the preparation of the teaching aids made the lesson more meaningful to the learners. Instead of having all the learners work on one figure, the teacher prepared different figures for each group (cooperative learning). This could help arouse learners' interest in what the other groups were working on to prevent them from getting bored when the others are presenting their answers. At one stage when learners were making noise, the teacher remarked: "*Listen because you did not do this one. You only did yours...the one that you are going to share with us. So they did something different from yours*" (lesson 2, line 126-128). Moreover, the teacher gave clear instructions to her learners about what they were expected to do. "*...the person who is going to report you have to show us the shape so that we can also see...then we'll also see whether you applied the correct formula...*" (lesson 2, line 118-122).

Teacher A's lesson focused on achieving the lesson objective. The lesson objectives were clearly stated at the beginning of each lesson so learners knew what was expected of them. In lesson one the teacher introduced the lesson by telling learners what the focus of the lesson was going to be. "*So today we are going to talk about solving of equations...*" (lesson 1, line 1)

This was also observed in lesson two when the teachers started by telling the learners what was going to be covered in the lesson. "*So now for today we'll be looking at perimeter and area of different shapes...So which means by the end of today each one of you should be able to calculate the perimeter and the area of a triangle, a square, a rectangle. Parallelogram, rhombus, trapezium, kite and a circle*" (lesson 2, line 1-6)

Teacher B used the question and answer method throughout her lesson in lesson one (table 4.3 aspect no.3). The question and answer method although it is sometimes used in the LCE is associated with TCE. Despite the fact that the lesson was based on corrections, this method was used to its extreme because even when doing corrections different learners can be asked to present their answers on the chalkboard and then the teacher can ask them to explain how they arrived at those answers. By so doing, the teacher can then determine what problems his/her learners are encountering on a given topic. However, teacher B did it in such a way that she stood in front of the class throughout, asked learners questions and called on them to respond. The following is an extract from the lesson showing some of the questions asked by the teacher.

The first question:

Teacher: ...b says the ages of boys in the mathematics class falls in: 14y, 16y, 19y, 17y, 14y, 16y, 15y, 16y (the teacher writes down the data on the chalkboard). *Ok that was the data given. Now what is the highest value? What is the highest value? Hands...hands up*!" (lesson 1, line 28-34)

The second question:

Teacher: ...then we come to mean...mean...add all the values 14y + 16y + 19y + 17y + 14y + 16y + 15y + 16y. What is the answer Sauyere? (lesson 1, line 49-52).

In the second lesson however, learners were actively involved in the learning process (table 4.4 aspect no.3). At the beginning of the lesson, the teacher asked learners to present their answers on the chalkboard and give explanations. "*You'll come and do it on the chalkboard. You will come and do it on the chalkboard*" (lesson 2, line 8-9). This was followed by a short teaching session in which she clarified learners' misconceptions.

"*...Now you don't...we don't leave neg...negatives at the variable...at the letters so we need to get rid of negative x. So what do we do? We need to divide by...by negative. So this negative here will become a positive and here there's a positive divide by a negative...*" (lesson 2, line 82-86). She then gave an example of solving a more advanced equation. "*Ok I hope these were simple. Ok let's go ahead now. A little bit to your standard now...Now we need to solve whereby two sides we have the unknown...8x = x + 35*" (lesson 2, line 177-181). Thereafter, she gave learners an exercise to do in class which she marked. Time was well managed in this lesson and the sequence of the lesson enhanced learners' understanding of solving equations.

4.3.4 Classroom environment supports learning of mathematics

Teacher A's class had signs of mathematics all over. Posters of mathematical drawings and problems where displayed on the wall of her class. This does not guarantee learning but it adds value to the subject. Learning was evident in the learners' performance in the group work (table 4.1 & 4.2 aspect no.4). At one stage when a learner from one of the groups was hesitant to read out the definition of solve, the teacher encouraged him by saying: "*Just read what is there. There is no right or wrong answer. We all learn from each other*" (lesson 1, line 37-38). This creates a relaxed learning environment where learners are encouraged to learn. She also thanked learners for their contributions.

After group 4 had presented their answer, teacher A said: "*Thank you very much and then group 4?*" (lesson 1, line 76). This is another way of encouraging learner participation. The fact that she acknowledged learners' answers is also another practice that creates a conducive learning environment. After the learners had given their definitions of "solve and equation" she remarked: "*So if we look at our answers there's no big difference. We all have the understanding of solving as there's a problem existing and you have to solve it*" (lesson 1, line 88-91)).

This was also observed in the second lesson (table 4.2 aspect no.4) when the learners were presenting their answers on perimeter and area. The teacher encouraged learners to

continue with their presentations although some of their answers did not make sense. Learners' answers were left on the chalkboard and the teacher encouraged learners to analyse the answers presented by the other groups. "*Thank you very much. We'll comment...So while the thing is here you start checking whether it's correct or not so we'll tell them where they went wrong.*" (lesson 2, line146-148). Therefore learners did not just sit passively while the others were presenting their answers. They were busy studying the answers presented by the other groups. This is an effective way of keeping learners on task.

Listening is a skill that was encouraged in both lessons as the teacher kept calling on learners to listen to one another as they were presenting their answers. "*Listen please!*" (lesson 2, line172). This is important in a learner-centred classroom because when learners are listened to they begin to feel they have something worthwhile to contribute to the teaching and learning process.

Although the teacher expected learners to use certain mathematical rules and formulae, she was not strict with them because after giving the learners an example they were allowed to proceed without her intervention. She only intervened after all the groups had presented their answers.

The situation in teacher B's lesson one can be described as tense (table 4.3 aspect no.4). She started her lesson by shouting at a learner who was not properly dressed. "*Hey! Kandingu put that thing (*referring to the shirt*) in your trousers*" This was followed by a threatening remark to a learner who was making noise. She was warned that she would be beaten with a broom. "*Natalia, I'll get the broom*" (lesson 1, line 2). Obviously, teacher B was trying to maintain discipline in her class and ensure that learners were paying attention but scolding learners might scare them off. This could result in poor participation among learners.

Moreover the teacher's expectations of the learners did not promote learning because on two occasions, learners were asked to say who had told them to leave out the units. In a

LCE approach, learners are encouraged to be creative and innovative. Therefore, instead of asking learners **who** had told them to leave out the units, the teacher could have asked them to explain **why** they had left out the units. The following extract was taken from parts of the lesson in which the teacher asked such questions

Teacher: Did you leave the ys? (referring to ys from the data, e.g.16y, 17y…)
Learners: Yes
Teacher: Oh! Why not?
Learners: We leave… (meant to say we left them out)
Teacher: Who said you should leave it? (lesson 1, line 40-44)

This was repeated in line 135-139 of lesson 1
Teacher: Did you leave out the cm?
Learners: Yes
Teacher: Who told you that?
Learners: No one

Such remarks may give learners the impression that they cannot do what they are not told to do and as a result they become dependent on the teacher as the only source of knowledge and the only one to tell them what to do.

A different scenario was observed in lesson two though (table 4.4 aspect no.4). The teacher was more patient with the learners and encouraged them to give their own explanations. The teaching approach in lesson two can be described as more learner-friendly and it promoted learning. Remarks such as: "*Let's wait for Natalia to finish…Who is confusing her?* (lesson 2, line 17, 26)*…You almost…almost there…Now can you polish it…finish it* (lesson 2, line 43, 47). *Who's having a different answer?…*" (lesson 2, line 116) were heard during this lesson. This shows the teacher's interest in helping learners understand. The teacher asked other learners if they had different answers before giving them feedback on their answers.

Learners were not expected to follow rules and formulas strictly rather the teacher was more interested in their explanations. In one of the equations, the learner wrote x/3 = 8. The solution was x = 24. When she was asked to explain where the 24 had come from the learner did not know how to explain it so she started erasing her answer thinking it was wrong. The teacher remarked: "*I didn't say rub...I'm asking a question. Did I say it's wrong?*" (lesson 2, line154).

4.3.5 Encourages learners to ask questions

Encouraging learners to ask questions is an important aspect of LCE. However, this was not observed in teacher A's lessons (table 4.1 & 4.2 aspect no.7) as she was the one asking questions most of the time. At no stage during her lessons were learners given the opportunity to ask questions.

This was also not evident in teacher B's first lesson (table 4.3 aspect no.7) as learners did not ask any questions throughout the lesson and they were not encouraged to ask questions. It is good practice to ask learners if they have questions in a LCE framework as it helps the teacher to find out what learners have mastered and what they are struggling with.

In lesson two of teacher B's lesson (table 4.4 aspect no.7) however, learners asked questions because the teacher encouraged them to ask. When learner 30 raised his hand the teacher responded by saying: "*Ok, ask*" (lesson 2, line 227). She was prepared to answer learners' questions and she even involved learners' in answering some of the questions. When a learner asked where the 7 in the expression 8x –x had come from, the teacher asked who among his fellow learners was going to answer that question. "*Madam I don't understand why...where does that 7 come from?*" (lesson 2, line 252). The teacher responded: "*Who is answering?*" (lesson 2, line 253). This was a good way of showing the learners that she is not the only source of information, that other learners can also help in answering questions.

4.3.6 Employs meaningful tasks and provides real – life examples

Meaningful tasks are tasks that make sense to learners or tasks that learners can relate to. The tasks that teacher A prepared for her learners in both lessons were meaningful because she started with their preconceptions and led them to the formal conceptions (table 4.1 & 4.2 aspect no.9). The teacher gave real – life examples of equations when she explained to the learners that $2 + 2 = 4$ means $2 + 2$ is the same as 4. The equal sign is often taken for granted by learners from the lower grades that they rarely realise that they are making comparisons when they use it. This is an important factor to remember in algebra when dealing with "solving equations" because learners are expected to use this understanding of the equal sign to verify their answers when they substitute their solutions into the original equations.

In lesson two I expected teacher A to engage learners in outdoor practical activities, especially with regard to the calculation of perimeter since in our interview she had stated that learners could be asked to measure the perimeter of a room to help them understand the concept of perimeter better. Some of the groups could not calculate the perimeter of the given shapes correctly because despite the definition given they did not understand how to calculate it. This activity could have enhanced learners' understanding because for instance as they moved around the class to calculate the perimeter, they would have developed a broader understanding of the concept of perimeter.

There was no evidence (table 4.3 aspect no.9) of this aspect of LCE in lesson one of teacher B's lesson as the teacher engaged learners in questions and answers throughout the lesson. Moreover, all the questions came from the learners' textbooks (book-bound). As mentioned earlier, meaningful tasks are tasks that learners can relate to i.e. make sense to them. Such tasks are designed in such a way that learners' prior knowledge is elicited.

In lesson two the tasks given were more meaningful (table 4.4 aspect no.9) because the teacher explained what the learners were expected to do when solving equations.

Moreover, the tasks were scaffolded so learners could make sense of these tasks. She gave examples related to tasks that she had prepared for her learners. For instance the teacher gave learners the following example before giving them a similar exercise: $8x = x + 35$. Learners were taught how to solve such equations. "*The first thing you do is...you have to identify like terms...* (lesson 2, line186-187). *Ok now the second step...bring them one side*" (lesson 2, line 212). She then gave them the following equation which they had to solve on their own: $2y = 9 - y$. Most of the learners found the exercise easy because they were prepared on how to solve such equations.

In addition, the teacher used real-life examples to help learners understand what it means to operate with variables. "*If you have 8...for example let's say you have 8 apples, you take away an apple. How many apples have you taken*?" (lesson 2, line 261-262). The teacher was trying to help learners understand that the x can be compared to an apple (1 apple).

4.4 DISCUSSION

When we teach mathematics, we teach certain values implicitly. "Values in mathematics education are the deep affective qualities that education fosters through the school subject of mathematics. They appear to survive longer in people's memories than does conceptual and procedural knowledge, which unless regulated tends to fade" (Fosnot, 1996: 94). The discrepancies in teacher practice and their interpretation of LCE can be attributed to their values or their experiences of learning mathematics. In this section, I discuss my findings from the interviews and the observations by looking at some of the important aspects of LCE and how they are perceived by my participants. These include; prior knowledge, interpretations of LCE, implementation, advantages and challenges.

4.4.1 Prior knowledge and LCE

Quality in education can be achieved if:

teachers have a holistic view of the learner, valuing the learner's life experiences as the starting point of their studies. Teachers should be able to select content and methods on the basis of a shared analysis of the learner's needs, use local and natural resources as an alternative or supplement to ready-made study materials and thus develop their own and the learner's creativity (BETD, 2006: 1-2).

The quote above summarises the importance of prior knowledge in the reform approach. Prior knowledge is the core of LCE. From the constructivist's perspective, prior knowledge plays an important role in the learning process. This is what distinguishes LCE from TCE approach. The traditional approach took very little (or no) cognisance of the learners' prior knowledge. Learners were perceived as empty vessels who had to be filled with knowledge (Olson, 1992 & Fennema & Nelson, 1997).

Prior knowledge is the key principle on which constructivism is based. Learning occurs when learners construct knowledge in their minds (Hinchey, 1998). The process of knowledge construction involves interactions between the learner's prior knowledge and the new knowledge. Learners try to fit the new knowledge into their existing schema and this is where the teacher's intervention is required. The teacher should facilitate this process to ensure that meaningful learning occurs.

Indeed, we cannot talk about LCE without talking about prior knowledge. In all LCE activities, teachers should ensure that they keep the aspect of prior knowledge in mind otherwise very little or no learning will occur. Learners can be given group work or pair work but if the task given is beyond their level of understanding, they will put the task aside and engage in other discussions (which may not be related to the task at all) while waiting for the teacher to provide them with answers. Sguazzin & van Graan (1999: 56) assert that "The quality of the learning experience will be enhanced in classes where teachers have a real belief in the value of the learners deconstructing myths and existing knowledge and practicing the skill of locating information."

LCE can be a waste of time if the aspect of prior knowledge is not taken into account. Why would learners lose interest in something that they can relate to? Teachers should be aware that the types of activities that they give to learners determine the extent to which learning occurs. For instance, teacher A presented a topic on algebra which Mr Hausiku cited as an example of one of the most difficult topics to present using the L-C approach while teacher B presented a topic on statistics which was cited as an example of an easy topic to present using LCE (Hausiku, line 105-107). However, my findings reveal that teacher A's lesson on algebra was more L-C oriented than teacher B's lesson on statistics. It is the planning at the end of the day that really determines how successful one is with this approach.

4.4.2 Interpretations of LCE

Early literature in this research field reveals that teachers lack a common understanding of the reform approach. This has resulted in different interpretations of LCE (Sguazzin & van Graan, 1999). This was reiterated by Mr Hausiku, a mathematics education officer who also believes that teachers are not well prepared for the implementation of LCE during their training (Hausiku, line 158-162).

This study has revealed that participants seem to have a common understanding of LCE since they all described it as a teaching approach that is centred around the learner. However, none of the participants made reference to constructivism as the paradigm underpinning LCE. Indeed, LCE is centred around the learner but it is the fact that knowledge is constructed in the mind of the learner that clearly distinguishes LCE from TCE.

4.4.3 Implementation aspects

Teacher A regards the definition of new terms, the involvement of learners in explaining concepts, the use of outdoor mathematics activities, classroom arrangement and exposing learners to real life examples as important aspects of the implementation of LCE. The

definition of new terms is important as it allows both teachers and learners to have a common understanding of the terms that are used in a given topic.

Exposing learners to outdoor mathematics is indeed an important aspect of LCE. As stated in the NIED document (2003), the teacher should learn to use the immediate environment as a teaching resource in the reform approach. The immediate environment broadens the learner's view of education in general of mathematics as a discipline in particular. Thus the learner extends this understanding to mathematical concepts. Mathematical concepts should not be restricted to the textbook or the classroom. There are a lot of mathematical opportunities in our environment that mathematics teachers can seize and use to help their learners understand mathematics better. Teacher A provides an example on the topic of measurements where learners can be asked to measure the perimeter of their rooms. By so doing, learners can develop a broader view of perimeter. They begin to understand that perimeter does not only apply to rectangles and squares drawn in textbooks or on the chalkboard.

One of the important issues that has emerged from this research is that mathematics is too classroom-bound. It is for this reason that learners often ask: "What am I going to do with mathematics?" This is due to the fact that there are few examples of its use out of the classroom. The reform approach calls for a far more broader and relevant range of knowledge, intelligence, context and skills (NIED, 2003). Therefore, mathematics teachers should become more creative and innovative in order to make a difference in the teaching and learning of mathematics.

Classroom arrangement is another important aspect of LCE because it says a lot about the kind of teaching and learning that goes on in a classroom situation. One of the underlying themes in a conceptual change model (learner-centred model) based on Posner, Strike, Hewson and Hertzog model (Brophy, 1996) is the establishment of a caring environment where learning is celebrated. It all starts with the classroom arrangement. What picture does the classroom portray when learners enter it? A L-C friendly classroom is one where learners feel they can express their ideas without being victimised or criticised.

Teacher B employs both L-C and T-C approach in all her lessons. However, the topic that she is dealing with determines whether the lesson will be more L-C oriented or T-C oriented. When dealing with easy topics, she takes on the role of a facilitator but when dealing with difficult topics, she assumes the role of a knowledge provider. By eliciting learners' prior knowledge, teachers also get to know their learners' experience and background in mathematics. This could guide them in their lesson preparations and help them assist learners according to their learning needs.

Teacher B regards the move from eliciting learners' prior knowledge to her intervention as TCE. I argue that this can still be regarded as LCE. The perception that LCE means learners do all the work and the teacher sits back and only listens to what learners bring up is a misconception. In LCE, the teacher is still expected to play his/her role as a teacher. According to Brophy (1996: 122), there is a stage in the implementation of LCE where the teacher is expected to introduce new concepts. This comes after the learners have been given the opportunity to wrestle with various possible explanations of these concepts.

Pedagogical changes can only occur if teachers are well prepared to implement LCE approach in the teacher-training institutions. The teacher-training curricula for secondary school teachers should be revised. As stated by teacher B, the main problem lies with secondary school mathematics. There might be other contributing factors such as the fact that secondary school mathematics is more abstract than primary school mathematics. We should therefore look at how mathematics content at secondary level can be addressed. As stated by Kilpatrick, (2001:376) "In helping, students learn, teachers must take abstract ideas and unpack them in ways that make the basic underlying concepts visible." This might be the skill that is lacking in some secondary school teachers. If mathematics is indeed human and fits into the human culture (Ernest, 1991), then teachers should be able to design activities that are learner-friendly and less abstract.

4.4.4 Value of LCE

For teacher A, the biggest advantage of using LCE is that it develops learners' personal interest towards any subject. Moreover, she says it also helps to develop learners' communication skills. She further states that LCE helps teachers evaluate their teaching strategies and improve their teaching approach. She also believes that this approach enables the teacher to attend to learners' individual needs since learners learn at different paces.

Indeed, LCE develops learners' interest in a subject. This is one of the fundamental principles of learner-centred approach (MBEC, 1993). Teaching learners who lack interest in a subject results in very little learning or no learning at all. It is for this reason that the reform approach focuses on understanding and helping learners develop interest in mathematics.

Interest can only develop if the content makes sense to the learners. The focus should therefore be on how to make mathematics content relevant to the learners. As stated earlier, the learners' prior knowledge plays an important role in the implementation of LCE. According to Brophy (1996:118), what the learner already knows drives what he/she pays attention to and how new knowledge is understood. Learners cannot be expected to develop interest in something that does not make sense to them. There should be a way of linking abstract mathematics to learners' prior knowledge.

Learner-centred approach develops learners' communication skills. As learners interact with one another, they learn to express themselves freely and get their ideas across. Communication is an important skill in the reform approach. It is through communication that teachers get to understand their learners' ideas, thoughts, misconceptions, etc. Moreover, communication facilitates the development of respect and tolerance among learners. These are qualities that are advocated for in a L-C environment (Brophy, 1996). As they communicate with one another, they learn to understand that they can have different views but still live together in harmony.

The Namibian constitution advocates for the freedom of speech as one of the fundamental human rights in a democratic society. This is a right that learners can learn to exercise in the classroom. As adults, they will learn to appreciate this right and foster it among the young generation.

The development of learners' communication skills should not be seen as the sole responsibility of the language teacher. It should be perceived as a cross-curricular task since good communication promotes learning in all disciplines. Learners who communicate well make teaching easier.

Listening is a prerequisite of good communication. Learners should be encouraged to listen to their fellow learners as they can learn from them. Noise usually erupts when learners are given the opportunity to speak in class because the others feel they are at the same level and there's nothing they can learn from them not realising that they can actually improve their communication skills by listening to other learners speak in class. In both lessons teacher A kept reminding learners to listen while the other learners were presenting their answers. She repeatedly instructed them to listen. "*Let's listen. Let's listen. Listen means you shut your mouth and then you listen* (lesson 2, line 32-35).

As teachers try out different strategies they also evaluate their success (or failure). They then refine them to suit their learners' needs and their context. According to Kilpatrick et al (2001:382), teachers who have acquired a repertoire of instructional routines can readily draw upon them as they interact with students in teaching mathematics. As teachers gain experience in using different teaching strategies, they start applying them successfully as they know which strategy works best in a given situation. "Researchers have shown that expert teachers have a large repertoire of routines at their disposal. They can choose among a numbers of approaches for teaching a given topic or responding to a situation that arises in their classes (Kilpatrick et al, 2001: 382).

4.4.5 Issues pertaining to the implementation of LCE

Teacher A cites the attitude of her colleagues as the biggest challenge. It is indeed difficult to work with teachers who still cling onto traditional (TCE) practices. These teachers measure success in terms of "notebooks accumulated and content learned as measured by examination standards rather than in terms of learners' achieving levels of problem-solving" (Olson, 1992:60). Teacher A's main concern is that they have not yet reached a consensus with her colleagues with regard to classroom arrangement. Her colleagues with whom she shares classrooms still prefer the traditional way of arranging classrooms. This means she has to rearrange her class everyday to suit her LCE teaching approach.

Moreover, it is also discouraging for teachers who want to shift from TCE to LCE if they are not supported by their colleagues. If classes have to be rearranged every now and then, those who are trying to implement LCE might eventually give up and revert to the traditional teaching approach since they might feel that their approach is not supported by the others. Alternatively, they might try to implement LCE in classroom setups that support traditional teaching practices. However, this kind of implementation is not supported by Hinchey who says "teachers who have not identified their goals and checked their practice may lose their way. It makes no sense to use positivist methodology to reach constructivist goals and vice-versa" (Hinchey, 1994: 39).

The lack of resources is another challenge identified by teacher A (and Mr Hausiku). She says teachers are heavily dependent on textbooks and learners' exercise books which are often inadequate. The reform approach can be a success if schools are well equipped with the necessary resources. Access is one of the major educational goals in Namibia (MEC, 1993). This implies that human and material resources should be in adequate supply.

In planning their lessons, teachers need resources to ensure that their plans are effectively implemented. As suggested by the participants, mathematics should be taught in a more practical way to help learners understand mathematical concepts better. This can be

achieved if there are enough resources that can help teachers move from their heavy dependency on textbooks (TCE) to more practical teaching in mathematics (LCE). It is the lack of resources that sometimes compels teachers to cling onto traditional teaching practices (NIED, 2003). However, teachers also need training on how to use the resources at their disposal in a more L-C way.

Time is teacher B's first concern with regard to the implementation of LCE. She says LCE is a waste of time and one cannot be certain whether learners are really engaged in activities that they are assigned to or not. Sometimes they make noises in their groups instead of doing the tasks assigned to them. Some teachers perceive LCE as a waste of time leading to indiscipline and very little learning (Farrant, 1980). This is teacher B's view on LCE although she seems to have mixed feelings about it. She gives an example of the fact that grade 10 teachers are expected to complete their syllabi in two terms (in August) and she says this cannot be accomplished if one employs LCE.

This compels some teachers (including teacher B) to use the traditional teaching approach where learners listen most of the time while the teacher covers the content so that learners are prepared to reproduce this content in examinations regardless of the level of understanding achieved in the process. This is done by the teachers because the performance of the teacher is measured by the pass rate of his/her learners. Therefore teachers will do everything in their capacity to ensure that their learners perform well in the examinations even if it means putting the LCE aside because no one really judges them on how well they implement LCE.

There is no doubt that some of the ministerial policies are in conflict with the reform approach. These policies perpetuate traditional practices in mathematics classrooms. On one hand, the policies encourage the use of LCE but on the other hand nothing or little is done to remove the obstacles that might hinder the implementation of this approach. For instance time restrictions, examinations and the type of examination questions that learners are exposed to. Some of the examination questions still promote the memorisation of facts. This is in conflict with the principles of LCE. Therefore, teachers

perceive group work where learners spend time discussing content that might not help them in examinations as a waste of time. They would rather use that time to teach and direct the course of learning and determine themselves to what extent content is covered.

4.5 CONCLUSION

There seems to be no mismatch between teacher A's practice and what she advocates for i.e. LCE. The data gathered from teacher A's lessons corresponds with the data in the questionnaire and interviews, to a larger extent.

However there seems to be a mismatch between teacher B's lessons and the data gathered from the questionnaire and interviews. Teacher B stated that she employs both LCE and TCE in her lessons. The use of these two frameworks was defended in the interviews. Teacher B's first lesson can be described as more T-C while the second lesson was more L-C. In the interviews teacher B cited as an example a lesson on statistics as an example of a topic that can easily be taught in a L-C way but when she presented her lesson on this topic, her approach was more T-C. Surprisingly, her lesson on solving equations (algebra) which is regarded by many as a less L-C friendly topic was more L-C.

Teachers seem to be knowledgeable in the theoretical aspect of the reform approach but the implementation aspect is still problematic. This trend was also observed in a small scale study that was conducted in 2007. This can be attributed to some of the factors (challenges) mentioned by the participants in this study. It seems the understanding and interpretation of the concept LCE is not the main obstacle in the implementation of LCE because the participants in this study seem to share a common understanding of the concept of LCE as can be seen in their responses to the interviews.

The other major contributing factor as stated by Mr Hausiku is that some of the teacher educators did not go through a LCE course to prepare them to educate student teachers on the implementation of LCE. The teacher educators are supposed to serve as role models with regard to the implementation of LCE but according to Mr Hausiku, they do not have

adequate knowledge on the practical part of the LCE framework. As a result, the training of teachers in this regard is more theoretical. Student teachers are not given the opportunity to witness lessons in which LCE is modeled. Consequently, it makes sense that there seems to be a mismatch between teachers' understanding of LCE and its implementation.

CHAPTER FIVE
CONCLUSION

5.1 INTRODUCTION

This study will be concluded by providing a summary of the research findings, followed by recommendations. I will then give a brief discussion of the limitations and constraints encountered in this research. Thereafter, I will discuss my personal reflections of the study and finally, I will look at the avenues for further research.

5.2 FINDINGS AND RECOMMENDATIONS

Subsequent to the research findings about the implementation of LCE in mathematics classrooms, I would like to make some recommendations. Contrary to my earlier argument (in chapter 2) in which I stated that if mathematics teachers understand the LCE framework they should be able to implement well, I discovered that there is no direct relationship between mathematics teachers' understanding of LCE and their classroom practice.

The study reveals that the poor implementation of LCE in mathematics classrooms is partly due to the inadequate training that teachers go through. All the three participants in this study admitted that LCE was introduced to them during their teacher-training course (BETD) but the L-C aspect was addressed in a very theoretical way. Thus teachers graduated from the College with more theoretical knowledge of LCE but they lacked the skills to put it into practice. One of the participants claims that even the teacher educators were not well acquainted with the implementation aspect of LCE because it was not modeled in their lectures.

This was also evident in the interview because the question on L-C activities was poorly answered by all the participants. This shows that even though the participants know what LCE is, they have a problem identifying and employing L-C activities. This is a concern because it raises questions about the kind of teaching that prevails in their classrooms.

Furthermore, it was discovered that the two participants whose lessons were observed, did not give learners the opportunity to ask questions. This is a very important aspect of LCE because it helps the teacher to identify the problems that his/her learners are experiencing and assist them accordingly. It was also evident in all the lessons observed that the tasks prepared by the teachers were highly examination and syllabus driven. This is problematic, as an LCE approach demands a wide range of assessment tasks which implies that the tasks performed in class need to have a broad and wide ranging focus.

This is a dilemma because on one hand, teachers are expected to become more creative and innovative in their practice: "What teachers do must be guided both by their knowledge of concepts and skills to be mastered and by the experiences, interests, and learning strategies of their students" (MBEC, 1993: 10) while on the other hand, they are expected to prepare learners for internal and national examinations. The failure rate in national examinations is still very high and for many learners, especially grade 10 learners, failure means the end of their school lives. An alternative such as the Namibia College of Open Learning (NamCol) is either too costly or too difficult for them.

This situation compels some teachers to turn a blind eye to the benefits of using the LCA and stick to traditional methods that are geared to help their learners succeed in examinations. In most instances these are T-C methods. Moreover, teachers are usually held accountable for the failure of their learners regardless of the approach used in their teaching. Although it is clearly stated that examinations "will never be sufficient as our sole indicator of quality education" (MBEC, 1993: 39) they are still perceived as such by many people, including the policy makers.

Another challenge with regard to examinations is the way that examinations are set. Some of the examinations do not promote the reform approach because the questions are based on the recall of facts rather than understanding. In the interview with the advisory teacher he urges mathematics teachers to use previous examination questions in their classroom activities to prepare their learners for examinations (line 346-357).

Examinations are perceived as an instrument by which teachers can rate their performance. As a result, teachers tend to continue drilling learners to enable them to remember mathematical facts, formulas and rules in examinations because the nature of the examinations calls for this approach. In an earlier study, Bethell had the following to say about examinations:

> Emphasis on failure is endemic throughout the education system with students expecting to fail, teachers expecting them to fail and with Examiners setting up papers to ensure that large numbers fail. If the situation is to be reversed and the emphasis placed on positive achievement then a great effort will be required to re-educate all concerned (Bethell, quoted in MBEC, 1993: 124).

Despite the fact that this report was published about 18 years ago the situation in many schools has barely changed.

Based on the findings of this study, I would like to make the following recommendations:

- Mathematics teacher-educators should be trained on the aspect of the implementation of LCE so that they can be equipped with the knowledge and practical skills needed to train student teachers. They should be able to help student teachers distinguish between L-C and T-C activities.

- Learners should be given the opportunity to ask questions in every lesson. Provision for this should be made in the mathematics teacher's lesson plan structure.

- The role of examinations in the assessment of mathematics should be revisited because it has a major impact on the teaching and learning in mathematics classrooms since most of the current activities are geared towards the preparation of learners for examinations. Examinations account for 70% of the learners'

overall performance in mathematics while the continuous assessment accounts for 30% only. It is for this reason that teachers spend more time on preparing for examinations rather than on other perhaps more important learning activities.

- Assessment tasks and strategies should be designed to promote and reflect a L-C approach. They should develop learners' ability to "think critically, to compare and contrast, to synthesise, to imagine and to innovate..." (MBEC, 1993: 125). They should not be too book-bound because this is what leads to the book-dependency syndrome by some teachers.

- More classrooms should be built to solve the problem of overcrowdedness which sometimes compels some mathematics teachers to implement an approach that is more T-C focused in their classrooms. This should be supplemented by other innovative and exciting teaching and learning aids.

- Teachers who were trained in the colonial era should be sensitised about the reform methods by organising meaningful workshops for them.

- Teachers should re-evaluate their attitudes towards mathematics before they can change learners' attitudes because some of the negative attitudes that learners develop towards mathematics are perpetuated by teachers.

- The duration of periods should be revised because the current 40 minutes seems to be inadequate for the implementation of L-C activities.

5.3 LIMITATIONS

The major limitation of this study is that the third participant was not found. The input of this participant could have contributed immensely to the findings of this study and my

research question could have been fully answered. However, an important lesson was learnt from the absence of this participant. The fact that none of the mathematics teachers in the seven selected schools opted for TCE as their teaching approach would have implied that most of them had adopted LCE.

What transpired however is that only one of the teachers from the seven selected schools opted for LCE while the rest opted for a combination TCE and LCE. This implies that teachers are not comfortable with the extremes i.e. a more L-C approach or a more T-C approach. This trend could be attributed to the fact that teachers are expected to move away from the traditional teaching methods so most of them cannot openly advocate for a teaching approach that is in contradiction with the national policy (reform approach). However, since the implementation of LCE is still problematic for many mathematics teachers it makes sense that most of the teachers in the selected schools did not opt for it. A combination of LCE and TCE was the convenient option for most of the mathematics teachers from the seven selected schools.

The lack of popularity of the LCE approach among mathematics teachers can be attributed to the following reasons:

1. The situation in schools does not support the implementation of LCE.
2. Mathematics teachers are not well acquainted with the implementation of LCE.
3. Mathematics teachers do not support the implementation of LCE.

Whatever the situation in schools is attributed to, it is obvious that teachers find comfort in positioning themselves in the middle of the road, because they believe that both approaches have characteristics that can promote the teaching and learning of mathematics. The two approaches are perceived by some teachers as two extremes so to maintain the status quo they opt for a combination of TCE and LCE.

5.4 CONSTRAINTS

Several constraints were encountered during this study. My transfer from my former work station in November 2007 which was a school, to the current one (Rundu College of

Education) affected my research in some way. Firstly, it was not easy for me to get in touch with my participants. Secondly, my participants started seeing me and the purpose of my research in a different light as opposed to when we were all school teachers.

Thirdly, my new work schedule was too hectic and unfamiliar, especially during the school based studies (May to August 2008). Despite the fact that I was new at the institution, I was appointed as a cluster coordinator for the mathematics and science department which entails, setting up weekly observation schedules for the lecturers, ensuring that student teachers have the prescribed number of observations and solving some of the problems that students experience in the field. This was not an easy task. There were times when I had to put my studies on hold and catching up was not easy.

The other constraint was the transfer of one of my participants (teacher A) who was promoted as head of department for mathematics and science at a school on the outskirts of Rundu. She also needed time to familiarise herself with her new work environment so I could not observe her lessons on the scheduled dates. It was also difficult for me to travel to her school because it is not easily accessible.

5.5 PERSONAL REFLECTIONS

This study has contributed positively to my personal, academic and professional growth. This was my first time to carry out a research of this magnitude so I had a lot to learn. I learnt how to deal with disappointments and reschedule appointments since I could not see some of my participants on the set dates. This study also gave me the opportunity to learn about the stages involved in an academic research. I enjoyed the data analysis stage the most because it made me look at some of the taken-for-granted statements and classroom practices with a different set of eyes, as I was trying to make sense of my participants interpretations of LCE and their classroom practice.

At one stage, I almost gave up on my studies due to financial constraints since I funded the first year of this course myself. I was not prepared for this course financially and this

affected my academic work negatively because my financial crisis directly affected my studies. I was determined to complete the course but I struggled to get the required funds. Fortunately, my second year was funded by ETSIP.

One of the most difficult issues I had to deal with was the fact that I had to take care of my sick and bed-ridden sister throughout this year (2008). Her health had been deteriorating and there were times when I thought she was not going to make it. During the June contact session in Okahandja, I took leave for data collection but that same week she fell very sick and was admitted in hospital. This affected my data collection plans for the week.

5.6 AVENUES FOR FURTHER RESEARCH

Firstly, if I get an opportunity to conduct further research in this field, I would look at teacher preparation for the implementation of LCE at the colleges of education because this seems to be the root cause of the problems that teachers experience when they leave the colleges. I would therefore investigate the practices of teacher educators that have led to the persistence of traditional teaching methods in mathematics classrooms.

Secondly, I would look at mathematics teachers' perceptions and attitudes towards LCE since the data from the questionnaires shows that it is not popular among teachers. It has been seventeen years since its inception yet mathematics teachers do not seem to have embraced it.

Thirdly, it would also be interesting to investigate the practical applicability of LCE in state schools because although LCE is a national policy, resource wise little has been done to pave the way for its implementation.

5.7 CONCLUSION

This has been a worthwhile study because although it is only a case study, a lot can be learnt from its findings. If the education system in Namibia is to be improved, there should be a way of monitoring progress on the educational policies that are introduced in schools. One way of doing that is through research and the outcomes of such research should serve as an eye opener to the policy makers and all stakeholders in the education sector. Otherwise, names of policies could change e.g. TCE to LCE but the practice could remain the same or their intended purposes might not be achieved. Therefore, policies should be constantly revisited to assess their applicability or effectiveness in the environments that they are meant to be applied.

Although some of the findings in this study might not be new, there is always a new dimension to every problem because the contexts in which research is carried out differ. I therefore believe that although this research does not address all issues pertaining to the persistence of traditional teaching practices in mathematics classrooms it can shed light on some of the L-C aspects or issues that have been taken for granted.

Finally, as a mathematics lecturer at one of the teacher-training colleges in Namibia, this study helped me to reflect on my teaching and day-to-day interactions with my student teachers and how I can help them become better implementers of LCE in mathematics classrooms. I believe that change in the teaching of mathematics in schools can only occur if the teachers are prepared on the implementation of LCE and if mathematics lecturers model it in their teaching.

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APPENDICES

APPENDIX A-QUESTIONNAIRE

1. What is your general view of the concept Learner Centred Education (LCE)?

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2. What is your general view of the concept Teacher Centred Education (TCE)?

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3. Indicate the orientation of your teaching practice.

a) More Learner Centred Education
b) More Teacher Centred Education
c) Both LCE and TCE

APPENDIX B-INTERVIEW QUESTIONS

Teacher A- More learner-centred orientated

1. Can you briefly describe your experience of learning Mathematics in school?
2. What inspired you to become a Mathematics teacher?
3. Where were you trained as a Mathematics teacher?
4. Would you regard your training as adequate for the challenges that you encounter in your Mathematics classroom?
5. What do you understand by the concept learner-centred education?
6. Where and when did you first encounter the concept LCE?
7. How do you implement LCE in your Mathematics classroom?
8. Provide some examples in you r practice that can be described as LC.
9. How is LC best practiced in a Mathematics classroom?
10. What challenges or difficulties do you encounter with regard to the successful implementation of LCE?
11. What are the advantages using the learner-centred approach in a Mathematics class?
12. Do you think all Mathematics teachers in Rundu have embraced a learner-centred approach? Why? Or why not?
13. What message do you have for Mathematics teachers in Rundu?

Teacher B- More teacher-centred orientated

1. Can you briefly describe your experience of learning Mathematics in school
2. What inspired you to become a Mathematics teacher?
3. Where were you trained as a mathematics teacher?
4. Would you regard your training as adequate for the challenges that you encounter in your Mathematics classroom?
5. What do you understand by the concept teacher-centred education?
6. How do you implement it in your Mathematics classroom?
7. What challenges do you encounter with regard to the successful implementation of teacher-centred education?
8. What are the advantages of using the teacher-centred approach in a Mathematics classroom?
9. What makes a teacher-centred approach different from a learner-centred approach?
10. Why do you think some teachers do not use a teacher-centred approach?
11. What message do you have for Mathematics teachers in Rundu?

Teacher C- both LC and TC orientated

1. Can you briefly describe your experience in learning Mathematics in school?
2. What inspired you to become a Mathematics teacher?
3. Where were you trained as a Mathematics teacher?
4. Would you regard your training as adequate for the challenges that you encounter in your Mathematics classroom?
5. What do you understand by the concept learner-centred education and teacher-centred education?
6. Provide examples of best practice using a combination learner-centred and teacher-centred education?
7. How and when do you implement these concepts in your Mathematics classroom?
8. What challenges do you encounter with regard to the successful implementation of these two concepts?
9. What are the advantages of using both teacher-centred and learner-centred approach?
10. What message do you have for Mathematics teachers in Rundu?

Education Officer (mathematics)

1. Can you briefly describe your experience of learning mathematics in school?
2. Before your appointment as a subject advisor for mathematics, you were a teacher. What inspired you to become a teacher?
3. Where were you trained as a mathematics teacher?
4. Would you regard your training as adequate for the challenges that you encountered in your mathematics classes?
5. The Namibian reform policy calls on all teachers including mathematics teachers to use LCA in their classrooms. What do you understand by the concept LCE?
6. Where and when did you first encounter this concept?
7. How did you implement LCA in your mathematics classes?
8. Can you provide some examples in your practice that can be described as LC?
9. What are the advantages of using LCA in a mathematics class?
10. What challenges or difficulties did you encounter with regard to the successful implementation of LCA in your mathematics classes?
11. As a subject advisor for mathematics, what has your experience been of the implementation of LCA by mathematics teachers?
12. Why do you think some mathematics teachers still use traditional teaching methods in their classes?
13. How can these teachers be assisted?
14. What message do you have for mathematics teachers in Rundu with regard to the implementation of LCA?

APPENDIX C-OBSERVATION SCHEDULE

LCE aspects		**TCE aspects**	
1. sound knowledge of mathematics		1. sound knowledge of mandated mathematics content	
2. adequate knowledge of students' prior knowledge		2. teacher authority vested in subject knowledge	
3.adequate knowledge of instructional Practice		3. emphasis placed on the mastery of mathematics content	
4. classroom environment supports learning of mathematics		4. learners expected to follow certain mathematical rules and formulae strictly	
5. use of evidence and shared expertise		5. knowledge perceived as 'out there'	
6. promotes ownership, commitment, Shared responsibility		6. little emphasis on understanding	
7. encourages learners to ask questions		7. more teacher-talk	
8. arouses learners' curiosity		8. tasks are syllabus and examination driven	
9. employs meaningful tasks and provides real-life examples		9. textbook-bound	

APPENDIX D-LETTER TO THE REGIONAL DIRECTOR

Ausiku Charity
P.O. Box 2407
Rundu
.....

To: The Regional Director
Kavango Region
P/Bag 2133
Rundu

Dear Sir/Madam

Re: Permission to conduct research at selected schools in Rundu

I am a part-time masters' student enrolled with Rhodes University. I am specialising in mathematics education. Research is a compulsory component of this course.

My research is based on the implementation of Learner Centred Education (LCE) in mathematics classrooms. This research topic is of interest to me because I have observed that seventeen years since the introduction of LCE in Namibian schools, its implementation has remained a concern. I would therefore, like to investigate its implementation of (or lack of it) in grade 9 mathematics classrooms.

I will distribute questionnaires to the following schools: Sarusungu CS, Sauyemwa CS, Kasote CS, Elia Neromba SS, Rundu SSS, Romanus Kamunoko SS and Dr Romanus Kampungu SS. However, my research sites will not exceed three schools since the selection of my participants will depend on their responses to the questionnaires.

I am therefore requesting your office to allow me to conduct my research at any of the above mentioned schools. I believe my research will contribute to better teacher practice in mathematics classroom in this region and the nation at large.

Looking forward to your positive response.

Yours Faithfully
.....
Charity M. Ausiku

APPENDIX E-LETTER TO SCHOOL PRINCIPALS

P.O. Box 2407
Rundu
.....

To: The Principal
.....
.....
.....

Dear Sir/Madam

Re: Permission to conduct research at your school

I am a part-time masters' student enrolled with Rhodes University. I am specialising in mathematics education and research is a compulsory component of this course.

My research is based on the implementation of Learner Centred Education in mathematics classrooms focusing on grade 9 teachers. I would therefore appreciate it if you could allow me to conduct my research at your school.

Looking forward to your positive response.

Yours Faithfully
.....
Charity M. Ausiku

APPENDIX F-CONSENT FORM

Consent Form

I, ... voluntarily agree to participate in Ms Charity Ausiku's research. I am aware that the data that will be collected will be reflected in her report but I am assured of the principles of confidentiality and anonymity as far as data handling is concerned. I am also aware that I can withdraw my participation at any stage of the research process.

....

Signature of participant Date

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION

KAVANGO REGION

PRIVATE BAG 2134, RUNDU, NAMIBIA

Tel. : (066) 258 9111
Fax : (066) 258 9213 / 258 9320
Enq.: **Alfons M. Dikuua**

Ref.:

03 June 2008

TO: The Inspector of Education: Rundu Circuit
The School Principals

SUBJECT: PERMISSION TO VISIT SCHOOLS

This serves to give permission to Ms. Charity M. Ausiku, a part time masters' student to conduct research at selected schools in Rundu Circuit. Her research is based on the implementation of Learner Centred Education (LCE) in Mathematics.

These discussions should however not interfere with the normal teaching time.

Thank you

Alfons M. Dikuua
REGIONAL DIRECTOR

MINISTRY OF EDUCATION
KAVANGO REGION
2008 -06- 03
OFFICE OF THE REGIONAL DIRECTOR
PRIVATE BAG 2134, RUNDU
REPUBLIC OF NAMIBIA

All official correspondence must be addressed to the Regional Director

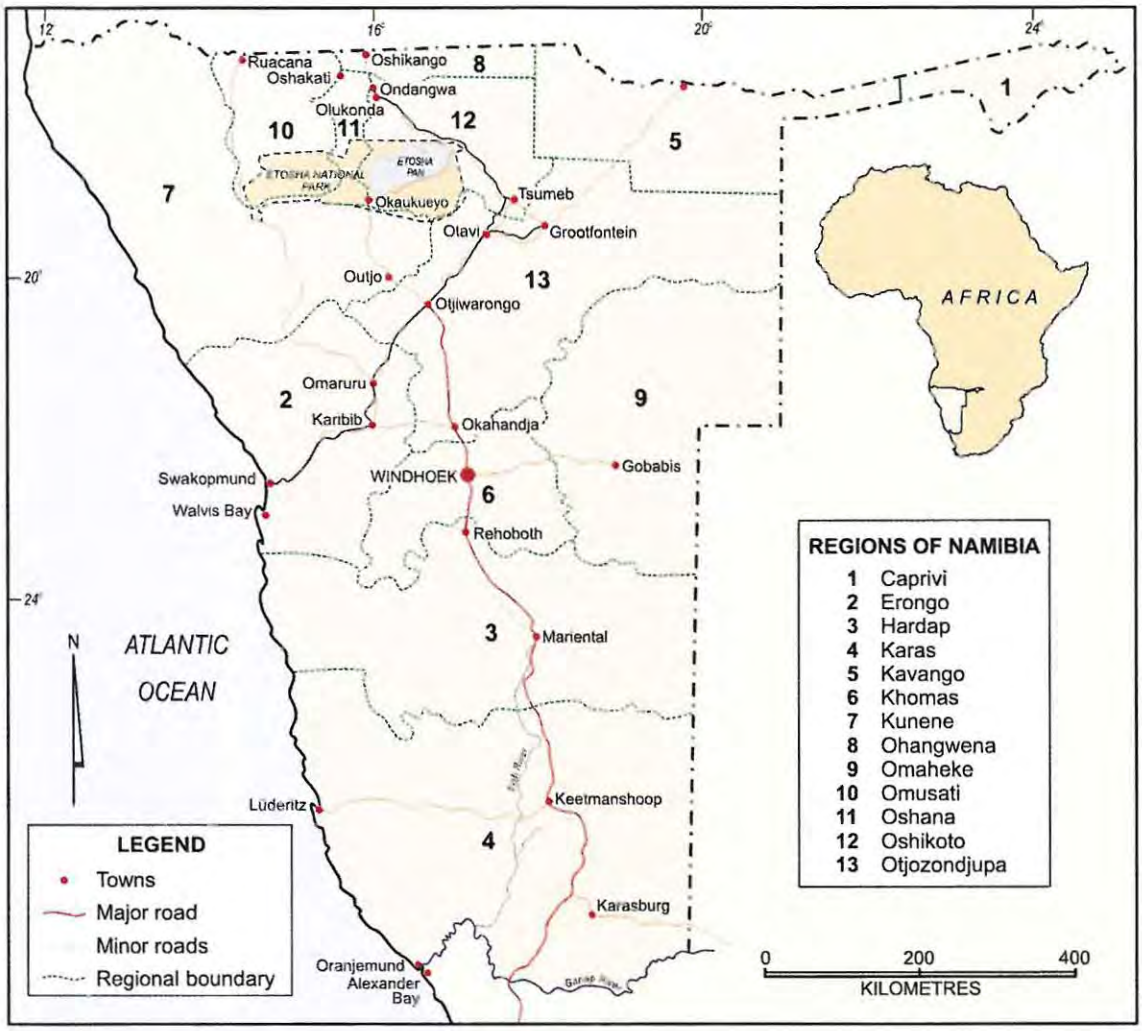

***Figure 1*: Regions of Namibia.**

(S. Abraham, 2006. Graphics Services Unit, Rhodes University, Grahamstown)